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CHOICE OF EXTRACTION METHODS IN ASSESSING AVAILABLE NUTRIENTS OF SOME BANGLADESH SOILS.
II. Phosphorus and Potassium

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Abstract

Morgan's reagent appeared to be the best for available phosphorus estimation among the five extractants used. The uptake of phosphorus in relation to its availability as assessed by Morgan's reagent was significantly corrected both at the flowering (0.755 and 0.758) and harvesting stages (0.798 and 0.876) under controlled and fertilized conditions. Phosphorus extracted by acidified NaCl (pH 1) was found to be significantly correlated with the plant uptake at the flowering stage only. Available K extracted by acidified NaCl (pH 1) has been found to be significantly correlated with the plant uptake at both the stages of growth for the two conditions, the values for being 0.772 (0.05) and 0.824 (0.05) at the flowering stage and 0.755 (0.05) and 0.768 (0.05) at the harvesting stage for the two conditions respectively.

Introduction

The present work is a continuation of the works in this line (Anam *et al*. 1976, Enayetullah 1976) in the pursuit of choosing a suitable extractant for interpreting the available phosphorus and potassium status of some soils of the country in relation to plant growth (uptake). More of the representative soils and different types of extractants than those used in the previous study have been considered in the present study.

Materials and Methods

The materials and methods, green house experiment and the extractants used have been described in part I (Anam *et al*. 1978). The available P was determined by using a Coleman Junior II spectrophotometer after the development of molybdophosphoric blue color in HCl system (Jackson 1958) at a wavelength of 660 millimicron. Available K was determined by using a NIL Digital Flame Photometer.

Results and Discussions

The amounts of available phosphorus and potassium excracted by different methods are presented in Table 1 (a and b) and the amounts of

Table 1. Available phosphorus and potassium contents of soils before cropping (in ppm). (a) Phosphorus, (b) Potassium.

Soils	N NaCl	NaCl (pH 1)	Methods of Morgan's reagent	extraction 0.3N HCl	Spurway Test 0.028N CH_3COOH
(a)					
Thakurgaon	3.00	9.00	9.50	50.00	2.30
Gaibandha	3.00	8.50	5.00	16.00	1.40
Serajgonj	2.00	12.50	4.00	4.75	1.40
Daudkandi	2.00	3.20	3.90	4.75	2.20
Kotowali	3.20	2.50	3.75	12.50	1.80
Hathazari	3.20	6.00	13.50	60.00	3.00
(b)					
Thakurgaon	109.00	162.00	139.00	151.00	37.50
Gaibandha	89.00	142.00	106.00	128.00	32.00
Serajgonj	120.00	240.00	144.00	199.00	46.50
Daudkandi	112.00	138.00	140.00	130.00	33.60
Kotowali	120.00	152.00	108.00	127.00	33·20
Hathazari	99.00	139.00	126.00	128.00	35.10

the corresponding elements in the paddy plant and rice grains are presented in Table 2 (a and b).

Table 2. Percent phosphorus and potassium in paddy plants and rice grains. (a) Phosphorus, (b) Potassium.

Soils	Flowering stage		Harvesting stage		Rice grains	
	Control	Fertilized	Control	Fertilized	Control	Fertilized
(a)						
Thakurgaon	0.210	0.230	0.150	0.190	0.210	0.230
Gaibandha	0.210	0.250	0.190	0.226	0.180	0.210
Serajgonj	0.200	0.223	0.180	0,190	0.210	0.210
Daudkandi	0.230	0.240	0.200	0.213	0.220	0.216
Kotowali	0.220	0.260	0.180	0.220	0.190	0.220
Hathazari	0.230	0.280	0.170	0.190	0.220	0.236
(b)						
Thakurgaon	1.955	2.286	1.520	1.683	0.624	0.729
Gaibandha	2.033	2.692	1.750	1.808	0.687	0.703
Serajgonj	1.950	2.613	1.550	1.923	0.650	0.724
Daudkandi	1.876	2.137	1.260	1.590	0,624	0.703
Kotowali	1.870	2.137	1.420	1.582	0.602	0.677
Hathazari	1.900	2.423	1.425	1.578	0.624	0.729

It is apparent from the tables that the amounts of phosphorus and potassium extracted from a particular soil by different extractants as well as by a particular extractant from different soils differed appreciably. The content of phosphorus and potassium in the plants at the flowering stage was higher than that at the harvesting stage. The variation in the contents of P and K is perhaps related to the difference in the fertility status of the soils.

