A COMPARISON OF EXTRACTION METHODS TO ASSESS THE AVAILABLE Ca AND Mg IN SOME BANGLADESH SOILS

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Abstract

Extractants used in the study indicated that NaCl was best suited to the determination of available Ca and Mg of some representative soils of Bangladesh. NaOAc ranked next to NaCl for Ca and Morgan's extractant for Mg. There existed a high correlation between these extraction methods and the uptake of Ca and Mg by the paddy plants at the vegetative as well as at the flowering stages of their growth. Rest of the methods failed to give any meaningful indication.

Introduction

The knowledge of available nutrient status of soils is of utmost importance for the efficient use of fertilizers. This necessitates the determination of availability of different nutrients present in the soil. Various research workers tried in the past and still are trying to develop methods to assess the available nutrient status in soils with respect to different crops (1,2,3,5,9). As nutrient availability in soils and their uptake by plants are controlled by a number of factors viz., soil, climate, and the inherent characteristics of the plants themselves, the investigators in this field are bound to face a number of obstacles in developing a suitable method of extraction for the assessment of available nutrients of soils with respect to plant uptake. Practically no work has yet been reported for Bangladesh soils in this regard. The present investigation aimed at finding a suitable method of extraction for Ca and Mg. Five chemical methods were studied with some representative soils of Bangladesh with respect to green house crop.

Materials and Methods

Five representative Bangladesh soils were included in the study (Table 1). The surface (0-15cm) soils were collected which varied in their physical and chemical properties (Table 1). Mechanical analyses were done by hydrometer method as outlined by Piper (10), and the texture was determined by the USDA (II) method ; pH of the soils were determined by a Pye

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glass electrode pH meter at a soil : water ratio of 1 : 2.5 ; organic carbon by wet oxidation method (12) and Ca and Mg by EDTA titration.

Green house experiment : Seven pounds of each soils were taken in earthen ware pots arranged in a completely randomized design in triplicates. Twenty healthy seeds of 'Chandina' variety of paddy were sown in each of the pots. The seedlings were thinned to 12 after 10 days. The soils in the pots were kept moist in the early stage of plant growth ; during rest of the period 2-3 inches of water was maintained stagnated in the pots. Half of the plants were harvested (with roots) after 50 days and the rest after 90 days of their growth.

Methods of extraction : The different extractants used to evaluate the Ca and Mg availability status of the soils with respect to 'Chandina' paddy are presented in Table 2. In all the cases the soil : extractant ratio was maintained at 1 : 10.

Results and Discussions

The amount of Ca and Mg extracted by different extractants and their percentage in the paddy plants at the vegetative (60 days old) and flowering stage (90 days old) are presented in Table 3 and 4 respectively. It is evident from Table 3 that the amount of Ca and Mg extracted by a particular extractant from different soils and also from a particular soil by various extractants are different. This related to the extracting capacity of the extractants as well as to the soil characteristics. Table 4 indicates that the amount of Ca and Mg contents of all the plants at the vegetative stage is higher than that in the flowering stage. This variation in plants are presumably related to the fertility status of the soils.

Calcium : Ca extracted by the NaCl and NaOAc were well correlated with the uptake at both the flowering and vegetative stages of the growth in plants (Table 5). Linear regression lines drawn between uptake and availability as determined by the various extracting methods also showed that the NaCl method fell more closely to the expected values (Figs. 1a and 1b).

Magnesium : A very high correlation existed between the uptake of Mg by paddy plants at the vegetative stage and that extracted by NaCl in all the soils (Table 5). Other extractants, viz., NaOAc and Morgan's gave significant but poor correlation in comparison to NaCl (Table 5). The remaining extractants failed to give any acceptable result. The NaCl and Morgan's extractants were found to be significantly but not very strongly correlated at the flowering stage (Table 5). All other methods of extraction were found to be insignificantly correlated at this stage of growth. It

was observed that the Ca and Mg extracted by NaCl and Morgan's extractants were significantly correlated with the uptake at both the stages of plant growth, although the slope of the line of regression indicated that the soils gave statistically different values with reference to Mg extracted by various extractants and that of the plants uptake. The correlation coefficients as well as the regression lines (Figs 2a and 2b) showed that NaCl was superior to any of the other extractants in determining available Mg.

Peech (9) also reported that neutral NNaCl is better than neutral N NH_4OAc for the extraction of available Mg in soils.

