Diagnosis and Improvement of

United States Salinity Laboratory Staff

Contributing Authors:

L. E. Allison	L. Bernstein	C. A. Bower
J. W. Brown	M. Fireman	J. T. Hatcher
H. E. Hayward	G. A. Pearson	R. C. Reeve
L. A. Richards	L. v. Wilcox	

L. A. Richards, Editor

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Preface

The Bankhead-Jones Act adopted by Congress in 1935 made funds available for agricultural research on a regional basis. At a meeting of representatives of the United States Department of Agriculture and the directors of the Agricultural Experiment Stations of 11 Western States, the decision was made to establish a salinity laboratory to conduct research on problems connected with the success and permanence of agriculture on saline and alkali soils. In 1937 the United States Regional Salinity Laboratory was established by the then Bureau of Plant Industry on grounds adjacent to its Rubidoux Laboratory in Riverside, Calif. A memorandum of understanding, providing for official collaborators, was entered into with these 11 Western States and Hawaii.

The Rubidoux Laboratory had been established by the Bureau's Division of Western Irrigation Agriculture in 1928 primarily to conduct research relating to the quality of water, with special emphasis on the toxicity of boron to plants. It was combined with the United States Regional Salinity Laboratory in 1948.

In 1951 official cooperation and collaborator representation was extended to include the 17 Western States, and the name of the Laboratory modified to United States Salinity Laboratory.

Close cooperative relations are maintained with the State Agricultural Experiment Stations and Hawaii through the official collaborators who meet annually to review the Laboratory's research program.

The United States Salinity Laboratory is administered in the Agricultural Research Service.

Introduction

Saline and alkali soil conditions reduce the value and productivity of considerable areas of land in the United States. The problem is an old one, and there is much information on this subject in the technical literature. It is the purpose of this handbook to bring together and summarize information that will be useful, particularly to professional agricultural workers, for the diagnosis and improvement of saline and alkali soils.

The nomenclature for these problem soils is still in a formative stage. This is illustrated by the diversity of usage of such prominent investigators as Gedroiz (1917), Hilgard (1906), Hissink (1933), Kelley (1948, 1951), and De Sigmond (1938). Ultimate agreement on nomenclature will depend on the role of exchangeable potassium. The facts now available on this subject are meager, but they suggest that the undesirable physical properties that are characteristic of alkali soils are caused by excessive exchangeable sodium. Other elements of the alkali metal group either do not occur in significant quantities or do not appear to have similar action in soils.

It is not the purpose of the writers to emphasize the definition of terms or to influence the usage of others; but, for clarity in the presentation of the subjects treated in this handbook, it was necessary to consider terminology, and a glossary of special terms has been included. In deference to past usage, the term "alkali soil" is employed to refer to soils that have a high exchangeable-sodium-percentage; and "saline soil" is used in connection with soils having a high value for the electrical conductivity of the saturation extract.

This handbook was first issued in multilithed form in 1947, and it has been widely distributed in this country and abroad.

No attempt is made to present a comprehensive review of the literature, because the handbook is intended primarily as a practical guide for those who are confronted with soil, plant, and water problems involving salinity and alkali. The first five chapters provide a basis for the evaluation and interpretation of measurements. The procedures and measuring methods given in chapters 6, 7, and 8 are those with which the Laboratory has had experience, and they are believed to have general applicability in the diagnosis and improvement of saline and alkali soils.

There are other measuring methods in current use in various localities that have not been included, but no particular significance should be attached to this omission. It is ***not*** possible to cover all special methods, and it is always advisable to consult with the State agricultural experiment stations for detailed information on local problems.

There is need for continued research on problems of saline and alkali soils and the many complicated interrelations to crop production on these soils. The close cooperative relations of the Salinity Laboratory and the agricultural experiment stations of the 17 Western States and Hawaii have provided an efficient arrangement for conducting investigational work with a minimum of duplication of effort and for exchanging and disseminating research information.

This handbook is the result of the combined efforts of the entire staff of the Salinity Laboratory. Those listed as authors have carried responsibility for writing various sections. Former staff members C. H. Wadleigh and A. D. Ayers were among the authors of the earlier draft and assisted in reviewing the present one. The illustrations were prepared by Miles S. Mayhugh and R. H. Brooks.

The writers are indebted to many reviewers, not all of whom are mentioned, who have offered helpful criticisms and suggestions. The sections relating to leaching and drainage in chapter 3 were reviewed by F. M. Eaton, Vaughn E. Hansen, 0. W. Israelsen, and Dean F. Peterson, Jr. W. C. Cooper, W. P. Cottam, F. M. Eaton, W. G. Harper, and W. J. Leighty reviewed chapter 4 and contributed suggestions relating to salt tolerance and indicator plants. Chapter 5 on quality of irrigation water was given special consideration by the collaborators, and this chapter was also reviewed by C. S. Scofield. Chapters 6, 7, and 8, dealing with methods, were reviewed by L. T. Alexander, B. J. Cooil, E. E. Frahm, J. C. Hide, A. J. MacKenzie, C. D. Moodie, A. H. Post, R. F. Reitemeier, and others.

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H. E. HAYWARD
Director

United States Salinity Laboratory
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