# Residual effects of cutting and grazing on grass/clover growth

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## Abstract

The residual effect of cutting and grazing during the growing season was investigated in the spring and summer growth in an organic crop rotation with 1-4 year-old grass-clover mixtures of white clover (*Trifolium repens* L.) and perennial ryegrass (*Lolium perenne* L.) either with or without red clover (*Trifolium pratense* L.) and with and without slurry. The white clover mixtures had significantly higher yields in spring and summer in swards that were previously grazed compared to previously cut swards, when slurry was applied. The percentage of white clover in spring was considerably reduced by previous grazing and this caused the yield response of slurry application to be highest following grazing. A similar effect on the clover content was not found in the summer growth. With the inclusion of red clover in the sward the effect of previous management on spring yield disappeared. Red clover was very abundant under the cutting regime, while the contents were declining with grazing.

Keywords: Cutting, fertiliser response, grazing, red clover, residual effects, white clover

## Introduction

Grass-clover production is affected by grazing animals through the recycling of nitrogen (N) in animal excreta. This immediately affects the growth and $N_2$-fixation of the clover (Rotz *et al.*, 2005), but may also have some effects on pasture production in the longer term. Grazing also imposes animal treading and more frequent defoliation, and different clover species have different abilities to survive under grazing conditions (Brummer and Moore, 2005). This experiment investigated the residual effect of grazing on sward production, composition and response to nitrogen fertilisation in perennial ryegrass/white clover mixtures alone or with inclusion of red clover.

## Materials and methods

The experiment was carried out in a grass-arable crop rotation (barley/grass-clover; 4 years of grass-clover; barley/catch crop) at Foulum Research Centre. In spring, grass-clover was undersown in a spring barley (*Hordeum vulgare* L.) cover crop. The seed mixture (sown at 26 kg $ha^{-1}$) was either 15% white clover and 85% perennial ryegrass (five leys in total) or 4% red clover, 14% white clover and 82% perennial ryegrass (three leys in total). Five grassland treatments were imposed in each grass-clover ley between 2006-2009. The treatments were: 1) Grazing regime with cattle slurry application in spring (100 kg total-N $ha^{-1}$); 2) Grazing regime without slurry application; 3) One cut with cattle slurry application in spring (100 kg total-N $ha^{-1}$) followed by grazing; 4) Cutting regime (4 cuts) with cattle slurry application (200 kg total-N $ha^{-1}$, half in spring and half after 1$^{st}$ cut); and 5) Cutting regime (4 cuts) without slurry application. Grazing plots were grazed continuously by heifers.
Effects of previous ley management were investigated by harvesting with a Haldrup plot-harvester; 18 $m^2$ in cut plots. In grazed plots, cuts were made in temporarily fenced off subplots (6 or 12 $m^2$) and the rest period was the same as for the cutting regime in spring

growth and 2nd regrowth. Botanical composition, dry matter (DM) yield and N content were determined as described by Søegaard (2009). Results were processed by analysis of variance (GLM) applying the Least Significant Difference (LSD) test using the SAS software.

Table 1. Dry matter (DM) yield, clover proportion and N concentration of herbage in spring and summer growth following different management in the previous and the year of harvest. Same letter within variable and species mixture indicate no significant differences ($P$>0.05).

| | | Spring growth | | | Summer growth | | |
|---|---|---|---|---|---|---|---|
| | | DM yield (t DM/ha) | Clover (% of DM) | N (% of DM) | DM yield (t DM/ha) | Clover (% of DM) | N (% of DM) |
| Ryegrass/white clover | | | | | | | |
| – Slurry | Cutting | 3.8$^{c}$ | 21$^{a}$ | 2.1$^{a}$ | 2.4$^{ab}$ | 58$^{a}$ | 3.3$^{a}$ |
| | Grazing | 3.9$^{c}$ | 11$^{b}$ | 1.7$^{b}$ | 2.4$^{ab}$ | 54$^{a}$ | 3.4$^{a}$ |
| + Slurry | Cutting | 4.8$^{b}$ | 13$^{b}$ | 2.1$^{a}$ | 2.2$^{b}$ | 34$^{b}$ | 3.0$^{b}$ |
| | Grazing | 5.4$^{a}$ | 4$^{c}$ | 1.8$^{b}$ | 2.7$^{a}$ | 34$^{b}$ | 3.2$^{a}$ |
| Ryegrass/white and red clover | | | | | | | |
| – Slurry | Cutting | 5.0$^{b}$ | 52$^{a}$ | 2.7 | 2.3$^{b}$ | 76$^{a}$ | 3.6 |
| | Grazing | 4.9$^{b}$ | 23$^{c}$ | 2.1 | 2.9$^{a}$ | 57$^{b}$ | 3.3 |
| + Slurry | Cutting | 5.6$^{a}$ | 31$^{b}$ | 2.5 | 2.5$^{b}$ | 70$^{a}$ | 3.7 |
| | Grazing | 5.9$^{a}$ | 16$^{d}$ | 2.1 | 3.0$^{a}$ | 51$^{b}$ | 3.6 |

