RECLAMATION OF SALINE-ALKALI SOILS BY LEACHING

DELTA AREA, UTAH

R. C. REEVE, L. E. ALLISON, D. F. PETERSON, JR.

BULLETIN 335

TURAL EXPERIMENT STATION
LOGAN, UTAH
In Cooperation with the
U. S. REGIONAL SALINITY AND
RUBIDOUX LABORATORIES
RIVERSIDE, CALIFORNIA

THIS BULLETIN is a joint contribution of the U. S. Regional Salinity and Rubidoux Laboratories and the Utah Agricultural Experiment Station which reports one phase of a cooperative investigation performed under a memorandum of understanding among the Utah Agricultural Experiment Station, the U. S. Regional Salinity and Rubidoux Laboratories, and the Millard County drainage districts. The work of the U. S. Regional Salinity and Rubidoux Laboratories was done under an allotment from the special research fund authorized by Title 1 of the Bankhead-Jones Act of June 29, 1935, and in cooperation with the agricultural experiment stations of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, and the Territory of Hawaii.

RECLAMATION OF SALINE-ALKALI SOILS BY LEACHING — DELTA AREA, UTAH

R. C. Reeve, L. E. Allison, D. F. Peterson, Jr.

Bulletin 335

Agricultural Experiment Station
Utah State Agricultural College
Logan, Utah
in cooperation with the
U. S. Regional Salinity and Rubidoux Laboratories
Riverside, California
December 1948

TABLE OF CONTENTS

Summary 3

Foreword 4

Introduction 5

The Delta Area 7

Experimental procedure 10

- Selection of leaching sites 10
- Plot layout 13
- Treatments 13
- Leaching operations 14
- Infiltration tests 14
- Soil sampling 14
- Cropping 15
- Harvest 16

Results 16

- Infiltration rates 16
- Drainage conditions 18
- Effectiveness of leaching 20
  - Changes in salt content from leaching 20
  - Changes in salt content during cropping period 23
  - Chemical changes from reclamation treatments 24
  - Crop response 32
- Feasibility of leaching 37

Conclusions 41

Literature cited 41

Appendix 43

Acknowledgements ..... *Inside back cover*

SUMMARY

A TWO-YEAR leaching study was conducted in the Delta Area Utah, to determine the requirements for reclaiming saline anc alkali soils. Studies were made at three widely separated locations or different soil types. Plots 30x40 feet were leached by ponding watei on the surface. The leaching treatments consisted of: (1) light leaching - 1 foot of water, (2) medium leaching - 2 feet of water, (3) heavy leaching - 4 feet of water, and (4) heavy leaching - 4 feet of water plus gypsum at the rate of 5 tons per acre.

After leaching, fall wheat was grown on the experimental plots and the yields for the various treatments determined. Three 6-inch irrigations, applied to all plots were required to mature the crop. The salinity status of the leaching plots was determined by chemical measurements before leaching, after leaching, and three times during the cropping period.

Before leaching, these soils contained excessive amounts of soluble salts, and the exchangeable-sodium-percentage was high. The salt concentration was highest at the surface and diminished with depth. On the basis of salt content and exchangeable-sodium-percentage, these soils may be classified as saline-alkali. Such soils usually require chemical amendments for reclamation unless sufficient soluble calcium in the form of gypsum is present in the surface soil. The soils at the experimental sites contained gypsum in amounts ranging from 2 to 23 tons per acre foot. The amount present was sufficient for reclamation purposes. Infiltration rates were sufficiently high for successful leaching. At two locations, the addition of gypsum did not improve infiltration, but at the third location, the infiltration rates were approximately doubled with the addition of gysum.

The amount of salt removed from the soil increased with the amount of water applied. One foot of water materially reduced the salt content of the surface foot of soil but accomplished little leaching below that depth. The application of 4 feet of water gave the greatest reduction in salt content throughout the root zone.

Yields varied inversely with the residual salinity of the soil. The relation between yield and salinity was found to be of hyperbolic character where yields increased more and more rapidly as salinity decreased. At the low salt levels, slight reductions in salt content resulted in large increases in yield.

The relation between yield and the amount of leaching water was found to be approximately linear. Yields increased directly with the amount of water applied for leaching at average rates of 10.2, 8.8, and 4.7 bushels per acre foot of water applied at site A, C, and D, respectively. Average yields of from 41 to 43 bushels per acre were obtained on the plots leached with 4 feet of water compared to yields of from 1 to 29 bushels per acre where no leaching water was applied.

FOREWORD

COOPERATIVE INVESTIGATIONS on drainage and reclamation of salted soils in the Delta Area, Utah, were undertaken by the Utah Agricultural Expericent Station, the U. S. Regional Salinity Laboratory, and Millard County Drainage Districts Nos. 1, 2, 3, and 4, under a memorandum of understanding effective January 1, 1946.

This investigation comprises project no. 250 of the Utah Agricultural Experiment Station, R. H. Walker, director; and project no. 50-46-1 of the U. S. Regional Salinity Laboratory, H. E. Hayward, director.

The objectives of the investigations covered by the memorandum of understanding were:

1. To study the effectiveness of present methods of drainage; tile and open drains.
2. To determine the possibilities of pumping from wells as a method of drainage in the Delta Area and the possibility of using the pumped water for irrigation.
3. To determine practical and economical methods of reclaiming unproductive saline and alkali soils of the area by leaching.

The leaching phase of these investigations has been completed and the results are reported herewith. The first and second phases concerned with the effectiveness of present drainage methods and the possibilities of pumping for drainage are in progress, but are not included in this report. However, it must be kept in mind that drainage and leaching are inseparable and must be considered as integral parts of an over-all reclamation program for the Delta Area.

ACKNOWLEDGMENTS

THE AUTHORS actively participated in the experimental work and carried the main responsibility in the preparation of this report, but many others made important contributions to the success of this cooperative project.

The project leaders were: O. W. Israelsen, Dean F. Peterson, Jr., and D. W. Thorne of the Utah Agricultural Experiment Station; R. C. Reeve and L. E. Allison of the U. S. Regional Salinity Laboratory, and W. C. Cole, chairman of the Delta Area Irrigation and Drainage Investigation Committee representing the Millard County drainage districts. J. E. Christiansen, formerly irrigation and drainage engineer at the U. S. Regional Salinity Laboratory, now dean of engineering at the Utah State Agricultural College, assumed active leadership in the planning and early phases of this study. D. W. Pittman of the Experiment Station also participated in the initial part of the program. E. A. Olafson, field engineer, assisted in the supervision of the plots and field operations during the summers of 1946 and 1947. R. G. Rickenbach, county agent, rendered helpful assistance in carrying out the field operations. The genuine interest and financial backing of the Delta Area Irrigation and Drainage Investigation Committee has been most gratifying. This committee is comprised of representatives of the four Millard County drainage districts, the four Delta Area irrigation companies, and other prominent business men in the area. D. D. Crafts has been especially active in supporting this research program.

(College series no. 798)