INFLUENCE OF SILICATE AND SULFATE SOURCES ON PHOSPHORUS SORPTION AND CORN YIELD

CONRADO M. DUQUE, SR.

JANUARY 1990

INFLUENCE OF SILICATE AND SULFATE SOURCES ON PHOSPHORUS SORPTION AND CORN YIELD

CONRADO M. DUQUE, SR.

SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
UNIVERSITY OF THE PHILIPPINES AT LOS BANOS
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE
DEGREE OF

DOCTOR OF PHILOSOPHY
(Soil Science)

JANUARY 1990

ABSTRACT

DUQUE, CONRADO M., Sr. University of the Philippines at Los Baños. College, Laguna. January 1990. Influence of Silicate and Sulfate Sources on Phosphorus Sorption and Corn Yield.
Major Professor: Dr. Henry P. Samonte

The potential of competitive anion adsorption for phosphate, using silicate and sulfate as a possible management strategy to increase phosphate availability to corn was tested on two extremely acidic, phosphorus deficient soils, Luisiana clay and Adtuyon clay. This study was conducted with the following objectives: a) to evaluate the effects of calcium, magnesium, potassium and sodium silicates on P sorption, available P and dry matter yield of corn, b) to evaluate the effects of calcium, magnesium, potassium and sodium sulfates on P sorption, available P and dry matter yield of corn, and c) to evaluate the effects of calcium silicate and calcium sulfate on available P, soil pH, exchangeable aluminum and grain yield of corn.

Application of 250 ppm and 500 ppm silicate in the form of calcium silicate on Luisiana clay decreased the P sorption maximum of the soil from 2.4522 to 2.4237 and 2.2969 mg P g^{-1}, respectively. Other silicate sources had lesser effect than calcium silicate in decreasing the P sorption maximum of the soil. Sulfate application resulted to a very slight decrease in the P sorption maximum of the soil.

On Luisiana clay not fertilized with phosphorus, application of different silicate and sulfate compounds did not increase dry matter

yield of corn but phosphorus application resulted in significantly higher dry matter yield. Combined application of 160 ppm P and 250 ppm silicate as calcium silicate and potassium silicate significantly increased dry matter yield of corn.

On Adtuyon clay, the application of either 60 kg P_2O_5 per hectare, 120 kg P_2O_5 per hectare or 250 kg silicate per hectare as calcium silicate significantly decreased exchangeable aluminum. Soil pH significantly increased with the application of either 250 kg silicate per hectare as calcium silicate or 120 kg P_2O_5 per hectare. Soil P test value increased significantly with the application of 60 and 120 kg P_2O_5 per hectare. The application of silicate and sulfate alone or in combination with phosphorus did not increase soil P test value at silking stage over the P treatments. Silicate and sulfate application alone however, resulted in significantly higher concentration of phosphorus in corn plants. Grain yield and P uptake of corn increased significantly with the application of either 250 kg silicate per hectare as calcium silicate, 100 kg sulfate per hectare as calcium sulfate, 60 kg P_2O_5 per hectare or 120 kg P_2O_5 per hectare.

Silicate and sulfate application alone slightly reduced P sorption, did not increase soil P test values but increased soil pH, decreased exchangeable aluminum, increased P concentration in corn plants, increased P uptake and grain yield of corn.

TABLE OF CONTENTS

PAGE

PAGE

LIST OF TABLES

LIST OF FIGURES

FIGURE		PAGE

LIST OF APPENDIX TABLES

APPENDIX TABLE | PAGE

APPENDIX TABLE

PAGE

INTRODUCTION

It is recognized that when water soluble phosphorus fertilizer materials are applied to many soils of the tropics and subtropics only about 10 to 30 percent of the added phosphorus is utilized by the plant (Hemwall, 1957). The remaining 70 to 90 percent is assumed to have been retained by the soil in various relatively insoluble forms. The efficiency of phosphorus fertilization therefore, is greatly affected by the ability of the soil to sorb P and render it less available to the roots of specific crop.

Phosphorus sorption and subsequent fixation by the soil is related to the degree of weathering and mineralogy of the soil. Weakly weathered soils dominated by 2:1 clays could retain 8 to 19 percent. for moderately weathered soils with 1:1 and 2:1 type clays 35 to 45 percent, and for highly weathered volcanic soils 60 to 90 percent (Metson and Blakemore, 1978). Other tropical soils of the order Oxisols like those in Hawaii could retain as much as 40 to 70 percent (Munns and Fox, 1976) while Oxisols in Central Brazil retain 77 to 90 percent of applied phosphorus fertilizer (Fageria and Filho, 1987). The main concern therefore in phosphorus fertilization of strongly acid soils dominated either by 1:1 type clay or oxide clay minerals is to increase the efficiency of applied water soluble phosphate fertilizer materials by reducing the effect of adsorption and/or fixation of phosphate ions by the soil.

A possible management strategy to alleviate or reduce phosphorus adsorption capacity of the soil is to employ the concept of competitive