AGRICULTURAL EXTENSION SERVICE UNIVERSITY OF CALIFORNIA

SOIL and WATER

Summer 1969 - No. 6



DIAGNOSING ORCHARD PROBLEMS - Don Rough, Norman Ross and Jewell Meyer are working in a trench excavated by a back-hoe. They are examining the soil environment in which the root system of a walnut tree is growing. The use of trenches is an excellent method of diagnosing orchard problems relating to soil conditions. (See story on page 1.)

Ayers, Booher, Branson, Duffin, Krantz, Marsh, Martin, Quick, Rible, Wildman
Edited by B. A. Krantz, Extension Soils Specialist, University of California, Davis

Cooperative Extension Work in Agriculture and Home Economics, U.S. Department of Agriculture, and University of California cooperating

Summer 1969, No. 6

CONTENTS

1. Wildman In, Krantz Out.
2. Diagnosing Orchard Problems.
3. Root Profile Studies in Orchards.
4. Dr. Rendig New Chairman.
5. Conferences on Soils and Land Use Planning.
6. More on Fall Fertilization With Nitrogen.
7. Fetilizer Supply and Demand.
8. Ultra High-Analysis Organic Compounds.
9. Private Water Systems.
10. What is an Acre-Inch of Water?
11. Use of Soil Surveys: Salinity and Alkali.
12. San Joaquin Valley Soil Reclamation Experiment.

PROTECTING THE ENVIRONMENT for all people.
13. Clean Water - Sacramento River.
14. Clean Water - Feather River.
15. Story Corner.

* * * * * *

WILDMAN IN, KRANTZ OUT

Starting with the next issue Bill Wildman will be the new editor of the Soil and Water Newsletter. I am leaving for India and a new 10-year program leading to the development of a Water Technology Center at the Indian Agricultural Research Institute, New Delhi, India. It is a cooperative program between the University of California, the Ford Foundation, and the Indian Council of Agricultural Research. The departments involved in this are the Departments of Water Science and Engineering, Soils and Plant Nutrition, and the Agricultural Extension Service. The University of California part of this program is financed by the Ford Foundation on a grant basis and those of us who are going will remain as staff members of the University of California with our salaries and administrative overhead paid directly to the University by the Ford Foundation. Dr. Lloyd Doneen and I are going on a relatively long-term basis. I plan to stay 5 years and Lloyd will stay at least 2 or 3 years. Bob Hagan will go on a short-term basis and there will be other short-term people following him.

Since I will still continue to be a "Soils Extension Specialist", I hope that I will still be able to contribute occasionally to the Soil and Water Newsletter.

We will be home each year on home leave and back at the University for an additional quarter every two years in order to keep in touch back home. We hope to have a replacement for me hired in the near future.

We appreciate the many fine remarks we have received from farm advisors and other readers regarding the newsletter. I'm sure you can all look forward to great improvements in the newsletter with a new and more youthful editor.

B. A. Krantz

DIAGNOSING ORCHARD PROBLEMS

The back-hoe has been used by a number of counties in recent years as a means of examining soil profiles in orchards. One practice is to line up a number of problem areas to be examined, and then hire a commercial operator with a back-hoe for a day to excavate the trenches. An 8-foot deep trench, 18 to 24 inches wide, with a sloping ramp at one end to permit easy access, can be dug in a few minutes. A bulldozer blade on the other end of the back-hoe tractor can be used to back fill the trench after the examination is completed. Care should be used in making deep trenches in soils which might cave in while people are in the trench.

The use of back-hoe trenches offers many advantages over trying to diagnose problems from a few auger holes. Augering destroys or masks much of the more subtle evidence, such as soil structure, fine root growth, and fine textural stratification. A back-hoe trench covers a greater depth and breadth. This permits studying root distribution at various depths and soil moisture conditions existing at the time. The soil may be picked away to expose the natural structure, root relationships, and stratification. Samples of roots or soil can be easily collected from various depths for laboratory tests.

Even then the answers don't always jump out at you, and it occurred to Stanislaus County Farm Advisors Norman Ross and David Ramos, and Area Soil Technologist Jewell Meyer that they could diagnose orchard problems better if they knew what was a normal root distribution and water extraction pattern for the good orchard soils in their area. Accordingly, they made trenches in representative soils and orchard crops in the county. Trenches were made tangent to the drip line of the tree. One-foot squares were marked off along the trench wall from the surface down to 10 feet deep. At least two counts for each foot depth were made for each tree. The following article describes some of the early conclusions and gives some representative root counts with depth.

L. J. Booher & W. E. Wildman

ROOT PROFILE STUDIES IN ORCHARDS

Root profile studies were started in Stanislaus County in November 1968. The immediate purpose of this study is to determine what the normal root distribution is for each kind of tree crop grown in this area and for each soil that is being used for orchard purposes. It is hoped that varietal and rootstock differences, if any, will be determined. The long-range objective is to enable us to be able to make specific recomendations as to species, variety, and rootstock for our major tree crops on any given orchard soil.

Walnuts are apparently not the long-lived crop that we have been led to believe. We have observed over the years that walnuts on sandy loams do not bear as well as those on heavier soils and that they decline much sooner. Crown rot in walnuts, for example, is more of a problem on a sandy loam than on a clay loam. Why?

To date we can only speculate as to the reason for declining walnuts. We think that for a given depth, the number of roots per square foot of profile area in a 10-year-old walnut orchard will be about the same in a sandy loam soil as it is in a loam. We are beginning to think that 10 years or so later the number of roots in the sandy soil will be only a fraction of the original number. Our guess is that we are dealing with soil pathogens, some of which are of the water-mold group.

