Acta Agrophysica, 2001, 52, 49-53

DEPENDENCE OF THE AMOUNT OF AVAILABLE PHOSPHORUS ASSESSED IN SOIL ON THE APPLIED ANALYTICAL METHOD

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A b s t r a c t. This paper presents the experimental data on the amount of available phosphorus in a sandy soil assessed by the Egner-Riehm (DL) method and water extraction method. Simultaneously, the effects of the addition to the soil of calcium oxide, calcium carbonate, powder superphoshate, and soil incubation on the P content was assessed.

It was found that available phosphorus content in the soil extracted by water was lower than that assessed by the Egner-Riehm method. The effect of lime application was different in the extracts obtained by the compared methods. As effect of liming, the available phosphorus content assessed by the water extraction method was smaller. The addition to the soil of powder superphosphate caused an increase of the available phosphorus recovery by both methods. The water extraction allowed 20% of the added phosphorus to be recovered.

K e y w o r d s: soil, water extraction, available phosphorus, calcium carbonate, calcium oxide.

INTRODUCTION

For the assay of available macroelements in soil by chemical methods, media solutions of acid, alkaline or neutral reaction are being used as extraction. The question of adjusting the extraction means in the laboratory to the way plants take the nutrients up, still remains open.

One of the methods used for the assay of available phosphorus in the soil is the van der Paauw [7] method, which uses water as the solvent. In the Netherlands, Gelderland province, in the years 1989-1991 basing on soil extraction with water, an atlas of soil resources was prepared which was used for the modelling of the effects of applied fertilization on crops [2]. Munk and Berman [4], Werner and Wiechmann [8] wrote that the amount of available phosphorus detected in the water extract is smaller than in the Egner-Riehm (DL) method. Hanks *et al.* [3], who extracted 38 soil samples with hot water under pressure for 1.4 mn. consider

this procedure to be well suited for the assay of nitrogen, potassium, sulphur, phosphorus soil content and its pH. Berton *et al.* [1] point out that results obtained by the water extraction method coincide with phosphorus amount taken up by plants only if farm manure or slurry were added to the alluvial soil.

This paper concerns the amount of available phosphorus in a sandy soil assessed by the Egner-Riehm (DL) method and water extraction method. Simultaneously, the effects of the addition to the soil of calcium oxide, calcium carbonate, powder superphoshate, and soil incubation on the P content was assessed.

MATERIALS AND METHODS

The experiment was done using a sandy-loam soil of pH (H_2O) 5.9, hydrolytic acidity 3.5 me/100 g, and 1.7% C content.

The following mineral fertilization was used:

- potassium (KCl) 125 kg/ha, which equals 4.1 mg K/100 g soil,
- nitrogen (NH_4NO_3) 240 kg N/ha, equals 8 mg N/100 g soil,
- phosphorus [powder superphosphate $Ca(H_2PO_4)_2$] 44 kg P/ha, equals 1.5 mg P,
- calcium (CaO, $CaCO_3$) at the equivalent of 1 Hh.

Soil samples were incubated in beakers at 20 °C. The available phosphorus content was assessed at 0, 2, 5, 10, 15 weeks, by the Egner-Riehm (DL) method [6], and by the water extraction [7]. The results were subjected to the analysis of regression.

RESULTS AND DISCUSSION

The amount of available phosphorus assessed by the water extraction method was relatively small, only 0.9 to 1.2 mg P/100 g soil. The addition of superphosphate caused an increase of the recovered phosphorus by Ca 0.3 mg/100 g soil which is about 20% of the added P. It was the case during the whole duration of the experiment (Table 1).

The phosphorus assessed by the Egner-Riehm method was 1.9 to 4.2 mg P/100 g soil (Table 2). This was 2.5 times more than in case of the method described by van der Paauw [7], and according to Munk and Barmann [4], and Werner and Wiechmann [8].

Both in the unfertilized soil and that which was enriched with the superphosphate, the addition of both forms of calcium caused a decrease of the available phosphorus recovery in the water extraction method; in the case of calcium carbonate addition by 0.7 mg P/100 g soil (Figs 1 and 2). Similar results were reported by

Table 1. Available phosphorus content in soil assessed by using water extraction method (mg P/100 g of soil)

Fertilizer dose	Time of incubation (weeks)				
	0	2	5	10	15
0	0.9	1.2	1.1	1.1	0.9
NPK	1.2	1.4	1.5	1.5	1.3
CaO	0.9	0.9	0.8	0.8	0.7
CaO + NPK	0.9	1.2	1.1	1.2	1.1
$CaCO_3$	0.9	0.5	0.7	0.7	0.5
$CaCO_3$ + NPK	1.0	1.0	0.8	1.2	1.1

Table 2. Available phosphorus content in soil assessed by the Egner-Riehm method (mg P/100 g of soil)

Fertilizer dose	Time of incubation (weeks)				
	0	2	5	10	15
0	2.2	2.6	1.9	1.9	2.1
NPK	3.7	4.0	3.4	3.5	3.7
CaO	2.0	2.6	2.3	2.7	3.4
CaO + NPK	3.4	4.2	4.0	4.0	4.1
$CaCO_3$	2.2	2.7	2.2	2.2	2.5
$CaCO_3$ + NPK	3.9	4.2	3.7	3.8	4.0

Okruszko *et al.* [5]. The incubation time had no influence on the effect of calcium addition on the lowering of the phosphorus recovery in the water extract. These results indicate that liming caused a solubility decrease of the phosphorus which was not introduced with the superphosphate.