The coefficients of correlation between the plant uptake of phosphorus from the controlled and fertilized soils and the availability of the element as assessed by Morgan's reagent in all the soils was found to be significantly correlated at the flowering as well as at the harvesting stage. The values of 'r' being 0.755 (0.05) and 0.758 (0.05) at the flowering stage and 0.798 (0.05) and 0.876 (0.01) at the harvesting stage under controlled and fertilized conditions respectively (Table 3a). The percent content of P in the grains and the

Table 3. Coefficients of correlation between phosphorus and potassium contents of paddy plants at various stages and rice grains and the corresponding available phosphorus and potassium contents in soils as obtained by different extraction methods. (a) Phosphorus, (b) Potassium.

Extraction Methods	Coefficients of correlation					
	Flowering stage		Harvesting stage		Rice grains	
	Control	Fertilized	Control	Fertilized	Control	Fertilized
(a)						
N NaCl	0.2935	0.7516*	—ve	0.2859	0.7564*	0.3987
NaCl (pH 1)	0.8746**	0.7640*	—ve	—ve	0.1854	0.1660
Morgan's reagant	0.7553*	0.7584*	0.7984*	0.8760**	0.8995**	0.9220**
0.3N HCl	0.2840	0.4986	—ve	—ve	0.3575	0.7696*
0.028N CH_3COOH						
Spurway test	0.7728*	0.4800	—ve	—ve	—ve	0.9592***
(b)						
N NaCl	—ve	0.4829	0.5159	0.1750	—ve	—ve
NaCl (pH 1)	0.7721*	0.8242*	0.7556*	0.7688*	0.8350*	0.9267**
Morgan's reagent	—ve	—ve	—ve	0.2023	0.0120	0.6197
0.3N HCl	0.2137	0.3797	0.2053	0.7796*	—ve	0.6314
0.028N CH_3COOH						
Spurway test	0.1300	0.3040	0.1271	0.7213	0.2001	0.6097

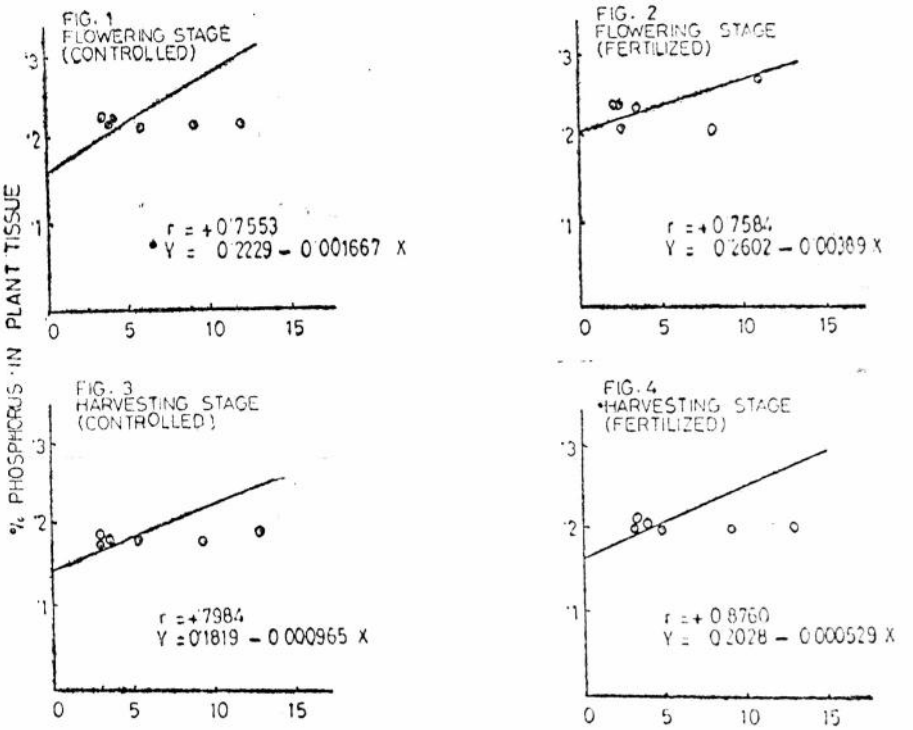
*, ** and *** indicate levels of significance at 5, 1 and 0.1 percent respectively.