Apricot orchards west of the San Joaquin River produce heavier crops and are much less affected by alternate bearing than those east of the river. A long-standing question has been whether climate or soil differences were involved. Our present guess is that apricots will produce better on a loam or clay loam than on a sandy loam. We may get the answer from our root studies.

A question that has come from the profile studies thus far has been that of the relative effectiveness of roots at various depths. We have been finding more root numbers at the 4-foot depth than at 2-feet. Does this mean that the rate of extraction will be greater at 4-feet? We have recently installed tensiometers and gypsum block at 1-foot increments down as much as 11-feet in order to at least determine the water extraction pattern. Some of the root and soil information collected to date are shown here in order to better visualize the nature of this work.

I. NONPAREIL ALMONDS ON LOVELL ROOTS (Trench at 8' from Tree)

	Vernalis Clay Loam			Hanford Sandy Loam		
	Av. Roots/	Soil Texture		Av. Roots/	Soil Texture	
Depth	Sq. Foot	Silt	Clay	Sq. Foot	Silt	Clay
1 Ft.	30	32%	33%	29	12%	4%
2	30	31	36	36	18	6
3	32	30	32	40	13	6
4	57	31	31	88	13	5
5	49	29	27	47	13	6
6	27	30	26	22	14	5
7	7			21	38	6
8				7	22	6

II. TILTON APRICOTS ON MYERS CLAY (Trench at 6' from Tree)

Depth	*Av. Roots/ Square Foot	**Av. Roots/ Square Foot	Soil Texture Silt	Clay
1 Ft.	31	30	45%	36%
2	38	42	45	40
3	35	37	38	45
4	23	20	39	46
5	11	10	42	43
6	10	14	41	41
7	11	13	42	32
8	11	7	45	33

* Apricot on plum root.
** Apricot on apricot root.

III. WALNUTS ON NORTHERN CALIFORNIA BLACK (Trench at 15' from Tree)

15 Year Paynes

Depth	Av. Roots/ Sq. Foot	Soil Texture Silt	Clay
1 Ft.	15	39%	32%
2	24	41	30
3	27	38	28
4	34	38	28
5	42	34	26
6	37	35	27
7	32	39	22
8	23	40	23
9	Many roots present at 11 ft.		

IV. WALNUTS ON NORTHERN CALIFORNIA BLACK ON HANFORD SANDY LOAM

12 Year Paynes

Depth	Av. Roots/ Sq. Foot	Soil Texture Silt	Clay
1 Ft.	26	26%	12%
2	72	26	11
3	90	30	11
4	54	32	6
5	56	26	2
6	29	25	2
7	4	10	2

N. W. Ross, D. E. Ramos, Farm Advisors
J. L. Meyer, Area Technologist
Stanislaus County

DR. RENDIG NEW CHAIRMAN

Dr. Victor V. Rendig, professor of Soils and Plant Nutrition has been appointed chairman of the Department of Soils and Plant Nutrition, Davis Campus, effective July 1, 1969.

Dr. Rendig obtained both the B.S. and Ph.D. degrees at the University of Wisconsin. He was appointed as junior soil chemist in the Experiment Station in 1949 and as a faculty member in 1956. Most of his research since coming to UCD has been in the area of relationships of mineral nutrition to crop quality. He has supervised a number of graduate students doing research on various soil-plant relationships.

B. A. Krantz

CONFERENCES ON SOILS AND LAND USE PLANNING

A series of regional conference on soils and land use planning will be held in California this fall and winter under sponsorship of the University of California Agricultural Extension Service, and the Soil Conservation Society of America, California chapter.

Meeting locations will be from San Diego to Redding. At each, emphasis will be on local soils and land use considerations.

The series, starting at UC, Davis, September 16, has been designed for land planners, public officials, agriculturists, resource developers, engineers, real estate brokers, and banking and credit industry members.

Agriculturists are generally aware of the usefulness of soil surveys, but the non-agriculturally oriented land users and planners are only beginning to recognize that soils information may be just as useful to them. The same soil characteristics which affect crop productivity also may affect the suitability of the land for housing, highway locations, and recreation sites.

A wealth of information on soil properties and behavior is available in published soil surveys covering most areas of the state. While much of it has been prepared for agricultural purposes, by applying proper criteria this same information may be interpreted for almost any type of land use. In these conferences the considerations that must be given to soil in land use planning will be outlined. Other speakers will show where to find this information and how to apply it to orderly land development.

At each conference the morning program will include seminar presentations on soils. The afternoon portions will present regional authorities in discussions of localized applications of soils information to land use planning.

Following the Davis session other meetings tentatively are scheduled for San Diego, Bakersfield, Los Angeles, San Francisco, Redding, the North Coast, and the Central Coast. Local scheduling will be announced when completed. A complete program of the first conference to be held at Davis is given below.

SOILS AND LAND USE PLANNING
September 16, 1969
Freeborn Hall, UCD

PROGRAM
Presiding - William E. Wildman

8:00 Registration* - Coffee
9:00 Welcome to the Conference - George B. Alcorn
9:10 Land Planners and Soils Men - J. Herbert Snyder
Do land planners know all they should about soils? Do soils men know all they should about land planning?
9:30 The Skin of Our Earth - Paul J.Zinke
Soils form over the landscape from rocks which slowly disintegrate under the constant action of water, air, carbon dioxide, and plant residues.
9:50 Scratchy, Slippery, Sticky - William E. Wildman
Soils are porous mixtures of three basic particles: sand, silt, and clay. The infinite combinations and arrangements of these particles account for

the wide variations in soil behavior and usefulness to man.