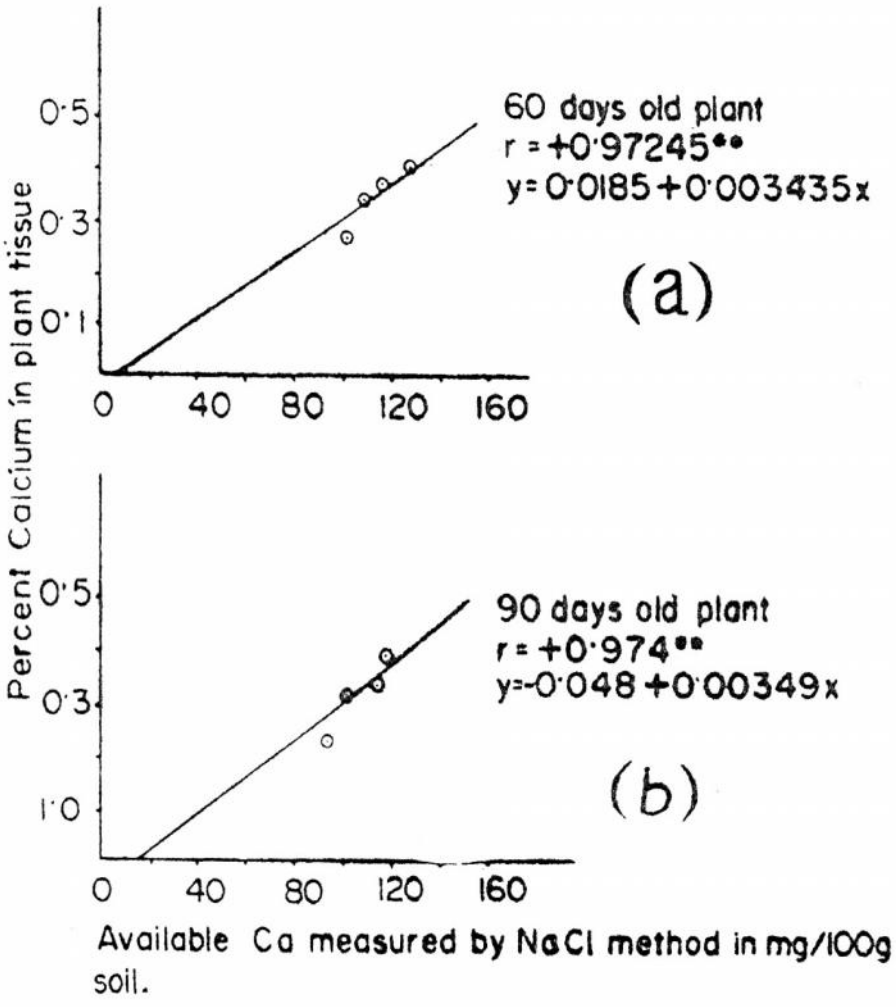

Fig. 1. Regression line of available Ca on the Ca content of plant tissue (**Significant at 1 per cent level).

