Legacy phosphorus desorption from U.S. Mid-Atlantic agricultural soils

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BACKGROUND

Chicken manure contains Phosphorus which is a vital nutrient in plant growth and crop production. The repeated addition of Phosphorus leads to build up of the nutrient. Due to leaching, erosion, and runoff, Phosphorus can enter water systems causing eutrophication. Over nourishment of Phosphorus promotes algae growth which may cause anoxic conditions leading to fish kills.

What Phosphorus species are in the soil and what is their mobility?

REFERENCES

1. Tingle19
2. Shed
3. MFT
4. CFT
5. Tingle13
6. Manure Shed
7. EFT
8. CGAp
9. Loamy Sand
10. Silt Loam
11. Loam
12. Cohesive
13. Silty Clay
14. Clay
15. Loamy Clay
16. Peat
17. Fine Loam
18. Fine Sand
19. Sand
20. Clay Loam

OBJECTIVES

1. Determine the rate of P loss in soil through desorption experiments.
2. Determine the strengths of P bound to other soil compounds by comparing the curves collected from different desorbing agents.
3. Determine speciation at micron scale

METHODS

Soil samples were sieved through a 2 mm sieve and sent to the soil testing lab to determine:
- Mehlich 3-routine analysis (agronomic need P)
- Microwave acid digestion (total P)
- Particle size analysis

Desorption experiments were completed by placing 200 mg of soil with 10 ml of desorption agent. These were then placed on the shaker at 200 rpm. The desorption agents included:
- Pure water (0.01M KCl)
- Acid rain (0.1M HNO3)
- Ligand exchange mechanisms (0.1mM Na2SiO3)

Soils powder mounted onto tape in order to not disturb structures of soil so imaging is more accurate to its natural environment.

RESULTS

Table 1: Average values of the concentration of P in all samples of EFT collected at each time interval and each desorption agent.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>EFT</th>
<th>MFT</th>
<th>CFT</th>
<th>Loamy Sand</th>
<th>Silt Loam</th>
<th>Loam</th>
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<tbody>
<tr>
<td>Time (d)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>35.4</td>
<td>34.8</td>
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</tbody>
</table>

Figure 1 (left): Soil texture and composition of each soil sample with respect to their separates. The concentrations of the elements of interest in each soil following Mehlich III extraction and EPA3051 (specific acid digestion method).

Figure 2 (below): Average values of the concentration of P in all samples at each time interval that was collected.

DESCRIPTION

soil samples of EFT collected at each time interval and each desorption agent.

Soils powder mounted onto tape in order to not disturb structures of soil so imaging is more accurate to its natural environment.

Figure 3: Average values of the concentration of P in all samples of EFT collected at each time interval and each desorption agent.

Desorption in 0.01M KCl

Desorption in 0.1M KCl

Figure 4: Average values of the concentration of P in all samples of Tangle 19-20 collected at each time interval and each desorption agent.

Desorption in HNO3

Desorption in Na2SO4

Figure 5: Average values of the concentration of P in all samples of CGAp collected at each time interval and each desorption agent.

Ongoing and Future Work

Future/ongoing extracting agents:
- 1 mM Na2SiO3 (to mimic some effects of sea level rise)
- 1 mM sulfate and 10 mM sulfate (to mimic some effects of sea level rise)
- 1 mM Na2SiO3 and 10 mM sulfate (to mimic some effects of sea level rise)

Acknowledgements

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