

**TITRATION CURVES  
AND BUFFERING CAPACITIES  
OF HAWAIIAN SOILS**

YOSHITO MATSUSAKA  
G. DONALD SHERMAN

**TITRATION CURVES  
AND BUFFERING CAPACITIES  
OF HAWAIIAN SOILS**

**YOSHITO MATSUSAKA  
G. DONALD SHERMAN**

**UNIVERSITY OF HAWAII  
COLLEGE OF AGRICULTURE  
AGRICULTURAL EXPERIMENT STATION  
HONOLULU, HAWAII      MAY 1950  
TECHNICAL BULLETIN No. 11**

## CONTENTS

	PAGE
ABSTRACT . . . . .	5
REVIEW OF LITERATURE . . . . .	7
METHODS OF ANALYSIS . . . . .	8
DESCRIPTION OF SOILS : . . . . .	9
Chemical analyses of low humic latosol; humic ferruginous latosol; humic latosol; hydrol humic latosol; reddish prairie and brown forest soils; red desert and reddish-brown soils; and of gray hydromorphic and dark magnesium clay soils.	
EXPERIMENTAL RESULTS . . . . .	19
Titration curves of the latosol groups; of reddish prairie, brown forest, red desert, and reddish-brown soils; of the gray hydromorphic and dark magnesium clay soils; and of clay fractions of certain soils. Influence of organic matter on nature of titration curve. Variation of titration curves of different soil families of each great soil group. Relationship between silica-sesquioxide ratio and nature of titration curve; between clay content and degree of buffering of soil; and be- tween "free oxide" content and buffering capacity.	
SUMMARY . . . . .	24
LITERATURE CITED . . . . .	25
FIGURES 1—10 . . . . .	27

## ABSTRACT

In the development of a liming program for the acid soils of the Hawaiian Islands, it was found that soils of the various great soil groups varied greatly in their lime requirement for correction of similar degrees of acidity. This variation in lime requirement appeared to be associated with the differences in the buffering capacities of the soils. Titration curves were made on more than a hundred soils selected from the typical profiles of the soil families belonging to the various great soil groups. The results of this study have justified the following conclusion regarding the nature of the titration curves and buffering capacities of the tropical and sub-tropical soils of the Hawaiian Islands:

The buffering capacity of Hawaiian soils was much lower than that found for soils of the temperate regions. The buffering capacity of the soils of the different great soil groups varied greatly; however, there was very little variation in the degree of buffering exhibited by the soils of the different soil families of each group. Each soil group has a typical titration curve. The soils of the low humic latosol and humic ferruginous latosol have the lowest buffering capacity, and the soils of the hydrol humic latosol and brown forest groups exhibit the greatest degree of buffering.

The organic matter fraction of the soil affects the degree of buffering above soil reaction of  $pH$  5.5. It is most "active" in neutral and alkaline portions of the titration curves. However, the organic matter fraction does not influence the nature of the curve. The general character of the titration curve is determined by the nature of the clay minerals. The kaolinite and iron oxide clays give rise to titration curves having a low buffering capacity and montmorillonite and hydrated aluminum oxide clays give titration curves having a high buffering capacity. The silica-sesquioxide ratio of the clay fraction of the soil or the quantity of clay in the soil was not related to the degree of buffering exhibited by the titration curve of the soil. This is probably due to the large amount of "free oxides" found in these soils. There is a direct relationship between the cation exchange capacity of the soil and its buffering capacity. The higher the cation exchange capacity the greater buffering would be exhibited by the titration curve of the soil.

## THE AUTHORS

YOSHITO MATSUSAKA—Assistant in Soil Chemistry, Department of Soils and Agricultural Chemistry.

G. DONALD SHERMAN—Chemist and Chairman of the Department of Soils and Agricultural Chemistry.

#### ACKNOWLEDGMENTS

The authors wish to acknowledge the assistance of the following: Dr. J. H. Beaumont for encouragement and many suggestions, Mary I. Fuss for assistance in the preparation of the manuscript, and Yoshihiko Kawano for the preparation of all the graphs included in the manuscript.