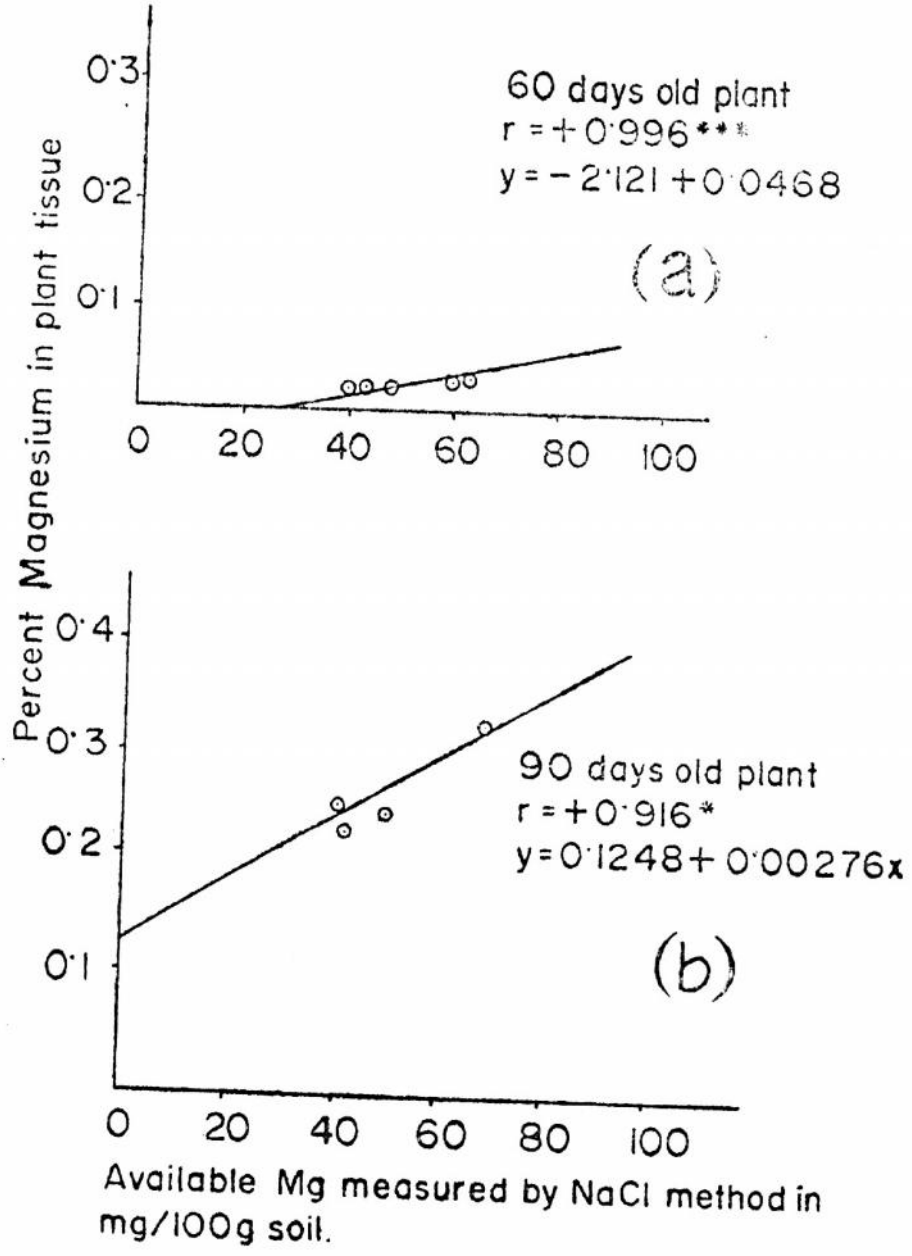

Fig. 2. Regression line of available Mg on the Mg content of plant trssue (*Significant at 5 percent levil ; *** Significant at 0.1 per cent level).

Table 1. Some physical and chemical properties of the soils

Soils (series)	Soil Tracts	Texture	pH	Organic C %	Total N %	C/N ratio
Santal	Middle Meghna flood plain	Clay loam	6.4	0.528	0.050	10.56
Serajgonj	Jamuna flood plain I	Loam	7.6	0.480	0.048	10.0
Tangail	Jamuna flood Plain II	Clay loam	7.2	0.509	0.059	10.0
Hajigonj	Brahmaputra flood plain	Loam	6.2	1.086	0.102	10.45
Joydebpur	Madhupur tract	Clay	5.0	1.168	0.108	10.81

Table 2. The different extractants used to evaluate the availability of Ca & Mg

Exctractants used	Author/s	Shaking period and procedure	Remarks
1% Citric acid	Dyer, B. 1894	2hrs. allowed to stand for 24 hrs. and filtered	Yellowish soln.
Neutral N NaCl	Hissink, D.J. 1923	stirred occasionally allowed to stand for 24 hrs. & filtered	colourless soln.
Morgan's reagent	Morgan, M.F. 1937	Half an hr., then filtered	colourless soln.
0.3N HCl	Nelson *et al.* 1952	2 hrs. then filtered	yellowish soln.
N NaOAC	Bower *et al.* 1952	1 hr. then filtered	colourless soln.

Table 3. Available Ca and Mg contents in the soils before cropping (mg/100g of soil) (a) Ca ; (b) Mg

Soil		Methods of extraction				
		N NaCl	N NaOAc	1% citric acid	0.3N HCl	Morgan's reagent
a)	Santal	120.0	128.0	137.0	148.0	144.0
	Serajgonj	112.0	120.0	148.0	160.0	152.0
	Tangail	120.0	124.0	176.0	190.0	172.0
	Hajigonj	96.2	96.2	92.5	104.0	96.0
	Joydebpur	88.2	91.3	91.0	103.0	96.0
b)	Santal	62.3	48.6	57.4	63.2	48.0
	Serajgonj	41.4	40.9	63.6	73.0	38.9
	Tangail	63.2	60.7	73.0	83.0	55.5
	Hajigonj	48.8	48.6	38.0	44.0	41.4
	Joydebpur	43.8	43.7	35.0	41.0	38.6

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Table 4. Percent Ca and Mg in paddy plants

Soils	Ca		Mg	
	60 days old	90 days old	60 days old	90 days old
Santal	0.390	0.373	0.350	0.300
Serajgonj	0.370	0.333	0.257	0.257
Tangail	0.390	0.370	0.366	0.300
Hajigonj	0.330	0.307	0.297	0.253
Joydebpur	0.270	0.247	0.270	0.230

Table 5. Co-efficients of correlation between Ca and Mg contents of 60 and 90 days old plants and the corresponding available Ca and Mg in soils as determined by various extracting methods

Methods	r values for Ca		rvalues for Mg	
	60 days old	90 days old	60 days old	90 days old
N NaCl	0.972*	0.974**	0.996***	0.916*
N NaOAc	0.945*	0.932*	0.880	0.694
1% citric acid	0.847	0.821	0.522	0.775
0.3N HCl	0.838	0.812	0.485	0.695
Morgan's reagent	0.866	0.838	0.925*	0.875*

* ** *** Significant at 5, 1 and 0. 1 per cent level respectively.

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