10:10 How do Soils Stack Up? - Gordon L. Huntington

As soils age they develop well-defined layers called horizons. Together, the horizons make the soil profile, which governs the soil's suitability for use, its stability, and its drainage characteristics.

10:30 Coffee

10:50 Who's Who among Soils - Richard C. Huff

Soil scientists examine and map soils in the field. Similar soils are placed in groups called "soil series." By understanding the names of soil series, their uses and limitations can be identified.

11:10 What's Where about Soils - Frank F. Harradine

Soil surveys are readily available for most areas of the state. Consult the Soil Conservation Service office serving your area, or the Department of Soils and Plant Nutrition, U.C. Davis, for all soil survey information.

11:20 How Soils are Interpreted for Use -- Panel

Moderator -- Leonard R. Wohletz
Open Space -- John H. Miner
Forest and Range -- W. L. Colwell,Jr.
Engineering -- Stanley N. Hobson

Information compiled in soil surveys may be interpreted for any proposed type of land use. Soils information should be considered as one of the basic tools to be applied in any land use activity.

12:20 Discussion

12:30 Lunch

1:45 How Soils Information is used by Planners - Panel

Moderator - J. Herbert Snyder
State Planning - Samuel J. Cullers
County Planning - Robert A. Peterson
Regional Planning - James H. Hickey
Community Planning - Gary Chase
Project Planning, Public - Stanley N. Hobson
Project Planning, Private - George C. Baron

The soils men have had the floor all day. Now it is the planner's turn to describe what use they make of soils information, and suggest how it might be more useful to them.

3:45 Adjourn

A proceedings of the conference will be sent to all registrants.

*Registration fee: $5.00 including lunch
$3.00 without lunch
$1.00 Students (without lunch)

William E. Wildman

MORE ON FALL FERTILIZATION WITH NITROGEN

In the May-June 1969 issue of Agronomy Journal is an article entitled "Effect of Time and Method of Nitrogen Application and Source of Nitrogen on the Yield and Nitrogen Content of Corn (Zea mays L.)" by C.K. Stevenson and C.S. Baldwin of Ontario, Canada. I mentioned a preliminary release of this information in the Fall 1968 issue of the Soil and Water Newsletter. To those of you who receive the Agronomy Journal, I think you will find the article informative. This represents the most comprehensive field experimentation which we have seen on this subject. For those of you who do not get the journal, I am enclosing the following portion of the abstract.

"Fall plowdown, spring preplant, and side-dress applications of nitrogen were compared in field experiments on Brookston clay, Brookston clay loam, and Haldimand silt loam soils. Ammonium nitrate, urea, and anhydrous ammonia were compared at 56, 112, 168, and 224 kg N/ha. Spring application (preplant or side-dress) produced higher grain yields than fall application in all experiments regardless of the rate of nitrogen applied. Preplanting the nitrogen was as effective in increasing grain yield as the side-dress method. Yield results with fall-applied nitrogen were poorer on the clay soil than the loam soils. Spring application of nitrogen gave 370 to 2,610 kg/ha higher yield of corn grain than fall application on clay soils, and 200 to 1160 kg/ha higher yield of corn grain on

the loam soils. No rate of nitrogen applied in the fall was found that would give the same yield as the optimum rate applied in the spring. The three nitrogen materials gave similar results whether applied in the fall or in the spring."

B. A. Krantz

FERTILIZER SUPPLY AND DEMAND

Editor's note: The following article was written by S. H. Bierly specifically for the Soil and Water Newsletter at our request. We think you will find his article informative and useful in your program.

Nitrogen is the most limiting fertilizer factor in California, and in important other western areas. We do experience capacity to overproduce N from time-to-time, and are currently in that situation. NH_3 is the principal basic material in formulation of other nitrogen products, and of the compounds and mixtures as well. If we could count on a normal weather pattern each year, we could anticipate an annual increase of 10% or more in fertilizer use in California. However, due to the extremely wet spring this year, our first quarter tonnage was off 29%. The first half should be about equal to last year.

Not only is the farmer in a cost-price squeeze, but so is the commercial fertilizer industry. And, in spite of steadily increasing use of fertilizers in the west, and in California particularly, new plants coming on stream to supply this market are more and more efficient, depressing prices sometimes below production costs of older, less efficient facilities. And bear in mind that capital investment in each new plant often runs to $25 million or more.

Sulfur is also most important in our manufacturing processes. And we are just now emerging (we hope) from a 2-year period of extreme shortage of sulfur. This caused some expensive modification to use of gypsum where such modification could be affected. Sulfuric acid is vital to production of ammonium sulfate, super phosphate, and other high tonnage materials. Sulfur-urea and other treatments are coming into use.

All our phosphate rock and a considerable tonnage of manufactured phosphate materials must be shipped in from the Phosphoria Sea area of Idaho, Utah and Montana, and some comes in (Oxy) from Florida.

Potash has been in good supply from Trona up to now, but, with growing large areas of potassium and phosphorus deficiency in California, we must adjust our sights considerably upward. New supplies of K, currently in the form of KNO_3, are showing up in California and the west. And, as the need for more arises, and I am sure it will, more tonnage will be developed for local use at Trona, and more will be shipped in, perhaps from Canada and New Mexico.

We are not concerned about increasing consumer acceptance, since the University and industry are effectively cooperating in research and education program, which is resulting in more demand for the materials in the proper amounts to grow bigger crops per acre of better quality, more efficiently. We are all recommending fertilizer as an investment in more net profit for the beleagured grower, rather than as another product available on the market. And this is true. The efficient grower sets the production pace in his neighborhood.

