



Nitrogen and potassium leaching from grassland soil depending on applied fertilizer type and rate and sward botanical composition



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Introduction

The objective of the present research was to compare nitrogen (N) and potassium (K) leaching from different types of grassland swards receiving organic manure and mineral fertilizers, and also to test the hypothesis that higher rates of N and K leaching occur in grassland fertilized with organic manure than with mineral fertilizers.

Materials and methods

The experiment used plastic mini-lysimeters (surface area 0.07 m²; volume 0.01 m³). The lysimeters were filled with a loamy sand soil (sand 64%, silt 29%, clay 7%).

Factors

1. Sward type

- grasses (*Phleum pratense*, *Lolium perenne*, *Poa pratensis*)
- grasses with white clover (*Trifolium repens*) mixture
- grasses with lucerne (*Medicago sativa*) mixture

2. Fertilizer type

- mineral fertilizer
- cattle slurry
- sewage sludge

3. Mineral fertilizer application rate (kg ha⁻¹)

- N₀P₀K₀ (control)
- N₀P₃₀K₆₀
- N₀P₆₀K₁₂₀
- N₆₀P₃₀K₆₀
- N₁₂₀P₆₀K₁₂₀
- N₁₈₀P₆₀K₁₂₀



Organic manures were applied in quantities according to the nitrogen rates of 60 kg, 120 kg and 180 kg ha⁻¹ and the application rate was calculated based on NH₄ content.

During the experiment amounts of leached water, total N and K content in the water on a monthly basis and herbage yield harvested five times in growing season were measured. The N and K content in the leachate were measured using a VarioMax CNS elemental analyzer and a flame photometer, respectively.



Results

The effect of the type of fertilizer applied on N and K leaching was weak (Table 1), with only two treatments (N₀P₃₀K₆₀, N₀P₆₀K₁₂₀) increasing significantly the K leaching from two sward types: the grass mixture and the grass-lucerne mixture.

Sward botanical composition influenced N and K leaching:

- the lowest amounts of N and K leaching came from the grass-white clover mixture,
- the highest amounts of N and K leaching were recorded from the sward with the grass mixture.

Increments in the N application rate up to 180 kg N ha⁻¹ y⁻¹ resulted in a small decrease in N and K leaching.

Table 1. Nitrogen and potassium leaching from grassland swards

Sward	Control	Fertilizer			
		Mineral		Slurry	Sewage sludge
		P K ¹	NPK ²		
N mg m ⁻²					
Grasses	2590 ^a A ³	2995 ^a A	2338 ^a A	2552 ^a A	2544 ^a A
Grasses + white clover	1900 ^a B	1555 ^a B	1458 ^a B	1810 ^a A	1675 ^a B
Grasses + lucerne	2412 ^a B	2644 ^a A	1947 ^a AB	2164 ^a A	1806 ^a AB
K mg m ⁻²					
Grasses	3690 ^{ab} A	4256 ^b A	2614 ^a A	2846 ^a A	2933 ^a A
Grasses + white clover	1147 ^a B	944 ^a B	692 ^a B	833 ^a B	656 ^a C
Grasses + lucerne	3157 ^{ab} A	3618 ^b A	2337 ^a A	2089 ^a A	1809 ^a B

¹ Mean of treatments N₀P₃₀K₆₀, N₀P₆₀K₁₂₀

² Mean of treatments N₆₀P₃₀K₆₀, N₁₂₀P₆₀K₁₂₀, N₁₈₀P₆₀K₁₂₀ kg ha⁻¹

³ The values with different letters in the same line and capital letters in the same column are significantly different ($P < 0.05$)

Conclusions

Initial results of our study did not support our hypothesis that organic manure treatments cause larger quantities of N and K to leach than mineral fertilizers. Leaching of N and K during the growing season depended almost solely on the yield of the sward, which was correlated negatively to the quantity of leached water.