USE OF ISOTOPIC EXCHANGE KINETICS FOR THE CHARACTERIZATION OF AVAILABLE SOIL PHOSPHORUS

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The aim of this paper is the analysis of isotopic exchange of phosphate ions in soil solution systems and the discussion of the relations between isotopically exchangeable phosphate ions and available soil phosphorus.

The experimental data of the isotopic exchange is fitted to a power function between 30 seconds and three mounths. These results are not analysed by the compartimental method but are examined through the stochastic method derived from the Hamilton-Steward technique.

The labile phosphate ions of soil, observed by isotopic exchange, must be separated in two very different groups : the first is a pool sensu-stricto and contains the phosphate ions in solution and some retained by soil particules ; the second group is actually only defined by the isotopic exchange with this first pool.

By the use of the stochastic method we can measure a mean exchange rate constant between soil phosphorus and solution phosphate ions ; the inverse of this value is the mean residence time of phosphate ions in solution. Some values presented in table 3 indicated that this time is very short (close to a few seconds). From the mean exchange rate wa also calculate a mean flux of phosphate ions between the more labile pool and the other phosphate ions.

Now we think that for a good description of the soil phosphorus fertility, it is necessary to take in account :

— The caracteristics of the more labile pool of phosphate ions ;

— The exchange constants between this pool and the other labile ions ;

— The fixing capacity for phosphate ions of the soil.

The last property must be defined not only in terms of quantity by also in terms of intensity, in the sense described by White and Beckett.

The example given here, is the analysis of the liming effect on phosphate ions. We can see, in table II and III and figure 2, that liming decreases phosphate ion concentration in soil solution but increases the mean exchange flux of phosphate ions between soil and the pool of available soil phosphorus.

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Table II : Influence of liming on phosphate ions mobility.

		n	R_1/R_0	m_1 µg P.ml-1	$M_1 + M_2$ µg $P.g^{-1}$sol
P_3	Témoin	0,175	0,62	0,89	13,4
	Chaulée	0,20	0,22	0,4	12,2
P_8	Témoin	0,18	0,62	0,9	13,5
	Chaulée	0,23	0,21	0,32	13,2

Table III : Influence of liming of the kinetics caracteristics of phosphate ions.

		m_1 µg P.ml-1	$M_1 + M_2$ µg $P.g^{-1}$sol	Km mn-1	Tm mn	ϕm µg P.mn-1	E 3 semaines ppm P
P_3	Témoin	0,89	13,4	0,27	3,7	3,6	87,5
	Chaulée	0,4	12,2	1,37	0,75	16,7	141
P_8	Témoin	0,9	13,5	0,26	3,84	3,5	92,2
	Chaulée	0,32	13,2	0,43	2,3	5,6	156

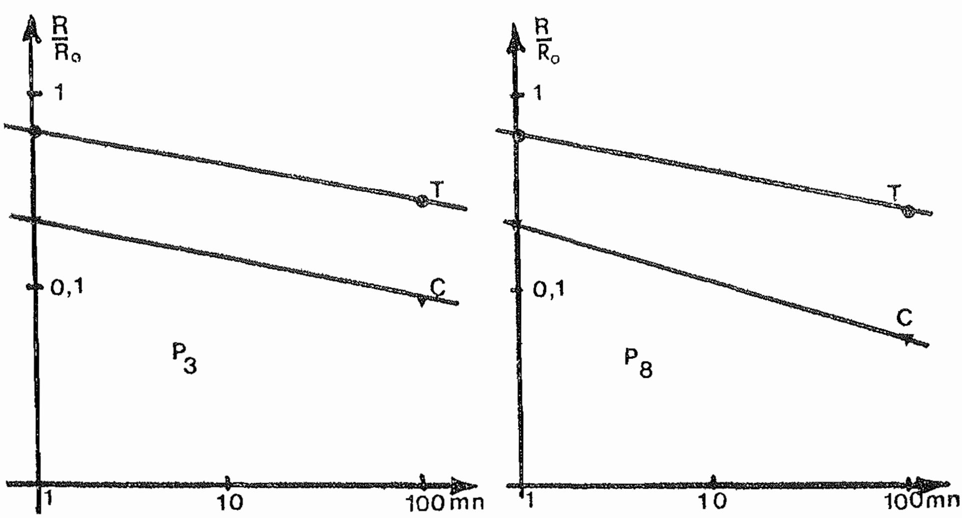

Figure 2 : Liming effect on two exchange ions kinetics.