Recovery of sorbed fertilizer phosphorus by three water extraction methods

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A calcareous loamy soil of, pH_{H2O} = 7.9 was incubated with 0, 80 and 320 mgP.kg-1 soil for one month. Four levels of acidification (pH 7.9, 7.3, 6.0 and 4.5*)* were adjusted by adding calculated volumes of HCl and incubating the soil samples far further one month, then equilibrated with different rates of phosphorus as 0, 80, 160 and 240 µg P.10 cm-3. The desorbed quantity of phosphorus was determined applying EUF, HWP and multistep desorp-tion methods.

The multistep phosphorus desorption study was applied to the soils with different previous P-additions under two levels of acidity (pH 7.9 and 4.5*)*. For this purpose, phosphorus adsorption was determined with different P-levels: 0, 80, 160 and 240 µgP. 10 cm-3 (recently additions), as 1 g soil and 10 cm3 of aqueous phosphate solution was shaken for 24 hours, and after that phosphorus desorption was measured by extraction with distilled water through 12 steps. (Tolner, Anas, Füleky 1996)

The EUF procedure was applied to the incubated soil samples under two levels of acidification pH (7,9 and 4.5) after adsorption experiments with phosphorus solutions (0, 80, 160 and 240 µgP.10 cm^3 (recently additions) as described in multistep water extraction technique. The residual solid phase was transferred quantitatively into the container of the EUF apparatus. The desorption has been conducted under a constant field strength of 400 V *5* cm^{-1} and temperature of 20˚C. Ten- minute fractions were collected for 400 minutes (Németh, 1976).

Hot Water Percolation (HWP) was carried out on the sols that have only received previous P-additions (0, 80 and 320 mgP.kg-1 soil) with a wide range of pH (7.9, 7.25, 5.99 and 4.51*)* with the HWP instrument. Hot water percolation (HWP) is a new, easily aplicable soil extraction method (Füleky and Czinkota, 1993). During hot water percolation the desorbable hydrolisable and easily soluble elements and compounds are extracted by hot water (102-105 °C at 120-150 kPa. 5 times extracts were collected.

The multistep extractable phosphorus amounts showed that, where the lower doses of P-fertilization is presented, the lower desorption of phosphorus is observed, so with the increasing of phosphorus fertilization (both previous and recent) increases the desorbable amount of phosphorus. The same conclusion was drown with the increasing of acidity, where the desorbable-P amount also increased. The same conclusions were proved by the consequences of the EUF and HWP methods, respectively. The added phosphorus can be recovered by all methods, depending on the time of P addition (previous or recent), the acidity of soil and on the method used.

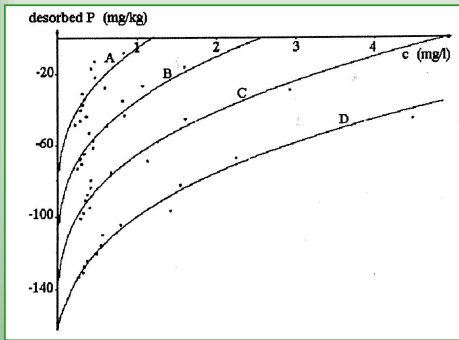

Figure 1. Desorbed phosphorus amounts from soil at P80 and pH 7.9, as a function of recent P additions, using multistep water extraction technique. (A,B,C,D are nominal P-doses 0, 80, 160 and 240 µg g-1 soil respectively.

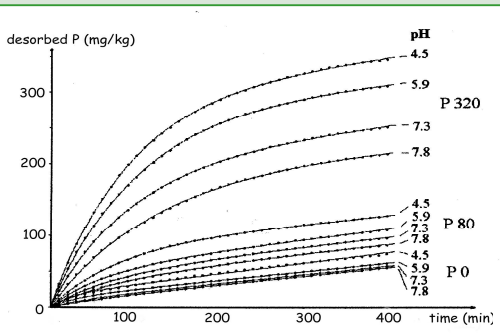

Figure 2. Desorbed phosphorus quantities from soils as a function of previously added-P and acidification, using EUF technique

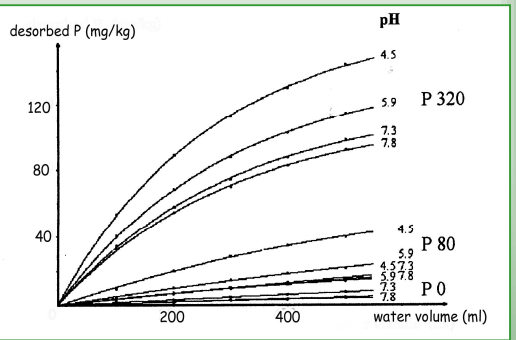

Figure 3. Desorbed phosphorus quantities from soils as a function of previously added-P and acidification, using HWP technique

The observations concluded from HWP technique showed that, the phosphorus recovery increases also with the P-loading and acidification, and the values are lower than those calculated from the other two methods. This fact is caused by the much shorter extraction time.

Previously added-P ($mgP.kg^{-1}$)	Non-acified soil, pH 7.86				Acified soil pH 4.51			
	Recently added phosphorus ($mgP.kg^{-1}$)							
	0	80	160	240	0	80	160	240
0	-	11	23		16	27	36	
80	15	23	31	41	24	34	40	48
320	50	60	65		54	55	62	

Table 1. Phosphorus recovery percentages as the function of P-additions (previous + recent) and of acidification, using multi-step water extraction technique

Previously added-P ($mgP.kg^{-1}$)	Non-acified soil, pH 7.86				Acified soil pH 4.51			
	Recently added phosphorus ($mgP.kg^{-1}$)							
	0	80	160	240	0	80	160	240
0	-	14	28		8	17	22	
80	13	28	42	67	27	22	37	46
320	67	77	82		47	59	65	

Table 2. Phosphorus recovery percentages as the function of P-additions (previous + recent) and of acidification using EUF technique

Previously added-P ($mgP.kg^{-1}$)	Acidification pH			
	7.86	7.25	5.99	4.51
0	-	0	2	6
80	4	4	7	14
320	21	23	27	34

Table 3. Phosphorus recovery percentages as the function of previously P-additions and of acidification using HWP technique

Füleky Gy. and Czinkota I. (1993): Hot Water Percolation (HWP): A New Rapid Soil Extraction Method. Plant and Soil, **157**, 131-135.
Németh K. (1976): Electro-Ultrafiltration (EUF). Allgemeiner, Teil.Hannover.
Tolner L., Anas A. Wahdan, Füleky Gy. (1996): Model of the Multistep desorption of the phosphate content adsorbed by the soil (in Hun.). Agrokémia és Talajtan, **45**. (3-4). 295-306.