Since ammonia is the key to most fertilizer needs, and for the formulation of other materials, I will give you the latest figures I have on California and western production capacity, as of June, 1969.

Collier, Brea, California - 260,000 tons on stream.

Collier, Kenai, Alaska - 525,000 tons, just recently on stream.
(Collier junked its earlier, 1954 plant at Brea)

Hercules, Hercules, California - 70,000 tons on stream.

Occidental, Lathrop, California - 96,000 tons on stream.

Pennsalt Chemicals Corp., Portland, Oregon - 7,000 tons on stream.

Phillips Pacific Chemical Co., Kennewick, Washington - 130,000 tons on stream.

Reserve Oil & Gas Co., Hanford, California - 21,000 tons on stream.

Shell Chemical Co., Ventura, California - 202,000 tons on stream.

Shell Chemical Co., St. Helens, Oregon - 88,000 tons on stream. (Shell has closed its old operation at Pittsburgh.)

J. R. Simplot Co., Pocatello, Idaho - 54,000 tons on stream.

Southwestern Agrochemical Corp., Chandler, Arizona - 40,000 tons on stream.

Standard Oil of California, (Chevron), Richmond, California - 131,000 tons on stream.

Valley Nitrogen Prod. Inc., Helm, California - 176,000 tons on stream.

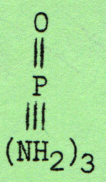
Valley Nitrogen Prod. Inc., El Centro, California - 210,000 tons <u>now</u> on stream.

Since it is said that the new, large capacity ammonia plants can turn out NH_3 costing as low as $20 per ton, it is apparent that the older, less efficient plants will not be able to compete. And so we look for continued capital investment in new plants.

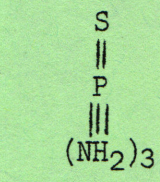
Sidney H. Bierly
General Manager
California Fertilizer Association

ULTRA HIGH-ANALYSIS ORGANIC COMPOUNDS

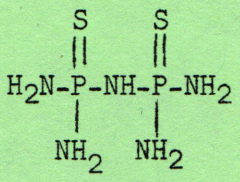
In the last issue of Soil and Water, we saw the chemical structures of some ultra high-analysis fertilizer compounds. This time we will study the crop response to these compounds. The compounds again are:



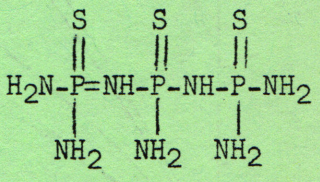
43-32.5-0 (elemental)
43-74-0 (oxide)



37-27.2-0+29S
37-62-0+29S



34-29-0+29S
34-66-0+29S



33-30.8-0+31S
33-70-0+31S

n = 10
29-33.4-0+32S
29-76 - 0 + 32S

Greenhouse experiments were conducted to evaluate the compounds for N and P. Two crops of corn were grown on all plots. The second crop was grown to evaluate the possibility of delayed release of nutrient from compounds which were poor sources of nutrient for Crop 1. The standard for Nitrogen is Ammonium Nitrate; for Phosphorus, concentrated Super Phosphate. Figure 1 shows results from linear compounds as sources of P.

