

Phos4You: Quality assessment of phosphorus fertilizers

recycled from municipal wastewater



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Phosphorus demand in Europe

- Phosphorus (P) rock is listed as a critical raw material¹
- Europe depends highly on import of mineral P (> 90 %)
- Around 15 % of the P in Europe is wasted as sewage sludge or ash²
- The recovery potential of P in municipal sewage water in North-West Europe is estimated to be 26%

Phos4You project goals

- Resolve the demand for P within the scope of circular economy
- Process valuable P from municipal wastewater to fertilizing products
- Demonstrate 6 innovative P-recovery technologies (see below)
- Provide the missing piece of the circular puzzle, standardized quality assessment of new products³
- Ensure safety leading to applicability of the recovered material on the market
- Address social barriers in terms of acceptance and legal aspects



Novel P recovery technology

- Thermal process
- Sludge leaching
- Ash leaching
- Nature based process
- P adsorption
- P salt precipitation

Fertilizing product

- P slag
- DCP/P acid
- Ca/K/Mg phosphate
- Microalgae
- Granules
- MAP/DCP

Quality strategy

P availability

Plant uptake

- Pot and field trials will be set up to examine the P availability of new fertilizing products
- Results from chemical extractions will be compared with plant uptake to determine the optimal method for P analysis

Chemical extraction

- Most common practice
- Variety of methods on national level
- Each fertilizer type characterized by different method (legislation)

Biomarker

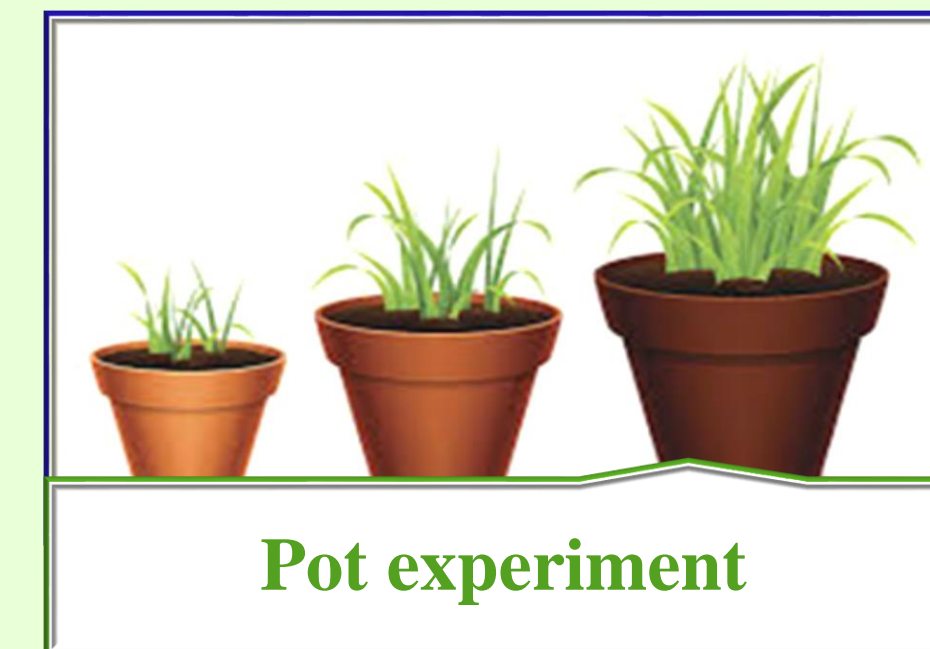
- Lipid P index, a plant response to P uptake in plant roots

Passive sampling techniques

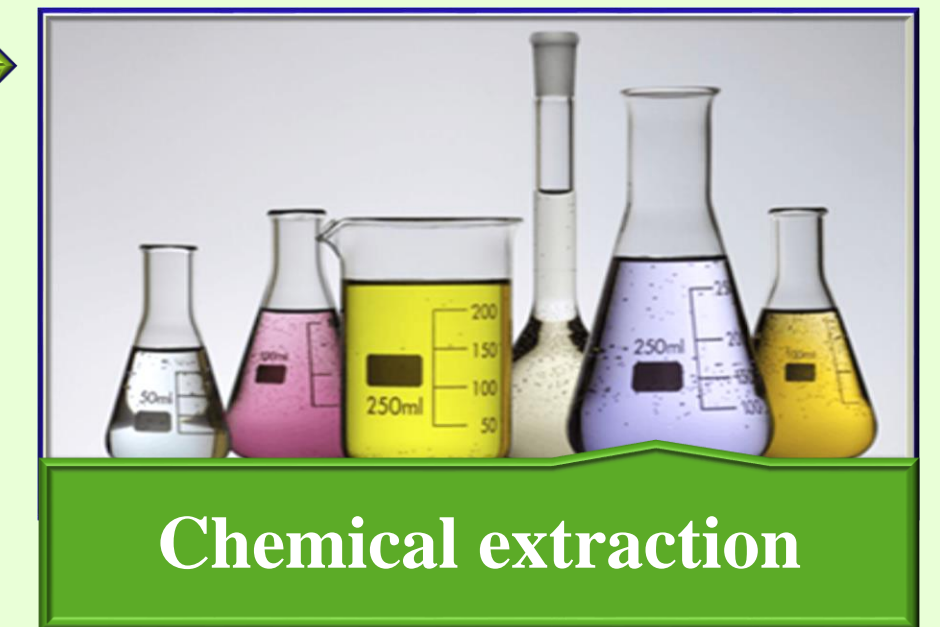
- Rhizons, Diffusive Gradient in Thin films (DGT) and Plant Root Simulator (PRS) probes are being used to mimic plant uptake and measure P availability in the undisturbed soil
- Previous research^{4,5,6,7,8} already demonstrated that these techniques are better correlated with plant P uptake than any of the chemical extraction methods