availability of the element as assessed by Morgan's reagent showed significant relationships, the values of 'r' being 0.899 (0.01) and 0·922 (0·01) under controlled and fertilized conditions respectively. Acidified NaCl (pH 1) ranked second in superiority in determining available phosphorus. However, while this method showed significant relationship with P uptake at the

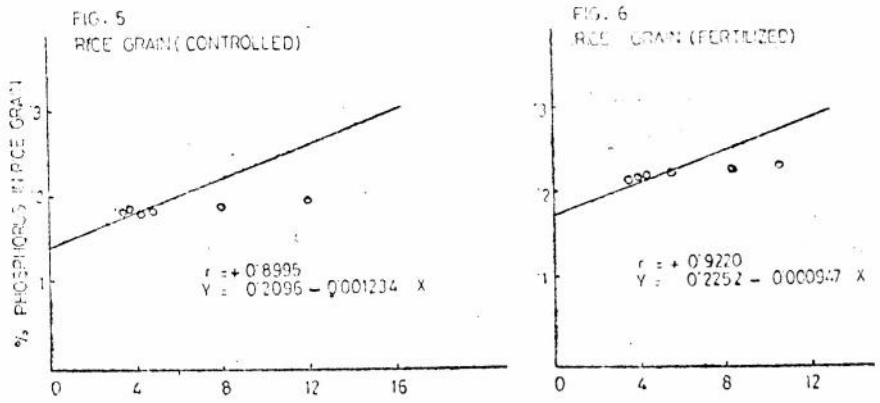
flowering stage only, the former one was found to be better correlated at all the stages of growth (Table 3a). The other methods gave incomprehensible results.

Acidified NaCl (pH 1) extractable potassium was found to be significantly correlated with the plant uptake both at the flowering and harvesting stages. The 'r' values being 0.772 (0.05) and 0.824 (0.05) at the flowering stage and 0.755 (0.05) and 0.768 (0.05) at the harvesting satge under controlled and fertilized conditions respectively. The amount of K in the grains and the availability of it as determined by acidified NaCl (pH 1) method was significantly correlated under controlled and fertilized conditions, the values of 'r' being 0.835(0.05) and 0.926(0.010) respectively. The other methods showed inconsistent and insignificant results (Table 3b).

Linear regression equations were calculated to see the distribution of the observed plant uptake of phosphorus and potassium with respect to soil available P as assessed by Morgan's reagent and available K as assessed by acidified NaCl (pH 1). The regression lines drawn for phosphorus (Figs. 1-6)