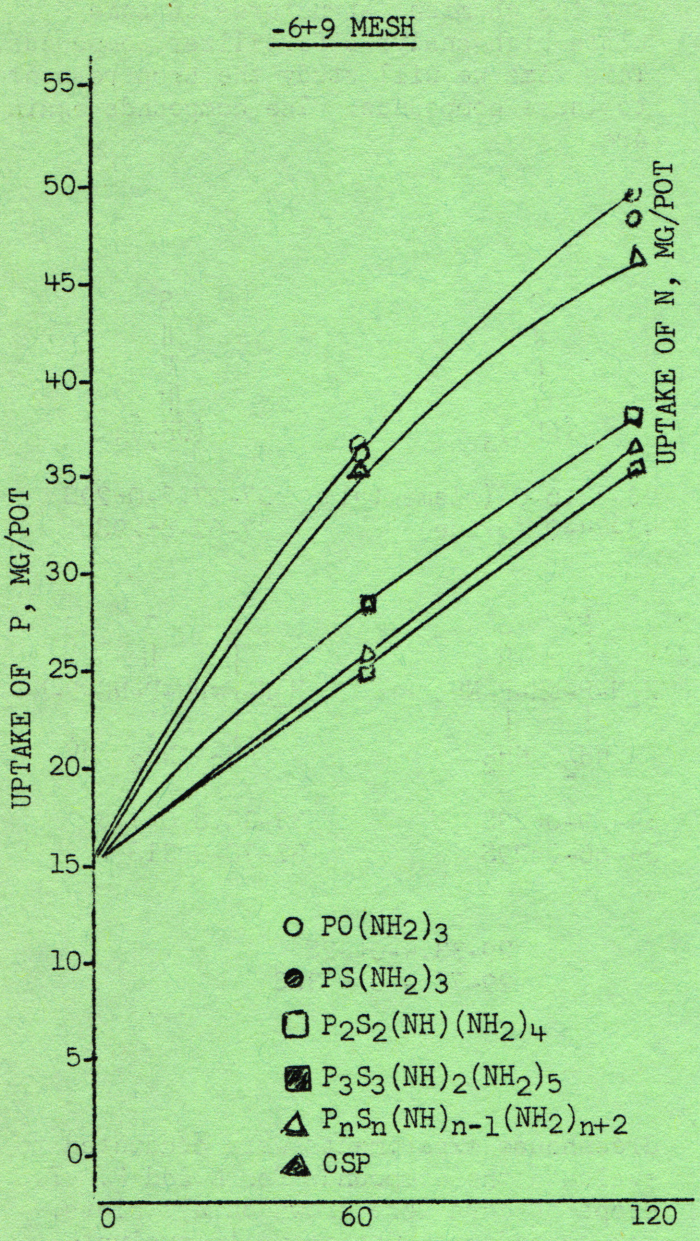
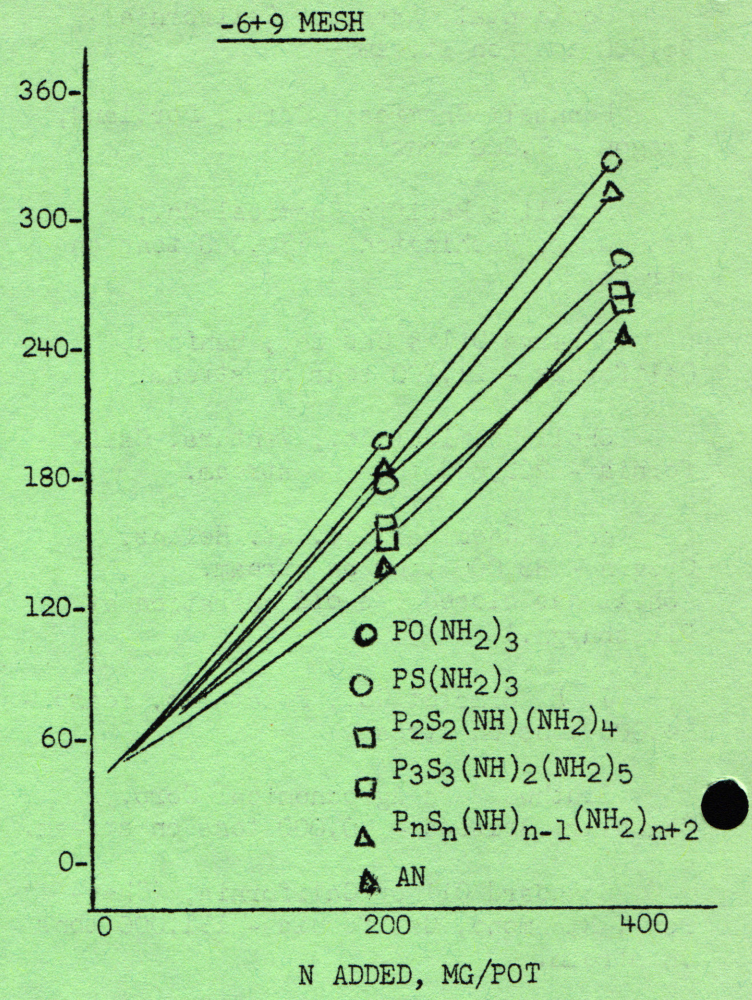


Figure 1

Note: 1. Both monomers equivalent to CSP.
2. Moderate decrease in effectiveness of thio compounds as chain length increases.

Figure 2 shows results from linear compounds as sources of N.



Note: 1. All good sources as compared to AN.
2. Relatively small variation among structural variants.
3. Early stage toxicity not evident in Figure 1 which is based on total uptake of 2 crops. N was recovered in Crop 2 from certain treatments which were moderately toxic to Crop 1. No toxicity was noted in P source test, probably because of lower rates. Toxicity was apparently caused by evolution of H_2S in soil.

Warren J. Sharrat
TVA - Field Representative

PRIVATE WATER SYSTEMS

The Midwest Plan Service, operated by the AES in the midwestern states, has prepared an excellent publication on domestic water systems. This describes various sources of water, collection and storage facilities, piping, and water treatment. This 60-page publication can serve as an excellent reference in answering requests for help in developing home or farmstead water supplies. Copies of MWPS-14, "Private Water Systems", can be purchased from Midwest Plan Service, Iowa, State University, Ames, Iowa 50010 for a small price.

L. J. Booher

WHAT IS AN ACRE-INCH OF WATER?

The unit acre-inch represents a volume of water. Yet, it is commonly misused in California Agriculture and University circulars to show a depth of water. Authors of publications misusing this unit are justly deserving of criticism by other scientists who know better.

An acre-inch is a volume of water equal to 27,154 gallons or 3,630 cubic feet. It is also equal to water 0.01 inch deep on 100 acres, or 100 inches deep on 0.01 acre. In other words, to properly use this term to show depth you must indicate the area over which this volume of water is applied. The term "acre-inch per acre" correctly indicates a depth. Written algebraically this is:

$$\frac{\text{acre-inch}}{\text{acre}}$$

Since the term "acre" appears in both the numerator and denominator, they can be cancelled out leaving inch which is a unit of depth.

A preferred term for showing depth, instead of "acre-inch per acre", is "inches depth of water".

The unit "acre-foot" also shows volume of water. For instance, it is correct to say the farmer used 360 acre-feet of water during a year. If he applied this water to 120 acres, you can say that the average depth of water applied was 3 acre-feet per acre.

The words acre-inch and acre-foot should always be written with a hyphen.

L. J. Booher

USE OF SOIL SURVEYS: SALINITY AND ALKALI

The question has been asked "How can we compare the salinity and alkali values from the soil survey bulletins with our present salinity and alkali values in terms of EC (electrical conductivity) and ESP (exchangeable sodium percentage)?