Field experiment



Pot experiment



Chemical extraction



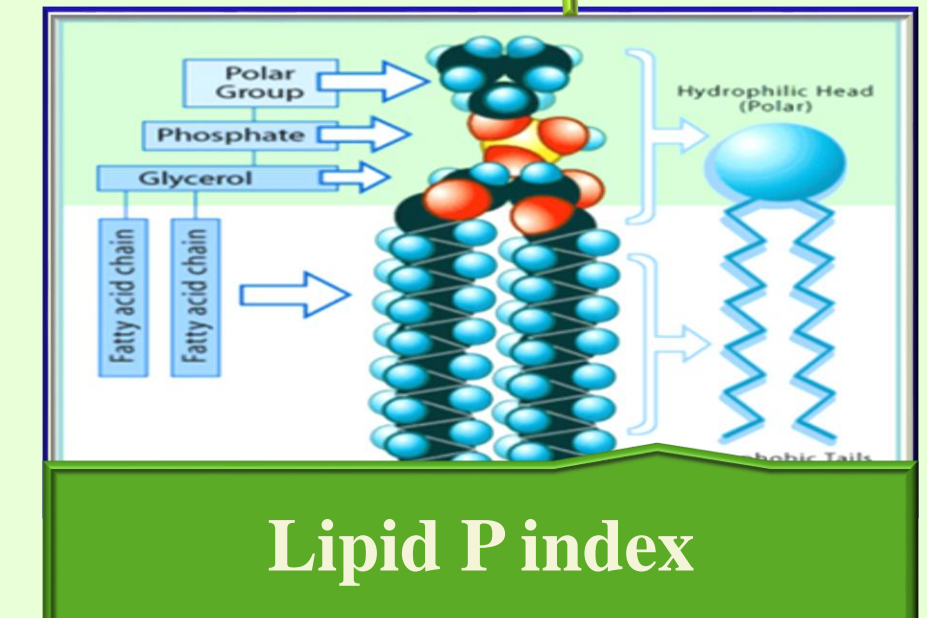
Rhizon



DGT

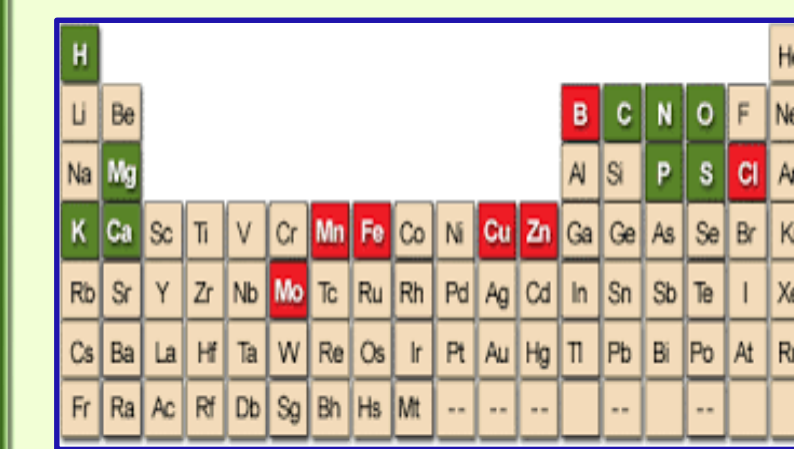


PRS probes



Lipid P index

Inorganics



- Plants demand (micro- and macro-) nutrients
- Heavy metals may limit their growth and pose risks to the environment
- Detailed characterization of the total and available nutrients and heavy metals is necessary

Organic



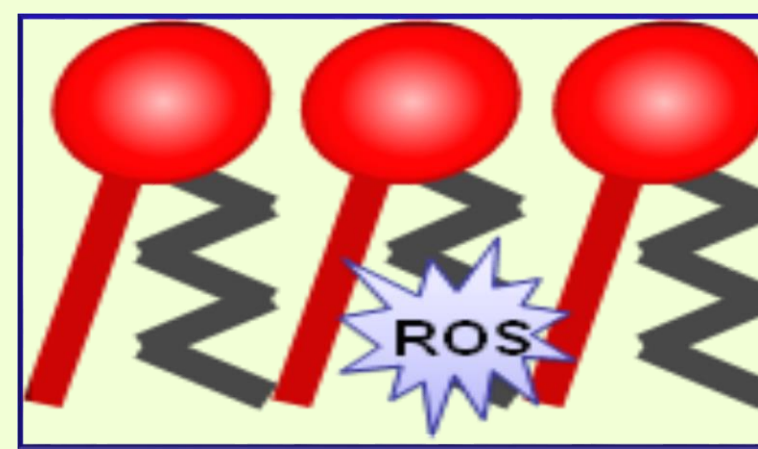
- Fertilizing products containing organic matter are more prone to contamination
- Today's wide use of pharmaceuticals and hormones may pose a risk in the future
- Utilization of PCBs, PAHs, etc. is decreasing, though not absent

Pathogens



- The current commonly examined microbial list is very limited and excludes potential presence of spores
- More research is needed to ensure the safety

Ecotoxicity



- Nature response to fertilizing products can be assessed by running various ecotoxicity tests
- Effects are measured on bacteria, algae, invertebrates, plants, soil organisms and biomarkers

Quality assessment targets

- Valorization of the new P fertilizing products and proposal of standard method
- Fertilization recommendation for fertilizer stakeholders and end users

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