

## Introduction

Reducing phosphorus (P) in the diet fed to dairy cows substantially lowers the P content of manures. In the US a comparison of P in runoff following surface applications to maize of high and low P dairy manures (8.9 vs 4.9 g P kg<sup>-1</sup>) showed a large reduction in total P (TP) and dissolved reactive P (DRP) of 75 and 90% respectively (Ebeling *et al.*, 2002).

A comparable experiment with September applications of high and low P manures (13.3 vs 4.9 g P kg<sup>-1</sup>) to grassland at Hillsborough, Northern Ireland, found smaller % reductions of P than reported from the US with total phosphorus P and DRP decreases of 47% and 66% respectively.

However concentrations of DRP in manure impacted runoff from grass were up to 9 mg P L<sup>-1</sup> compared to < 1 mg P L<sup>-1</sup> for DRP in runoff from maize in the US from a reduced P manure treatment with a similar P content (5 g P kg<sup>-1</sup>). The high DRP concentrations observed in runoff from grassland could reflect differences related to land cover as maize stubble consists of mostly bare soil. To test this, a runoff experiment was carried out on maize stubble at Hillsborough, three months post harvest and compared with P measured in runoff following an autumn application of the same manure to grassland.

## Method

Paired split plots were set up in maize stubble in a randomized block design with eight replications. Olsen P measured was at index 2 (22 mg kg<sup>-1</sup>). Slurry (13.3 g P kg<sup>-1</sup>) was surface applied to the plots at 50 m<sup>3</sup> ha<sup>-1</sup> and 6% DM. After a two day interval, simulated rainfall was delivered using a portable rainfall simulator (Bowyer-Bower and Burt, 1989) at a rate of 40mm hr<sup>-1</sup> for 30 minutes. Runoff was collected and analysed for TP, total dissolved P (TDP) and DRP using standard colorimetric techniques. Particulate P (PP) was calculated as the difference between TP and TDP. Differences between treatments were assessed by repeated measures analysis in the maize experiment.

## Results

DRP (50%) dominated TP in runoff from maize manured plots with particulate P contributing 41% (Figure 2). By comparison PP accounted for 78% of TP from the maize control plots.

The fractionation of TP in manure impacted runoff from maize was almost identical to that from the grassland experiment (Figure 1) but the mean TP concentration in runoff from maize stubble of 14 mg L<sup>-1</sup> was less than TP of 33 mg P L<sup>-1</sup> from grassland.

Applying slurry raised TP in runoff from maize by 9.8 mg L<sup>-1</sup> compared to runoff from the control treatment. For grassland the increase was 30.2 mg L<sup>-1</sup>.

On the maize plots surface ponding during the experiment may have lowered surface runoff from the plots and runoff from these plots of 3.1 mm was only slightly larger than from grassland (2.5 mm) so that dilution could not explain the differences in concentration.

The much higher TP concentrations in runoff from grass were responsible for a higher TP loading from manure applied to grass of 0.9 kg P ha<sup>-1</sup> compared to 0.5 kg P ha<sup>-1</sup> loss from maize stubble following applications of the same manure at a rate of 14 kg P ha<sup>-1</sup>.

## Conclusion

Adoption of reduced P diets on dairy farms will lower the P loss to water potential associated with surface applications of manure.

Somewhat surprisingly, applications of manure to maize showed a lower rate of P loss compared to grassland. This may reflect the limited vegetation cover of the maize plots which allows the manure P to interact with and be fixed by P the surface soil.

## References

- Bowyer-Bower, T.A.S. & Burt, T.P. 1989. Soil Technology 2:1-16  
Ebeling, A.E., L.G. Bundy, J.M. Powell and T.W. Andraski. 2002. Soil Science Society of America Journal 66:284-291

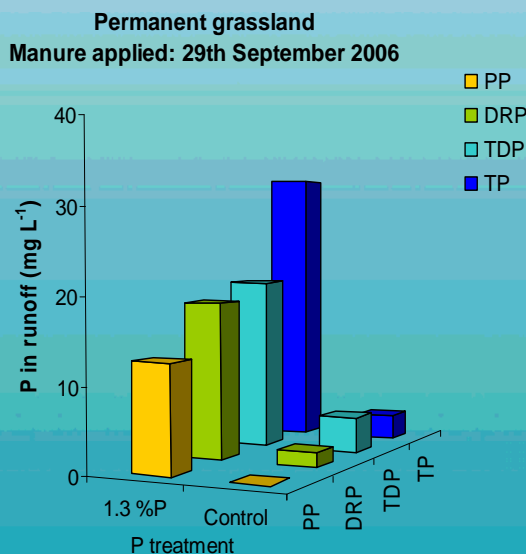


Figure 1: P fractions in runoff from grassland

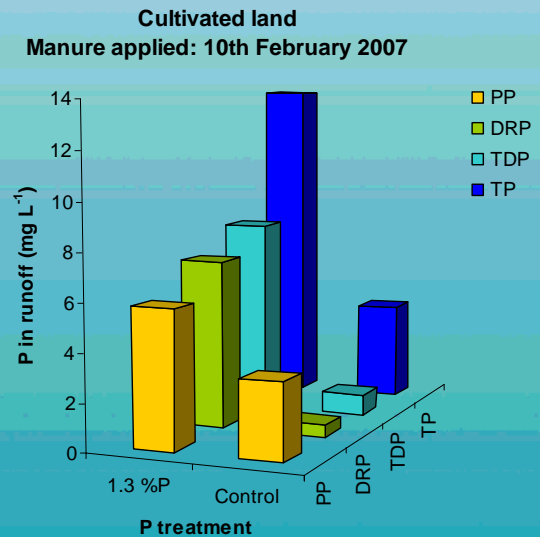


Figure 2: P fractions in runoff from maize stubble