1. Salinity

In most soil survey bulletins, the terms salinity and alkali may be used interchangeably to designate salinity (soluble salts) and is sometimes referred to as white alkali. The quantity is shown as a percentage value.

(If high sodium (ESP) is a problem, such areas will be delineated as black alkali and designated by the symbol "B").

It is difficult to make direct conversion of percentage of alkali as shown in the survey bulletins to electrical conductivity in millimhos as used in most AES laboratory reports. In general, however, comparisons are possible based on expected cropping performances about as follows:

Severity of Problem	EC (mmhos) AES Lab	Alkali (%) Soil Survey
May restrict growth of very salt sensitive crops	<4	F = Free <0.2%
Restricts growth of many crops	4 to 8	S (Slight) 0.2 to 0.5%
Restricts growth of all but salt tolerant crops	8 to 16	M (Moderate) 0.5 to 1%
Only a few very salt tolerant crops make satisfactory yields	>16	A (Strong) >1%

2. High ESP (exchangeable sodium percentage) or Black Alkali

Many soil surveys make no apparent real separation between salinity and ESP. However, if exchangeable sodium is an important problem, the high sodium areas are generally separated and may be mapped as "B" -- black alkali. The reclamation procedures needed for saline soils as compared to soils with a high exchangeable sodium (black alkali) are very different and these different soil conditions must be recognized in order to proceed and achieve a successful reclamation.

Saline soils, sometimes referred to as white alkali, have an EC above 4 (or salt percentage above 0.20%) as stated and can be reclaimed by leaching without soil amendments being added provided the water applied to the soil surface can move into and down through the soil. These usual salts are water soluble and water will dissolve and remove them as the water moves downward through the soil.

On the other hand, a soil with high exchangeable sodium (ESP) and referred to as a black alkali soil has low permeability to water and is more difficult to reclaim. Following an irrigation or rain, water may stand on these soil surfaces for many hours or days and is very slow to soak into the soil. Cropping troubles arise due to disease problems caused by water standing on the surface, or due to drought caused by lack of water penetration to supply roots of the crop. Still other problems arise due to actual toxicity of the exchangeable sodium as it is picked up by the crop roots and accumulates in the crop. Leaf burn, low yields, stunted plants and eventual death of the plants may be the end result.

Reclamation of these typical high sodium soils (black alkali) usually requires application of considerable quantities of a soil amendment such as gypsum followed by leaching. In some cases, good quality water plus subsoiling or soil modification may do the job.

Adequate sub-surface drainage is essential in reclamation involving either salinity or high exchangeable sodium. Artificial drainage is frequently an integral part of any attempted reclamation.

The older soil surveys discuss black alkali as related to sodium carbonates. Some of the more recent ones may delineate "black alkali" areas of the survey with a "B" in the delineated area. A field test for "black alkali" used in the Colusa survey employed phenolphthalein indicator as a measure of pH to pin-point the high sodium areas since a pink color (indicating high pH) results when this indicator is added to a soil-water extract which has a pH well above pH 8.4

The present measure of a high sodium soil is based on exchangeable sodium as determined in a prescribed laboratory procedure. A soil containing 15% exchangeable sodium (ESP) or more is usually considered to have a sodium problem. A high ESP soil usually has a pH above pH = 8.4. The newer designation of "sodium" affected soils is in good agreement with areas designated "B" (black alkali) of the soil survey bulletins.

The soil reaction values reported in soil surveys are of very little help in separating out high ESP or black alkali areas. As used in the soil surveys, soil reaction is "The degree of acidity or alkalinity of the soil mass expressed in pH values. . ." However, all values of pH = 8.0 or higher are included in the term "alkaline" and therefore cannot be used to make a separation for high ESP soils which would only include pH 8.4 and above. A very great many and probably a majority of the soils reported as pH 8.0 and above (alkaline) are calcareous and have no relationship to black alkali or high ESP.

Soil survey information can be interpreted in the terms we are now using for

salinity and sodium soils discussions. Be careful of definitions and understand that salinity problems refer to soluble salts; sodium problems refer to high ESP (exchangeable sodium percentage) or black alkali and the reclamation problems for each are usually very different. Drainage, however, is essential and is an integral part of either problem.

R. S. Ayers

SAN JOAQUIN VALLEY SOIL RECLAMATION EXPERIMENT

In June 1968, an experiment was started to reclaim a salt-affected soil high in boron located on the west side of the San Joaquin Valley near Blackwells Corner in Kern County. The site is representative of much of the new land in that area being developed for irrigation with imported Feather River water. The surface foot or two of such soils in their virgin state is generally non-saline. Below that depth excessive amounts of soluble salts, exchangeable sodium, and boron are present and usually increase with depth. Within the depth clay pans are also found that must be reclaimed for medium-and deep-rooted crops.

The purpose of the experiment was to study the rate of removal of the toxic material under two different leaching programs involving the application of water by sprinklers at 0.07 and 0.10 inches/hour. These low application rates were selected in order not to exceed the water intake rate of the soil and also to permit unsaturated flow of water through the soil, a condition which increases the efficiency of leaching and avoids lateral movement of water above a restrictive layer. Water costs on the west side are high, making it desirable to accomplish a maximum of leaching with a minimum of water.

Gypsum was applied to some of the plots at the rate of 5 tons per acre. Gypsum was also present in naturally occurring form in the subsoil of the experimental area. Barley was planted on all of the plots to protect the soil surface, and sprinkling was begun in June.

