COMPARISON OF LABORATORY METHODS FOR THE DETERMINATION OF PLANT AVAILABLE PHOSPHORUS IN COCONUT GROWING SOILS IN THE LOW COUNTRY INTERMEDIATE ZONE OF SRI LANKA

By

DUNUKARA MUDIYANSELAGE DAISY IRANIE WIJEBANDARA

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

March, 1997

ABSTRACT

Eight laboratory soil P analysis methods that could be used for the determination of available phosphorus of coconut growing soils were compared. The methods considered for the present study were Olsen's bicarbonate, Bray and Kurtz-1, Bray and Kurtz-11, 2.5% acetic acid (HAc), water, 0.01M calcium chloride ($CaCl_2$), anion exchange resin (AER) and anion exchange resin + cation exchange resin (AER+CER). The suitablity of the methods were evaluated by correlating soil P values of each method with plant growth data of a greenhouse pot experiment. The selected methods from the above experiment were further calibrated by a field experiment for the determination of soil critical P levels.

Ten soil series were sampled from two agro ecological regions IL_1, and IL_3 to represent a wide range of coconut growing soils. The pH of the soils ranged from 4.6 to 5.9. Two indicator plants, viz., *Pueraria phaseoloides* and *Panicum maximum* were grown in pots filled with each soil in a greenhouse with P and without P treatments and a basal dose of N, K and Mg for all the pots. The duration of the experiment was six months for each plant.

The total dry matter production, P concentration and P uptake of both crops were determined. Relative dry matter production (biological index) was obtained for each soil by the ratio of yield of -P treatment to +P treatment.

The suitability of the methods were evaluated by goodness of fit of relative yields of both crops and soil-P data to Cate and Nelson model (Cate and Nelson, 1971). Results showed that correlation coefficient (r) of 2.5% HAc (r; 0.629-0.836), Olsen's bicarbonate (r; 0.703-0.880), AER (greater than 4h extraction time) (r; 0.646-0.836) and AER+CER (greater than 4h extraction time) (r; 0.596-0.709 fitted highly significantly to the model than the other methods. Soil-P by water extraction (r; 0.532-0.609) and 0.01M $CaCl_2$ (r; 0.361-0.458) methods showed poor correlations and Bray and Kurtz-1 (r; 0.637-0.678) and Bray and Kurtz-11 method showed (r; 0.694-0.703) moderate correlation. Soil P extractable by both AER and AER+CER at different extraction times (1h, 2h, 4h, 8h and 16 for AER and 4h, 8h and 16 for AER+CER) were also evaluated by the above procedure. Results showed that correlation coefficient (r) ranged from 0.596-0.664 for *Panicum* and 0.684-0.836 for *Pueraria* at all extraction times except 2h.

Goodness of fit of plant P concentration and uptake and soil-P data to the model $Y = a + b (\log X)$ (where Y = leaf P data and X = soil P values) was examined. Results showed that water extraction ($r < 0.345$) and 0.01M $CaCl_2$ methods ($r < 0.161$) were also poor for the above relationships in the pot experiment. Those correlations were high ($r > 0.746$) for 2.5% HAc, Olsen's bicarbonate, AER, AER+CER and Bray and Kurtz-11 methods. Bray and Kurtz-1 method also showed fairly high correlation ($r > 0.666$).

Linear regression among soil-P testing methods showed that correlations of 0.01M

$CaCl_2$-P with all the other methods were poor. H_2O-P also showed significant linear correlations ($r > 0.719$) with other methods except 0.01M $CaCl_2$. Both AER-P at 4h, 8h and 16h extraction times and (AER+CER)-P at 4h, 8h and 16h extraction times showed higher correlations ($r > 0.9$) among each other.

Considering all the above correlations 2.5% HAc, Olsen's bicarbonate AER at 4h extraction time, AER+CER at 4h extraction time, Bray and Kurtz-11 and Bray and Kurtz-1 methods were considered suitable for routine P analysis. Water extraction method was moderately suitable and 0.01M $CaCl_2$ method was not suitable.

Olsen's bicarbonate, 2.5% HAc, AER at 4h extraction time and AER+CER at 4h extraction time were calibrated by a field experiment using *Pueraria phaseoloides* as an indicator plant. Correlation between soil-P and plant parameters showed that 2.5% acetic acid method was the best for the determination of available soil P under field conditions. The critical level for 2.5% HAc-P was 7.8 mg/kg. The suitability of other three methods in the descending order is (i) AER+CER (ii) AER and (iii) Olsen's bicarbonate. The corresponding critical levels are 5.34, 3.84 and 8.47 mg/kg.