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Low nitrate leaching from long-term grass-clover

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In the future there is expected to be a higher proportion of grass in the dairy crop rotation than today. Changes in the EU Common Agricultural Policy stipulate that subsidies should be decoupled from production. Pastures are thus better able to compete economically with other roughage/feedstuff sources.

Also, the development in farm size is dramatic and as dairy farms grow bigger, an increasing number of farms cannot use the entire crop rotation for grazing. The management of dairy cattle grazing becomes increasingly difficult with distance to the milking parlour, and on these farms we already experience grass-intensive rotations located close to the farm buildings.

Because of these conditions grass leys are expected to become older than the 2-3 years, which is currently most common. And this may affect both the production and the environment.

Lower leaching from grass-clover than ryegrass

We investigated four different pastures on loamy sand over an 8-year period:

- Grass-clover, unfertilised, grazed by dairy cows
- Grass-clover, unfertilised, cut
- Ryegrass, fertilised (300 kg N per ha), grazed by dairy cows
- Ryegrass, fertilised (300 kg N per ha), cut

Figure 1 shows nitrate concentrations in total annual drainage from the grass leys. Leaching losses from grazed leys were always lower for grass-clover compared to ryegrass. The difference was moderate in year 4-5, but in year 6-8 leaching from grass-clover was only 9-13% of the comparable losses from ryegrass. In year 8, nitrate leaching from grazed ryegrass was 119 kg N per ha compared to only 11 kg N per ha from grazed grass-clover.

Losses from cut grassland were generally lower and with no significant difference between ryegrass and grass-clover.

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The lower nitrate leaching from older grass-clover leys may be caused by two conditions:

1) Reduced nitrogen fixation.

Grass-clover fixes 2-300 kg N per ha in the first production years, but the amount gradually declines and in year 8 it was experimentally estimated to about 100 kg N per ha. The explanation is the natural feedback mechanism where high soil inorganic N levels limit the input from legumes. For comparison the fertiliser input to ryegrass was 300 kg N per ha throughout the experiment, which therefore carried a considerably higher loss potential.

2) Reduced yields in grass-clover.

As shown in **Figure 2**, the yield in 8-yr-old grass-clover was considerably reduced compared to the first production year – a drop from 9.4 t per ha to 5-6 t. The lower production resulted in less grazing and thus less deposition of nitrogen in urine and faeces and the N-surplus was reduced. In ryegrass leys, yield was almost maintained over time and the N deposition in urine and faeces was therefore also maintained. As a consequence, nitrate leaching was about 10 times higher in year 6-8 than from grass-clover.

Grass-clover in practice

In practice, a combination of the grass leys used in the experiment is often preferred, for instance moderately fertilised grass-clover with a first cut followed by grazing. On dairy farms the application of slurry is an obvious choice to avoid the typical yield reduction also experienced in this experiment. However, attention must be paid to the importance of management for nitrate leaching from older grass leys, as it primarily depends on the total N-input via N-fixation, applied fertiliser and N deposited by grazing animals.

Ample fertiliser supply to older grass-clover leys may cause increased leaching since conditions will approximate those of fertilised ryegrass in the experiment. On the other hand, the combination of cutting and grazing may reduce leaching compared to grazing alone as N is exported in the crop and less N is concurrently deposited by grazing cows.

The very low level of nitrate leaching from grazed 4-8-year-old grass-clover leys indicates that dairy crop rotations with a high proportion of grassland and with correct management are a suitable agricultural production in nitrate vulnerable zones.

References

Eriksen J., Vinther F.P. & Søgaard K. (2004) Nitrate leaching and N₂-fixation in grasslands of different composition, age and management. Journal of Agricultural Science. In press.

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