The sprinklers operated automatically each night for 12 hours. The following graphs show the levels of chloride, boron, and exchangeable sodium with increasing amounts of water applied at the rate of 0.1 inch per hour. Data for the 0.1 inch per hour rate were chosen for graphing because this rate did not exceed the soil infiltration capacity, and a lesser fraction of water was lost by evapotranspiration. Water amounts shown include an unknown amount consumed as evapotranspiration by the vegetative cover.

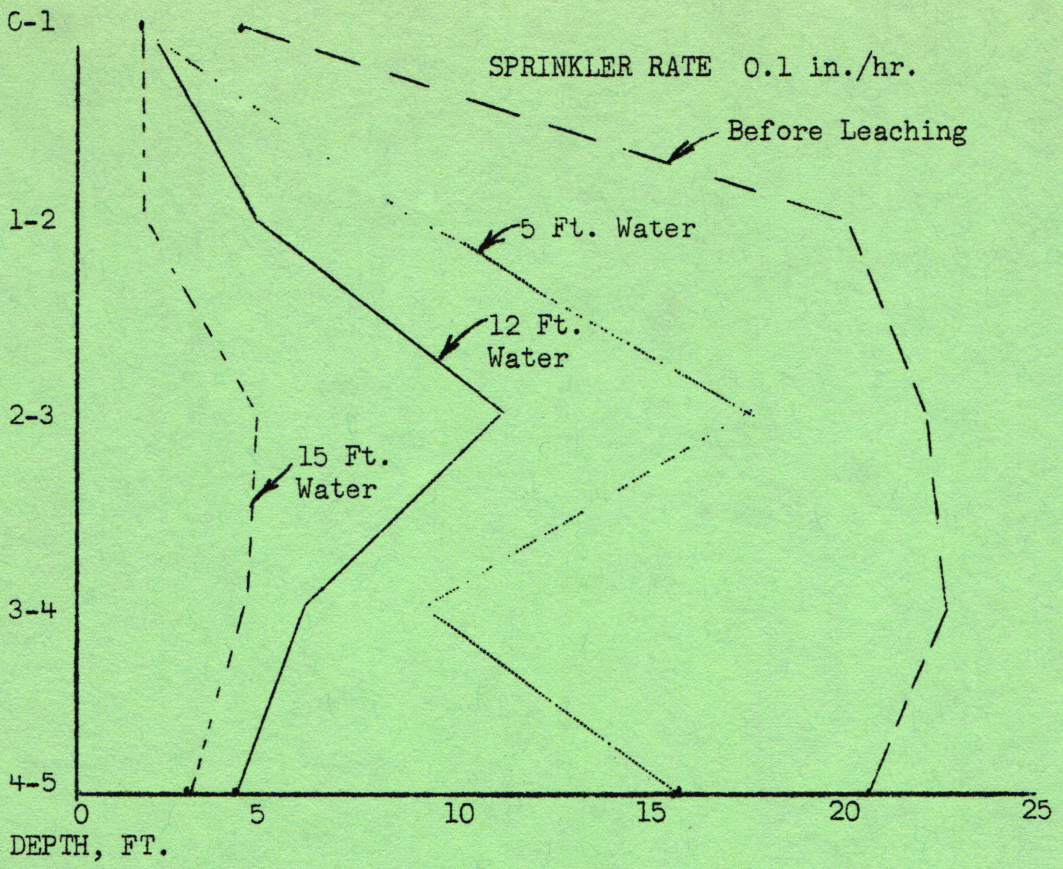
The graphs show that chloride, an index of soluble salts, was removed from the entire 5-foot depth of soil with less than 3 acre-feet of water per acre.

In contrast, boron was difficult to leach, requiring approximately 15 acre-feet of water per acre to reduce the saturation extract boron level to 1 ppm or less throughout the 5-foot depth.

