

Presumed yield benefit of grassland renewal is offset by loss of soil quality

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Introduction On clay soils in the Netherlands, permanent grasslands are renewed on average once every 10 years. An important motivation for this is the introduction of new perennial ryegrass (*Lolium perenne*) varieties to increase feed production and quality.

Objective Determine the longer term yield benefits of grassland renewal.

Methods In 2014, twenty permanent grasslands with at least 70% desirable grasses (*i.e. Lolium perenne* and *Phleum pratense*) were selected on ten dairy farms, of which:

- 10 young: renewed between 5 and 15 years ago.
- 10 old: renewed over 20 years ago.

Experimental plots of 15 m × 9 m were laid out on each field, containing:

- three 10 m × 3 m sub-plots fertilized with 0, 150 or 300 kg N ha⁻¹ yr⁻¹.
- 5 m × 9 m non-fertilized sub-plot for SOM, N-total and C-total measurement.

Grass was harvested (four cuts) weighed and sampled for dry matter (DM) and total N analysis. See Iepema *et al.* (2020) for details.

Results

- Lower herbage N yield in young grassland.
- No significant difference between young and old grassland for herbage dry matter yield and fertilizer N response.
- Lower soil organic matter (SOM), carbon (C-total) and nitrogen (N-total) for young compared to the old grassland soil.
- Grass productivity parameters (except NY-res) showed a highly significant positive ($P < 0.01$, $r > 0.65$) correlation with SOM, N-total and C-total.

Conclusions

- In the long-term, grassland renewal does not increase grass productivity (when grassland contains at least 70% desirable grasses), most likely because of loss of SOM as a result of ploughing.
- We do not recommend standard grassland renewal after 10 years to improve productivity.
- When the introduction of high yielding grassland varieties is necessary, the focus should be on oversowing rather than renewing the grassland.

Table 1. Mean (standard deviation in brackets) grass productivity and soil parameters in the 0-10 cm depth of the young (n=10) and old (n=10) grasslands on marine clay soil.

Parameter*	Unit	Young grassland	Old grassland	P-value
Grass age	years without cultivation	9 (4)	25 (4)	<0.001
DMY _{NO}	Mg DM ha ⁻¹ year ⁻¹	9.2 (2)	10.2 (1)	0.154
DMY-res	kg DM kg N ⁻¹	20 (6)	18 (4)	0.250
NY _{NO}	kg N ha ⁻¹ year ⁻¹	172 (50)	198 (21)	0.034
NY-res	kg N kg N ⁻¹	0.68 (0.06)	0.64 (0.09)	0.198
SOM	g. 100 g dry soil ⁻¹	10.7 (3.3)	13.3 (2.2)	0.031
C-total	g C. kg dry soil ⁻¹	45 (18)	61 (12)	0.002
N-total	g N. kg dry soil ⁻¹	4.8 (1.7)	6.3 (1.2)	<0.001

*DMY_{NO}: grassland dry matter yield without nitrogen fertilization, DMY-res: grassland DMY response to N fertilization, NY_{NO}: N yield without N fertilization, NY-res: grassland N response to N fertilization.



Reference Iepema, G., Deru, J.G.C., Bloem, J., Hoekstra, N., de Goede, R., Brussaard, L. & van Eekeren, N. 2020. Productivity and Topsoil Quality of Young and Old Permanent Grassland: An On-Farm Comparison. *Sustainability*, **12**, 2600.

