STUDIES ON RETENTION OF FERTILIZER PHOSPHORUS AND ASSESSMENT OF AVAILABLE PHOSPHORUS STATUS IN SOILS OF SRI LANKA

By

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Thesis

Submitted in partial fulfilment of the requirements

for the Degree of

MASTER OF PHILOSOPHY

in the

POSTGRADUATE INSTITUTE OF AGRICULTURE

of the

UNIVERSITY OF PERADENIYA

SRI LANKA

May 1996.

ABSTRACT

Assessment of available phosphorus status in soils is often unsatisfactory since P availability is regulated by many processes, mainly, adsorption, precipitation and diffusion. pH and P buffer capacity are the two main factors that influence P availability through their effect on these processes. In this study laboratory and greenhouse experiments were conducted using twenty soils from different locations of Sri Lanka with the main objectives of investigating the nature and magnitude of P retention in these soils and to identify suitable chemical extractants to assess P availability in relation to soil pH and P buffer capacity.

Initial available P status of soils were analyzed by five extractants, namely, Olsen, Bray-1, Bray-2, CAL and De-ionized water. An adsorption experiment was conducted by equilibrating soils with increasing P concentrations and measuring the solution P after equilibration. Adsorption data were fitted to different isotherms, including Langmuir, Freundlich, Temkin and Langmuir two- surface equations.

The relationships between soil properties and P adsorption parameters were studied by simple linear regression analysis. To obtain information on available P status of these soils a greenhouse pot experiment was conducted using rice (variety H-4) as the indicator plant, maintaining soil moisture at 70% field capacity. Cumulative

phosphorus uptake by rice plant after four harvests within a total vegetative period of 120 days was determined. Relationships between P extracted by different extractants with P uptake values were established by simple linear regression.

Results of the adsorption experiment indicated that in soils with pH greater than 5.0, precipitation seem to be the dominant mechanism of P retention. Langmuir one-surface isotherm was the most appropriate to describe P adsorption of these soils. None of the soil properties except cation exchange capacity showed a significant relationship with P adsorption parameters. Maximum Buffer Capacity (MBC) values calculated using two- surface Langmuir isotherm indicated that soils collected from Lunuwila was the least buffered while the soil collected from Nuwara Eliya was the most buffered with MBC values of 5.3 (µg P sorbed/ µg P in solution) and 5717 (µg P sorbed/ µg P in solution) respectively.

P quantities extracted by all extractants showed a significant relationship with cumulative phosphorus uptake. The highest correlation was observed with Bray-2 extractant (r^2=0.58**, $p<0.01$) and the lowest was observed with Olsen extractant (r^2=0.45*, $p<0.05$). When soils of pH greater than 5.0 were considered separately, the relationship between P uptake and amount of phosphorus extracted improved for all five methods, and for these soils CAL method seem to be the most suitable. None of the methods seem to be appropriate

to assess P availability of strongly acidic soils with pH less than 5.0. Of the chemical extractants tested, Bray-2, CAL and De-ionized water seem to be more suitable for estimating P availability in soils with low P retention. None of the methods except perhaps the Olsen method seem to be suitable to assess P availability of soils with high P retention. Bray-2 method was found to be the most suitable extractant to assess available P status of soils with a wide range of chemical properties. The findings of these experiments emphasize the importance of considering soil chemical properties such as pH and P buffer capacity in selecting an appropriate extractant to assess P availability of soils.