

AN APPROPRIATE EXTRACTION METHOD TO DETERMINE PLANT AVAILABLE PHOSPHORUS IN AGRICULTURAL SOILS OF THE UP COUNTRY INTERMEDIATE ZONE OF SRI LANKA *

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INTRODUCTION

Phosphorus is considered as the second most limiting element next to nitrogen in agro-ecosystems. Besides, phosphorus fertility is considered to be a limiting factor, particularly in highly weathered tropical soils, such as ultisols in up country of Sri Lanka. Application of chemical phosphorus fertilizers and animal manure to agricultural lands have improved soil phosphorus fertility and crop production but caused also environmental damages during the past decades (Jianbo *et al.*, 2011). Soil pH of more than 67% of the up country potato and vegetable grown soils is below 5, and such soils categorized as strongly or very strongly acidic soils (Kodikara *et al.*, 2008).

Many studies indicated that phosphorus availability and phosphorus use efficiency in particular soils is very low. Soil testing is the key factor for determining the need of phosphorus fertilization. If fertilization is required, test results guide the rate of application to optimize production and minimize environmental impacts. It is important to identify an appropriate extraction procedure from commonly used phosphorus extractants suitable for acidic up country soils considering plant phosphorus requirements. Consequently, the objective of this study was to assess the suitability of different phosphorus extraction methods, based on plant phosphorus uptake, for acidic up country soils.

* See "Tropical Agriculturist" Volume 164 for details..

MATERIALS AND METHODS

Thirty two soil samples were collected randomly from vegetable and potato growing areas across Badulla district representing up country intermediate zone. Samples were divided in to two parts, and one part was prepared for laboratory analysis and the rest was air dried and used in green house pot experiment. Pre treated soil samples were extracted using distilled water (water soluble phosphorus), NaHCO_3 (Olsen method), NH_4F , HCl (Bray I), NH_4F , HCl (Bray II) and H_2SO_4 , HCl (Mehlich I) and determined Total phosphorus of soil samples. Soil pH was determined by water (1:1) and 1M KCl (1:2.5) with a bench type pH meter.

Six inches diameter plastic pots filled with 1 kg of soil collected previously was used in the greenhouse pot experiment. Four lettuce seeds sowed in each pot, one was maintained for data collection and pots were arranged in CRD with two replicates. Sufficient amount of a fertilizer mixture, except phosphorus, was supplied in liquid form to ensure only the plant available phosphorus will be taken up in soil. Oven dried samples subjected to di-acid digestion to determine plant phosphorus contents.

RESULTS AND DISCUSSION

Soil pH in KCl ranged from 3.70 to 6.05 and measured in H_2O varied from 4.20 to 6.62. Mean pH in H_2O and 1M KCl were 5.67 and 5.03, respectively. Water extracted pH was highly correlated (0.909) with KCl pH. There is no significant correlation between pH values and phosphorus extractants. The interesting feature observed was pH H_2O showed negative correlation with all phosphorus extractants. The lowest phosphorus extraction ability was with water and Mehlich I showed the highest for soils tested. Based on the mean values of extracted phosphorus, the extraction power of tested methods can be arranged as $\text{H}_2\text{O} < \text{Olsen} < \text{Bray I} < \text{Bray II} < \text{Mehlich I}$ (Table 1).

The dry weights of more than 80% of plant samples were between 2 to 6 g while dry matter percentage of 7.88. The total phosphorus absorbed by lettuce plants were between 0.86 mg to 12.80 mg, thus there was a 14 times high phosphorus uptake from the lowest to the highest. The mean of the phosphorus in all parts of lettuce plant was 4.54 mg/plant. Plant dry weight and phosphorus

uptake were highly correlated (0.987). Correlation between Olsen phosphorus values and plant phosphorus uptake were comparatively lower than that of Bray I and II. Bray I showed the highest correlation (0.837) with P uptake and dry matter production of plants grown in tested acidic soils (Figure 1).

Table 1. Mean phosphorus values recorded in different extractions.

	Mean phosphorus values (mg/kg)					
	H ₂ O	Olsen	Bray I	Bray II	Mehlich 1	Total P
Mean	7.23	79.24	119.11	121.08	180.92	520.72
Standard deviation	4.68	22.16	22.78	24.49	19.18	120.95
Minimum	0.18	32.52	60.56	78.31	139.76	330.28
Maximum	16.89	124.45	165.42	165.52	220.16	763.08

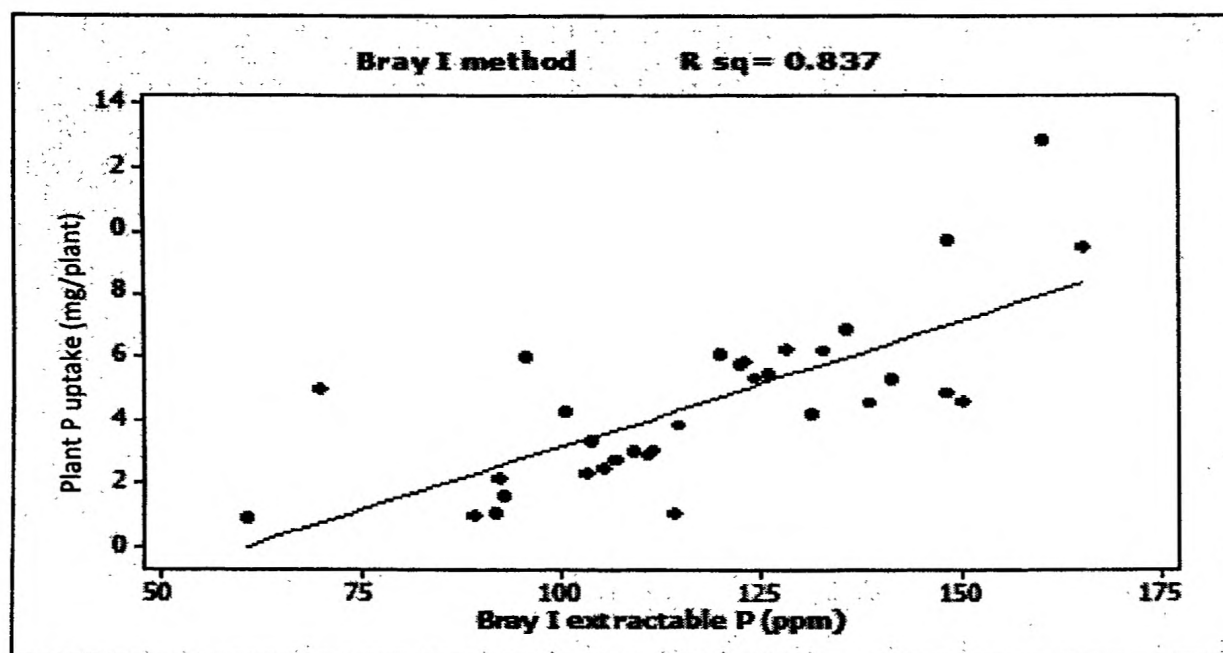


Figure 1. Relationship between plant phosphorus uptakes with Bray I.

CONCLUSIONS

All of up country Intermediate zone vegetable and potato growing soils are acidic and more than 93% of soil pH (H₂O) less than 6.4. The relative efficiency of phosphorus extraction methods tested were arranged as H₂O<Olsen<Bray I<Bray II<Mehlich I. Bray I showed the highest correlation with P uptake and dry matter

production of plants grown in tested soils. Therefore, it can be concluded that, Bray I as the most suitable method to test plant available soil phosphorus in up country intermediate zone soils concerning plant phosphorus uptake.

REFERENCES

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