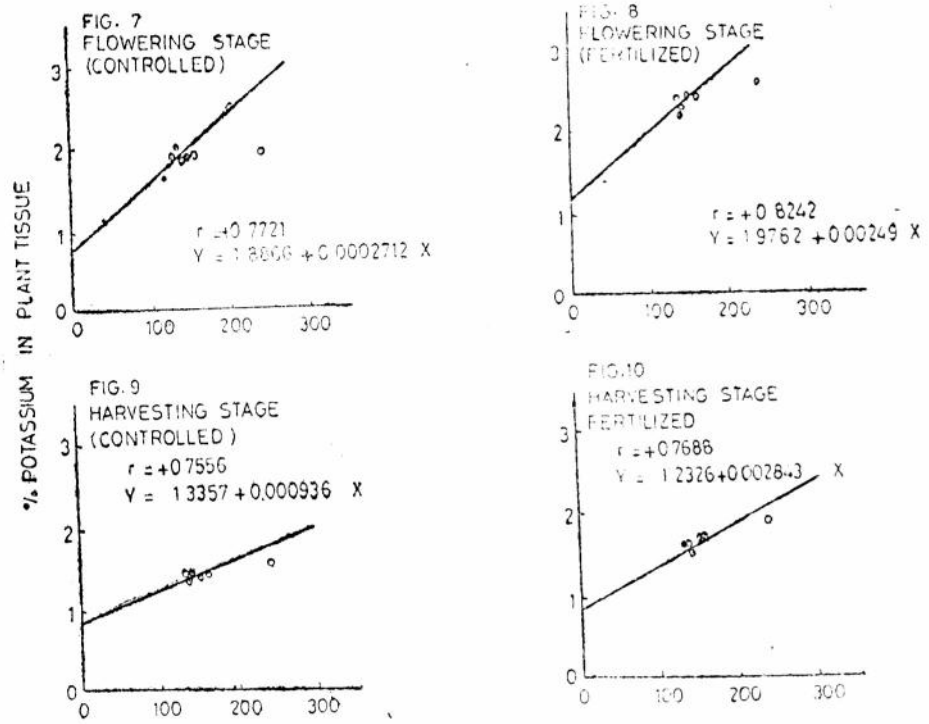


Figs. 1-4 Relationship between available phosphorus in soil and phosphorus content in plant tissue.

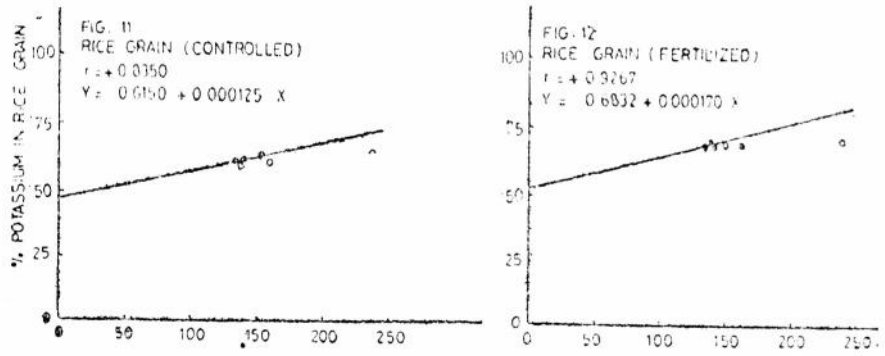


Figs. 5-6 Relationship between available phosphorus in soil and phosphorus content in rice grain, available phosphorus measured by Morgans method in ppm.

and for potassium (figs. 7-12) showed that the observed values fell very close to the expected values. The proximities of the values to the regression lines suggested that the relationships between Morgan's reagent extractable



Figs. 7-10 Relationship between available potassium in soil and potassium content in plant tissue.



Figs.11-12 Relationship between available potassium in soil and potassium content in rice grain, available potassium measured by acidified sodium chloride method in ppm.

P and acidified NaCl (pH 1) extractable K with their corresponding uptake by the plant was by far the best.

The suitability of Morgan's reagent for the assessment of available P for the soils of the country conforms with the findings of Anam *et al.* (1976) and Enayetullah (1976).

Results obtained in the present study for the assessment of available K show that none of the methods could perhaps claim to be successful if the partial success is not considered. However, for the estimation of available K of the soils of the country a suitable method is yet to be developed perhaps in accordance with the theoretical basis as elucidated by Schofield (1955) who divided availability measurment into "intensity of supply"-indicating how much nutrient is available immediately to plant roots, and the "pool"-the total quantity of nutrient that could be used by the plant.

The failure of chemical reagent in estimating available potassium is due to the fact that this element exists in soils in water soluble form, exchangeable and non-exchangeable form. Conventionally, exchangeable K is identified as the available form (Duthion 1968), but authors like Mortland (1968) and Arnold and Clause (1961) suggested that initially non-exchangeable K is as important as the immediately available forms as plant absorb large quantities of non-exchangeable K in addition to other forms. Cooke (1967) concluded that it is not surprising that the chemical extraction method would not be outstandingly successful which generally extract a fraction of soil potassium that is similar to the exchangeable potassium or is related to it".

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