As was shown in other reports, liming caused an increase of available phosphorus content in soil, if assessed by the Egner-Riehm method, and that effect increased with the incubation period (Table 2). Fertilization of the sandy soil with powder superphosphate caused an increase of the recovered available phosphorus content in the soil, independently of the applied extraction method. The effect of the fertilizer was stroger if calcium lactate had been used; this method allowed the recovery of almost all added superphosphate.

CONCLUSIONS

1. Available phosphorus content in the soil extracted by water was lower than that assessed by the Egner-Riehm method.

2. The effect of lime application was different in the extracts obtained by the compared methods. As effect of liming, the available phosphorus content assessed by the water extraction method was smaller.

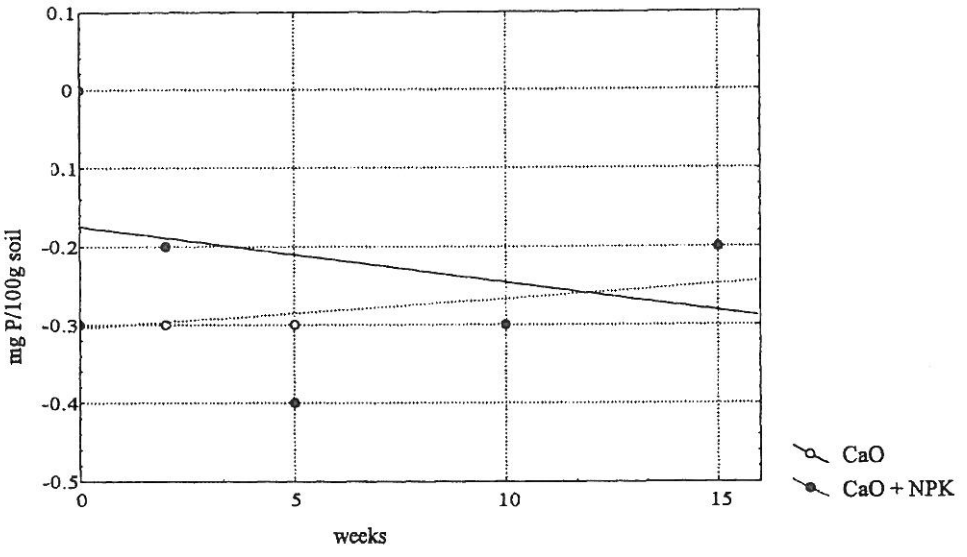

Fig. 1. Influence of CaO addition on the content of available phosphorus in soil, extracted with water.

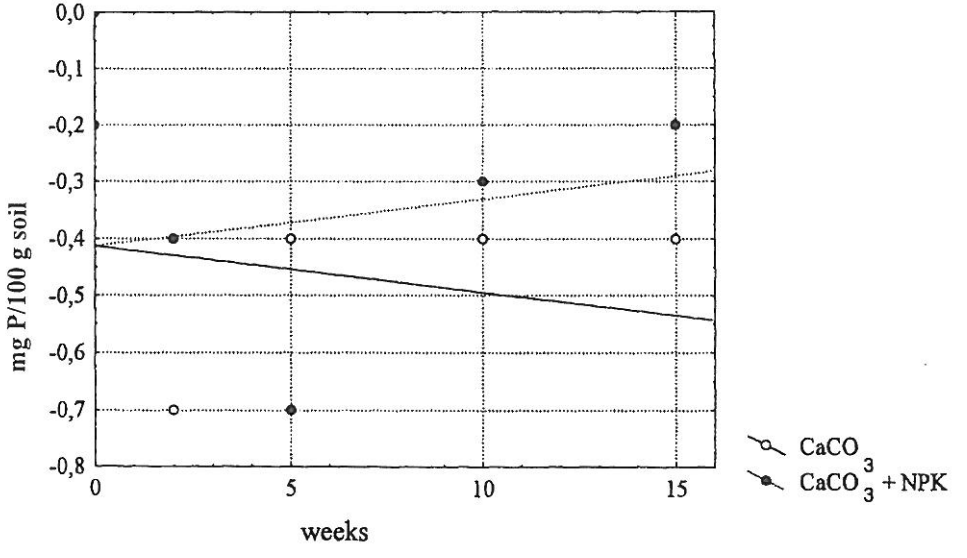

Fig. 2. Influence of $CaCO_3$ addition on the content of available phosphorus in soil, extracted with water.

3. The addition to the soil of powder superphosphate caused an increase of the available phosphorus recovery by both methods. The water extraction allowed 20% of the added phosphorus to be recovered.

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