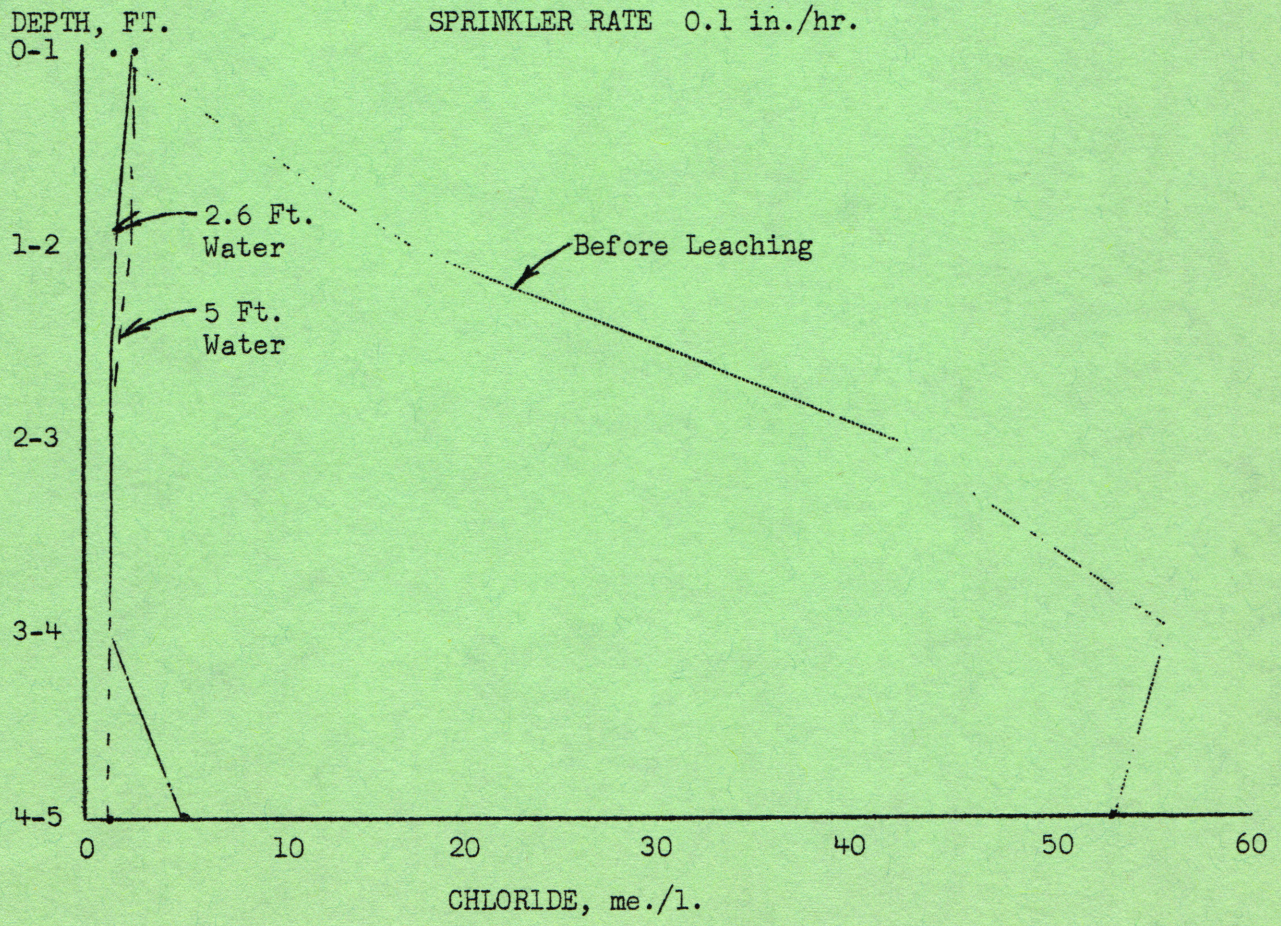
The quantity of water required to reduce the exchangeable sodium percentage in the soil profile to levels compatible with the tolerance of sensitive crops was also about 15 acre-feet of water per acre. Surface application of gypsum had no effect on the rate of removal of exchangeable sodium.

The plots are now being fallowed, after which the solubilization of boron will be determined. The boron removed by leaching is only a fraction of the total boron in the soil. Whether excessive plant-available boron levels will again build up in the soil after fallowing is not yet known. The answer has important implications regarding soil and water management practices on the Westside.

The reclamation experiment described is a project of the Department of Soils and Plant Nutrition, under the leadership of Dr. Frank Bingham, Riverside, in



EXCHANGEABLE SODIUM PERCENTAGE



PROTECTING THE ENVIRONMENT
for all people

CLEAN WATER - SACRAMENTO RIVER

Sacramento Valley "agricultural interests" have been successful in their efforts to get the Central Valley Water Quality Control Board to delay until July 1970 final adoption of water quality standards on the Sacramento River from I Street Bridge to Keswick Dam.

For the first time, a substantial segment of agriculture appeared at a water quality hearing and expressed its interest and concern. The board voted 4 to 3 to delay adoption of standards until July 1970, at which time agriculture again will need to make its voice heard. At that time agriculture must support the standards as proposed or must suggest alternative standards. But such alternate standards if proposed, must still protect the water quality for all the other beneficial uses as required by law.

The standards, as now proposed, would maintain the river at its present excellent water quality, based primarily on information gained by monitoring of existing surface water quality over a rather short period of time. DWR Bulletin 111 Sacramento River Water Pollution Survey, August 1962 and DWR Office Report, "Predicted 1990 Mineral Quality of Water in the Sacramento River with Emphasis on the Effects of Agricultural Drainage", November 1966, were used as the basis for the proposed standards.

Agriculture is not opposing the establishment of water quality standards.

Agriculture asked for the delay so that it would have more time to evaluate the effects of the standards upon the future development of the valley. It is essential that agriculture have not only a water supply but drainage also. Agriculture must be able to dispose of its waste waters either to the river, to a drain, or by some other conveyance system, to the ocean.

The year will be utilized by agriculture in cooperative effort among DWR, Agricultural Extension Service, Central Valley Water Quality Control Board and the Sacramento Valley irrigation, reclamation, and drainage districts to more fully explore the needs of agriculture for drainage and the potential contributions of irrigated agriculture to the salt load of the Sacramento River.

The hearings on adoption of the proposed standards will be reviewed in July 1970. At that time as a result of the study, agricultural interests will have two alternatives -

1. Support the proposed standards or

2. Propose changes to the standards that will be more acceptable to agriculture but will still offer needed protection for all other protected beneficial uses.

R. S. Ayers

CLEAN WATER - FEATHER RIVER

A public hearing on proposed water quality standards for the Feather River will be held September 11-12 by the Central Valley Water Quality Control Board. Location of the hearing is not definite at this early date but will probably be in Oroville.

If interested in details as to standards, etc., as proposed write to:

Central Valley Water Quality
Control Board
2424 Sixteenth Street
Sacramento, CA 95818

R. S. Ayers

STORY CORNER

"The poorest of all men is the one without a dream."

"There is no limit to the good a man can do --

if he doesn't care who gets the credit."

Author Unknown

"There are too many chiefs and not enough Indians."

Editor's note: The author of this statement has never been to India.

B. A. Krantz
Extension Soils Specialist