

High losses of P to land drainage water from grassland swards despite a zero P surplus

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Introduction

There are limited long-term experimental studies of P losses from grassland and where they exist the application of inorganic P fertilisers and liquid animal manures have been applied on a whole farm basis, rather than on a site-specific basis to meet the grass requirements of individual plots or fields. The P fertiliser recommendations for grazed grassland swards are based on soil analysis, to maintain the Olsen-P status at index 2 (16 to 25 mg P litre⁻¹). The aim of the current study was to investigate the annual variation in P losses to land drainage water from a beef production system specifically managed to only receive inorganic P fertiliser to maintain the Olsen-P status at index 2

Materials and Methods

- P inputs (precipitation and fertiliser) and outputs (land drainage water and animal product) were measured on reseeded grazed grassland swards receiving different N inputs (100 to 500 kg N ha⁻¹ year⁻¹) for ten years (March 1989 - February 1999) at Hillsborough, Co. Down, Northern Ireland.
- All plots received the same maintenance application of P fertiliser (8.5 kg P ha⁻¹ year⁻¹).
- Soil cores (0-5, 5-10 & 10-15 cm depths) were collected in February each year and analysed for total P content.

Figure 1: Fitted and observed soil total P concentrations at 0-5 cm (▲), 5-10 cm (○) and 10-15 cm (■) depths

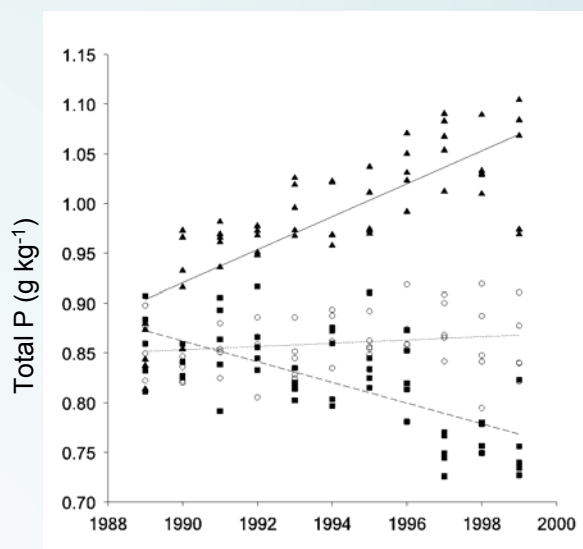


Table 1: Average annual P balance over 10 years

	Total P (kg P ha ⁻¹ yr ⁻¹)	Standard error
INPUTS		
Wet deposition	0.31	0.04
Fertiliser P applied	8.52	0.15
Total inputs	8.83	0.13
OUTPUTS		
Drainflow	0.89	0.04
Animal product	7.75	0.26
Total outputs	8.64	0.28
Inputs - Outputs	0.19	0.28

Results

- A fertiliser P application of 8.5 kg P ha⁻¹ year⁻¹ acted as a maintenance dressing and resulted in a zero P surplus (Table 1).
- Annual flow weighted mean total P concentrations in land drainage water ranged from 187 to 273 µg P litre⁻¹ and were well above the concentrations believed to trigger eutrophication.
- Annual total P lost to drainage water ranged from 0.28 to 1.73 kg P ha⁻¹, but was unaffected by N input.
- There was no significant net change in total P in the top 15 cm soil. However, there was significant accumulation of P in the 0-5 cm depth (equivalent to 8.2 kg P ha⁻¹ year⁻¹) and a significant decrease at the 10 to 15 cm depth (Figure 1).

Conclusions

A maintenance application of P fertiliser to minimize P surplus leads to P concentrations in drainflow well above that believed to trigger eutrophication. The P redistribution to the top few cm of soil from lower depths (despite there being a zero P balance) is likely to exacerbate P losses in overland flow and make improvements in water quality difficult to achieve.