

Revision of the manuscript: *Isotopic exchangeability reveals that soil phosphate is mobilised by carboxylate anions whereas acidification had the reverse effect*. Submitted to Egusphere by S. Staunton and C. Pistocchi.

We thank the reviewer for their careful reading and constructive comments. Our replies are indented below the text.

The work addresses the explanation of the mechanisms underpinning the release of phosphate from soil solid phases by the anions of organic acids commonly released in plant rhizosphere, in particular, oxalate and citrate.

The topic is not novel itself, being historically addressed by several publications of soil chemistry, (e.g., Barrow NJ (1984), *J Soil Sci* 35:283–297), some of which by the same Author (Staunton and Leprince (1996), *Eur. J. Soil Sci.*, 47:231-239) as the Authors properly explain in their Introduction. However, the question is here afforded for the first time using <sup>32</sup>P isotopic exchange, thus providing reliable information on P exchangeability; moreover, the experiment is designed to disentangle the contributions of the ionic strength of the solution, the changes in pH and the complexing/competing ability of the organic ions.

The experimental design is simple but smartly composed, well described and adequate for answering the research questions. The results are elaborated to evidence the differences among different soil samples and treatments induced by the variables of interest (They probably express the most suitable way to evidence the studied effects, however the addition of a table with the “raw data” of P exchange at each pH in the different soils would be nice to read). The different behaviors of the soils are not always easy to explain, however the given explanations are reliable.

The data presented in Figure 1 have not been subjected to complex treatment. We understand that some readers may wish to reproduce or re-treat data, and thus we propose to supply raw data as supplementary information.

The writing style is clear and concise, in line the experimental setup and the data presentation in the tables and figures.

A few minor specific comments are reported below:

Page 2, line 24: “optimization of legacy soil P”. May it be: “optimization of legacy soil P availability”?

We have made this revision.

Page 5, line 128. Suggestion: could you add a short explanation about the mechanisms of “salt effect” vs “pH effect”?

Thank you for this suggestion.

The text has been clarified, as follows

Acidification by addition of HCl implies the addition of chloride and therefore any observed effect could be due to both salt concentration or acidification. Salt effects are associated with variable charge surfaces and the formation of cation bridges. The effects of pH (acidification) and salt addition ( $10^{-2}$  N NaCl) are calculated by normalizing the ratio  $x/[P]$  with acidification (0.5) or salt (10 mM) with respect to that measured under standard conditions (no acidification or salt addition).

Table S1

Data shown in Figure 1. Ratio  $x/[P]$  for each of the soils with addition of various concentrations of sodium salt of oxalate, citrate or chloride with no acidification or acidification by 0.5 or 1 pH units.

$\Delta pH$	[salt] / N	Salt	$x/[P] / \text{dm}^3 \text{kg}^{-1}$			
			Cazevieille	Château Fourques	Montana Colera	Restinclière
0	0	-	1257	288	80	290
-0.5	0	-	2115	531	164	427
-1	0	-	2236	374	198	314
0	$10^{-4}$	Oxalate	1219	308	102	280
-0.5	$10^{-4}$	Oxalate	2201	558	210	435
-1	$10^{-4}$	Oxalate	2081	394	202	319
0	$10^{-3}$	Oxalate	900	235	58	203
-0.5	$10^{-3}$	Oxalate	2151	555	160	436
-1	$10^{-3}$	Oxalate	1880	342	168	283
0	$10^{-2}$	Oxalate	209	46	15	42
-0.5	$10^{-2}$	Oxalate	1001	339	43	252
-1	$10^{-2}$	Oxalate	1140	436	72	382
0	$10^{-4}$	Citrate	1189	300	93	276
-0.5	$10^{-4}$	Citrate	2188	547	178	433
-1	$10^{-4}$	Citrate	2166	401	206	325
0	$10^{-3}$	Citrate	1168	401	87	374
-0.5	$10^{-3}$	Citrate	1942	471	138	408
-1	$10^{-3}$	Citrate	1840	346	150	272
0	$10^{-2}$	Citrate	289	99	18	95
-0.5	$10^{-2}$	Citrate	602	201	26	188
-1	$10^{-2}$	Citrate	723	194	37	166
0	$10^{-2}$	Chloride	1095	449	144	392
-0.5	$10^{-2}$	Chloride	2491	564	190	391
-1	$10^{-2}$	Chloride	2315	295	209	365

Table S2

Data shown in Figure 2. Initial soil pH ( $pH_0$ ), buffer capacity ( $\text{mol H}^+ \text{kg}^{-1} \text{soil } \Delta pH^{-1}$ ), pH effect ( $x/[P]$  with  $\Delta pH = 0.5$  with respect to that with no acidification) and salt effect ( $x/[P]$  with  $[\text{chloride}] = 10^{-2} \text{ N}$  with respect to that with no salt addition).

	Cazevieille	Château Fourques	Montana Colera	Restinclière
$pH_0$	6.70	7.57	5.53	7.41
Buffer capacity	15.94	5.34	22.72	7.66
pH Effect	1.84	1.84	2.04	1.47
Salt Effect	0.87	1.56	1.79	1.35