FACTORS CONTROLLING ORGANIC AND INORGANIC PHOSPHORUS SPECIATION, AND THEIR RETENTION AND RELEASE KINETICS IN SOILS FROM AGRICULTURAL BUFFER STRIPS

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The Importance of Organic Phosphorus

Phosphorus (P) is known to be a major factor in the eutrophication of surface freshwater, with most arising from a diffuse agricultural source.

Buffer strips have been shown to be effective at retaining P, but most research has focused on inorganic P since organic P was not considered to be readily available to plants and microorganisms. However, some organic P compounds are, or can readily become, bioavailable, and thus may pose a pollution risk. This is particularly important because organic P can have a greater contribution than inorganic P to total P in runoff (taken to mean both surface and subsurface loss) from grassland[1].

Buffer strip soils have been shown to have higher dissolved organic P concentrations than neighboring agricultural soil due to increased microbial cycling[2]. The implication is that dissolved species may be very mobile, indicating buffer strips may increase the transfer of organic P from soil to watercourses.

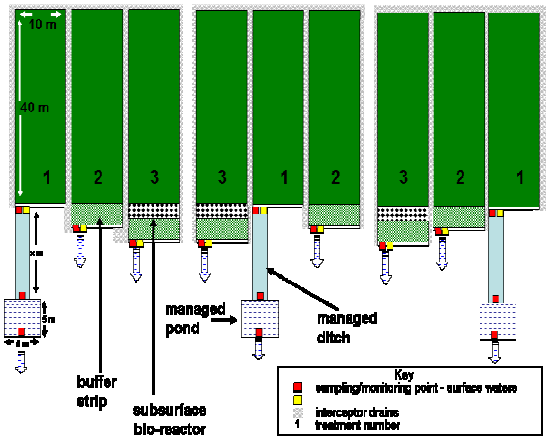
A Multi-Scaled Experimental Approach

Plot Scale

Objectives

To determine:

- Whether organic P represents a significant amount of the total P in runoff, and the organic P species present
- Differences in P quantities and forms between surface and drainage runoff
- The effect of spreading cattle slurry on the forms and quantities of P in runoff
- The effect of a buffer strip on these factors



Methods

Measurement of phosphorus species in the surface and subsurface runoff from hydrologically isolated plots (left), both with and without 6m buffer strips

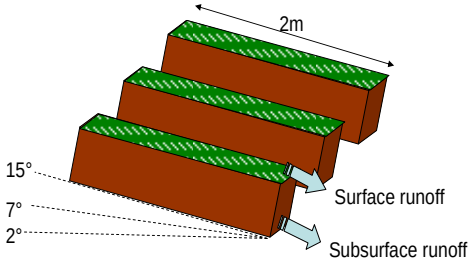
Measurement of P forms by colourimetric methods.

Speciation of organic P by enzymes, plus the development of analytical methods

Mesocosm Scale

Objectives

Research alludes to the importance of slope on the effectiveness of buffer strips for P retention, but this has never been rigorously investigated under realistic conditions, and is ignored under Environmental Stewardship Agreements



Methods

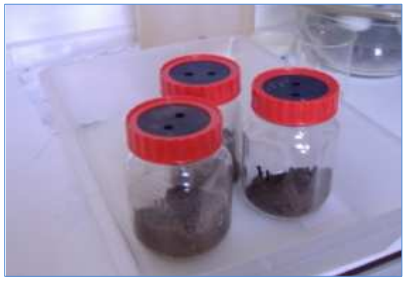
Intact, 2m x 0.5m x 0.3m soil blocks of 2 soil types will be used to investigate biotic and abiotic, surface and subsurface processes occurring in buffer strip soils with an emphasis on dissolved inorganic and organic P forms

Microcosm Scale

Objectives

To determine whether correlations between organic P species in water extracts of soil and soil properties, such as temperature, soil moisture content, and soil P content, exist.

Correlations with chemical extracts have been shown, but water extracts are more applicable to the risk of P transfer from the soil to water



Methods

Detailed analytical speciation and quantification of the organic P compounds in water extracts of soil and leachate, obtained from kilner jar or column studies

Acknowledgements

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References

1) Preedy, N., K. McTiernan, et al. (2001). "Rapid incidental phosphorus transfers from grassland." Journal of Environmental Quality 30(6): 2105-2112.

2) Stutter, M. I., Langan, J, and Lumsdon, D. G. (2009). 'Vegetated Buffer Strips Can Lead to Increased Release of Phosphorus to Waters: A Biogeochemical Assessment of the Mechanisms.' Environmental Science and Technology 43(6); 1858-1863