Achieving Environmental and Agronomic Soil P Targets under a Zero P Application Regime

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Introduction

Despite the implementation of EU regulations controlling the use of fertilisers in agriculture, high soil phosphorus (P) concentrations remain a significant threat to water quality in many areas of Northern Ireland (NI) (Figure 1). This project investigated the sustainability of zero P fertiliser application on soil P fractions, herbage P content and the risk of P loss to water.

Methods

Between 2000 and 2005 0, 10, 20, 40, 80 kg inorganic P ha\textsuperscript{-1} yr\textsuperscript{-1} was applied to five grazed grassland plots (FAO Soil Classification: Dystric Stagnosol), building the Olsen soil P status at 0-7.5 cm in the soil profile up to 19, 24, 28, 38 and 67 mg P L\textsuperscript{-1}, respectively. From 2005 to 2010, the plots received zero P applications, except for dung deposited by grazing animals. Changes in Olsen P were and herbage P content were monitored regularly during this period. Selected soil samples from 2000, 2005 and 2010 were also analysed for Total P (TP), Oxalate P (from which the degree of P saturation (DPS) was calculated) and Water Extractable P (WEP). (NMR and P fractionation data not presented)

Results

Figure 1: Distribution of areas of high soil P across NI. (Agronomic optimum for grasslands = Index 2).

Figure 2: Decline in Olsen P over 5 yrs of zero P applications. Based on rate of decline over 5 yrs the decrease from index 4 to mid index 2 = 13 yrs.

Figure 3: Relationship between rate of decline in Olsen P (based on weekly soil sampling) and initial P concentration in 2005.

Figure 4: Changes in TP on selected plots. Between 2005 & 2010 there was no significant decrease in total soil P on any of the plots.

Figure 5: Percentage contribution of inorganic P to TP on selected plots. Significant decrease (p<0.01) in all four plots between 2005 and 2010.

Figure 6: Changes in WEP on selected plots. Significant decrease observed between 2005 & 2010 in the 20, 40, 80 kg P/ha plot (p<0.05).

Figure 7: Changes in the degree of P saturation (DPS) on selected plots. Significant decrease (p<0.05) in DPS on the 40 & 80 kg P/ha plots between 2005 and 2010.

Conclusions

• Zero P application for 5 yrs to high P soils reduces the risk posed to water as indicated by environmental soil P tests.

• However, restricting P applications may have implications for the sustainability of intensive dairy farming in NI (Figure 8).

• Mitigating the risks to water quality from high P soils pose a significant challenge for dairy farming in Northern Ireland.