

Silage maize in crop rotations with different grass mixtures – N balances and N leaching

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Introduction and purpose

The cultivation of maize in Germany is expanding due to its use in animal production and increases in biogas production based on renewables. Maize often leaves considerable amounts of residual soil mineral nitrogen after harvest which might cause pollution of groundwater by nitrate leaching. To mitigate these negative effects, maize could be integrated in economically and ecologically sound crop rotations. The aim of this study was to test the hypothesis that maize in crop rotations with different grass mixtures and moderate N supply can have yields comparable to fertilised maize but with a significantly reduced N leaching risk.

Material and methods

- Two sites on sandy soils in northwest Germany
- Four crop rotation systems (parts of a sequence); two N fertilisation intensities (Fig. 1):
- Two grass mixtures with/without clover – no N or high N input
- Followed by maize with low N (23 kg ha⁻¹) or high N (180 kg N ha⁻¹)
- Sampling of leaching water with a suction cups
- Average clover contents (May-Oct.) were: 26% red clover (site1: 27 / site 2: 25) in 2006 and 18% white clover (31/6) in 2006 and 2007

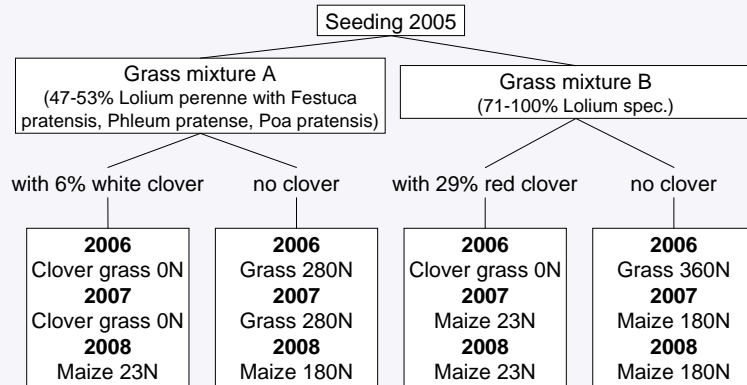


Fig. 1. Experimental design with crop rotation and N fertilisation.

Results

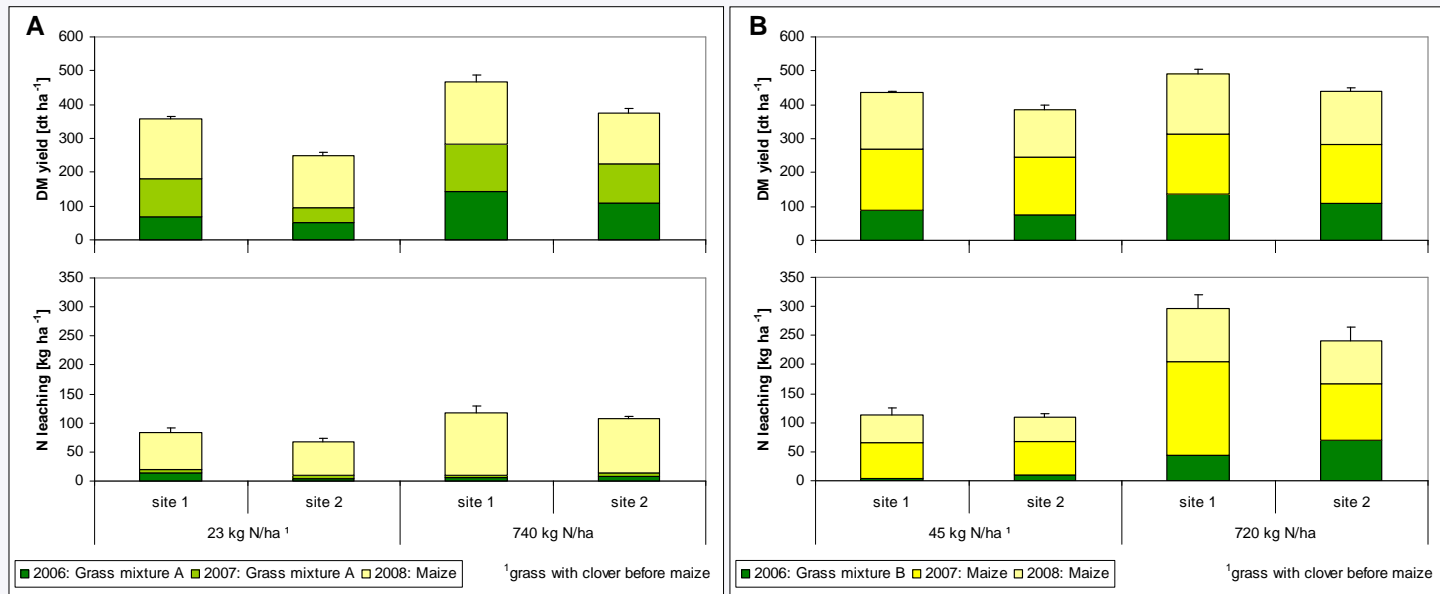


Fig. 2 A+B. DM yield and N leaching of crop rotation systems with grass mixture A and B; error bars are standard errors of the mean.

Tab. 1. Simplified N balances (N fertilisation–N yield) and cumulated N leaching over 3 years crop rotation. Values are accumulated over 3 years.

N input	Grass mixture A (2 yr.) – maize (1 yr.)				Grass mixture B (1 yr.) – maize (2 yr.)			
	low ¹		high		low ¹		high	
	site 1	site 2	site 1	site 2	site 1	site 2	site 1	site 2
Simplified N balance [kg N ha ⁻¹]	-635	-327	-42	87	-442	-372	36	164
Cumulated N leaching	84	67	116	108	113	109	297	241

¹grass with clover before maize: average clover contents (May-Oct.) were: 26% red clover (site1: 27 / site 2: 25) and 18% white clover (31/6)

Conclusions

- N fertilisation to maize following ley grass (2–3 years) can be reduced in the first year with no losses in DM yield.
- Mineralisation after ploughing of short-term grassland on sandy soil provides sufficient nitrogen in the first year – it is essential to drastically reduce the fertiliser N input to following maize in order to lessen the risk of N leaching.
- N leaching losses can be substantial when N from mineralisation is not considered – this can be a substantial gap in simple balances.
- Farms with intensive animal production might find it difficult to reduce N input from slurries to maize.