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Management options to reduce N-losses from ploughed grass-clover

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Introduction Nitrate (NO_3^-) leaching from grassland can be kept at acceptable levels, but is often high after ploughing for grassland renewal or for silage maize/grain production. In on-farm research with several organic farmers, management options are being explored to save scarce organic manure and to reduce N-losses.

Materials and methods A trial was conducted on a loamy löss (2.6% OM in 0-30 cm) with four treatments: A) 'standard' farmer practice, i.e. application of $20m^3$ of slurry in early spring (21 April), mowing grass (26 May), soil ripping, application of $18m^3$ slurry, ploughing and sowing of maize (1 June); B) and C) were similar to A, but with no slurry application before ploughing, or no slurry at all, respectively. D) as C), but with early soil ripping (27 April) to enhance N-availability. Field history included three years of arable crops followed by one-year grass-clover (> 50% clover). Mineral N-availability was measured 9 times at regular intervals, maize production was assessed by harvesting three rows of 3 m/plot. Mineral N-availability in the layer of 0-30 cm was modelled by the soil-N flow model NDICEA (Koopmans & Bokhorst, 2002).

Results The recorded mineral N-availability was lower than standard Dutch advice (185 kg N/ha), while recorded residual N was higher than the maximum Dutch advice to attain NO_3 leaching <50 mg/l, i.e. 90 kg N (Table 1). The recorded production follows mineral N-availability reasonably closely except for the early soil ripping treatment. Figure 1 shows the NDICEA-results, matching the recorded mineral N-levels closely (Table 2) except for the late growing period, possibly due to underestimation of the capillary capacity resulting in a predicted decomposition rate being lower than reality (2003 was an extremely dry year). Figure 1 also shows NDICEA-results of "treatment E", being similar to D but with silage maize following three-year-old grass-clover. Mineral N-availability is predicted to be much higher due to the decomposition of a much higher amount of easily available soil OM (roots and living soil organisms).

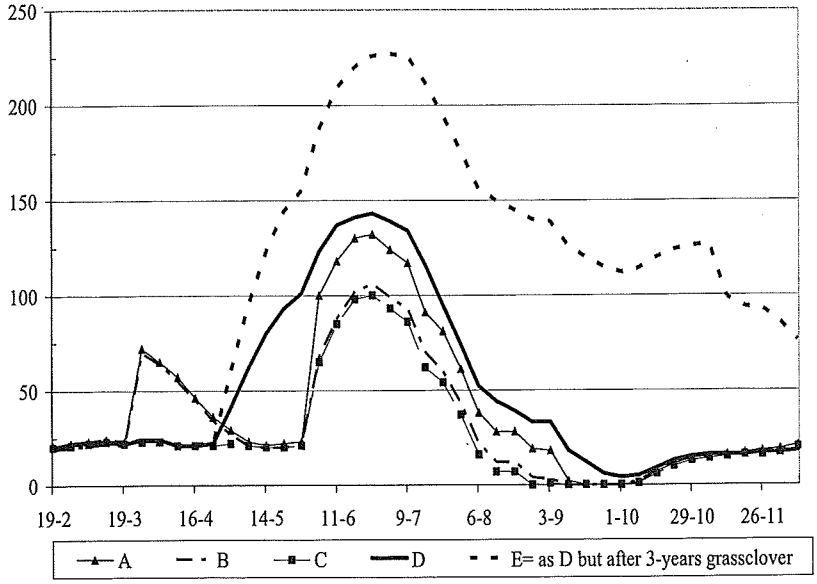
Table 1 Maize production and mineral availability for different management options

Treatment	Maize production (ton DM/ha)	Mineral N (kg/ha) at: 21-6 (0-60 cm)	25-11 (0-90 cm)
A	16.8	136	135
B	15.8	133	100
C	15.3	113	58
D	16.1	175	103

Table 2 Recorded mineral N-availabity (0-30 cm, kg/ha) for different treatments at different dates

	23-4	7-5	6-6	21-6	3-9	25-11
A	25	23	83	107	65	58
B	20	18	89	110	26	46
C	13	15	71	88	24	37
D	10	66	121	143	77	49

Figure 1 Simulated mineral N availability (kg/ha, 0-30cm)



Conclusion Silage maize production following grass-clover was increased by manure application but N-losses, both residual- N and denitrification losses (not shown), increased much more. This is particularly true for grass-clover leys older than 2 years. Early soil ripping enhances mineral N-availability and silage maize production without applying scarce organic manure, but also reduces grass production and increases potential N-losses. Therefore, future experiments will be concentrated on maize production without destroying the grass-clover to facilitate a more direct transfer of fixated N from clover to maize and possibly lower inherent N-losses.

References

Koopmans, C. J. & J. Bokhorst, 2002. Nitrogen mineralisation in organic farming systems: a test of the NDICEA model. *Agronomie* 22, 855-862