## Results and discussion

In swards with white clover mixtures, previous grazing compared to cutting significantly increased DM yields where slurry was applied (Table 1) in both spring and summer. Previous grazing significantly reduced the white clover content in the spring cut both with and without slurry, whereas there was no effect later in the season. Similar reductions in clover content in spring growth was not found on farms with dairy cow grazing (Søegaard, 2009), which could be due to a tighter grazing by heifers in this experiment. Usually the N concentration in herbage is greatly influenced by clover content. Taking this into consideration, the N concentrations in herbage in the previously grazed plots were relatively higher than in the previously cut plots probably due to the higher N supply from recycling of urine and faeces in the grazed plots. With the inclusion of red clover in the sward the effect of previous management on spring yield disappeared. However, in the summer growth, previous grazing increased yields compared with cutting. Including red clover in the sward increased the total clover content of the sward and both in spring and summer previous grazing reduced the red clover content significantly.

The species dynamics in the multi-species mixture sward (Fig. 1) may explain the responses to the management. Red clover was very abundant under the cutting regime, while the contents were declining with grazing whereas the proportion of white clover was positively influenced by grazing. It appears that the high red clover proportion during summer growth under cutting conditions was not able to compensate for the positive residual effect of grazing on grass yield probably caused by N excretion, increased tiller density and more stems as observed in the pasture. The experiment also had a treatment with a spring cut prior to grazing and the results (not shown) were not significantly different ($P$>0.05) from the results under whole season grazed management.

The yield response of fertiliser (100 kg total-N ha$^{-1}$ in cattle slurry) of the sward to the spring cut decreased from 37 to 27% in the white clover mix going from previous grazing to previous cutting and similarly from 20 to 13% in the red and white clover mix. Others have found the N response of grazed pure grass swards (Lantinga *et al*., 1999) and perennial ryegrass-white clover mixtures (Søegaard, 2009) to be lower than that of cut swards, probably due to N excretion by cattle in the grazed sward. In this experiment the residual effect was determined by making a cut in a fenced off part of the grazed plot. Under similar conditions,

with a longer rest period than normally during grazing, the higher yield and N response under grazing compared to cutting has also been found on farms (Søegaard, 2009) and it indicates a higher growth potential in grazed swards. The reduction in clover content caused by N application probably contributed to a significant N response in perennial ryegrass in the grazed sward.

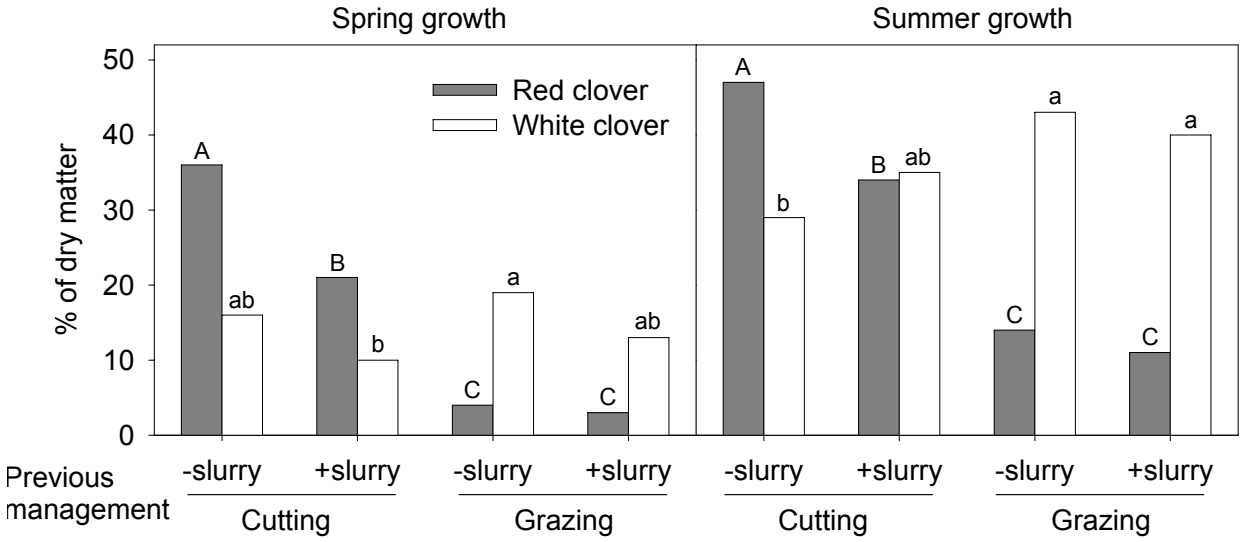


Figure 1. Proportion of red and white clover in a mixture of perennial ryegrass, white and red clover subject to previous grazing and cutting, with and without slurry. Same letter within growth period and species indicate no significant difference ($P$>0.05).

## Conclusions

The experiment showed profound residual effects of management on white clover-perennial ryegrass swards both with and without red clover. These effects can be utilised in farm management for improving yield and fertilizer response.

## References


Brummer E.C. and Moore K.J. (2000). Persistence of perennial cool-season grass and legume cultivars under continous grazing by beef cattle. *Agronomy Journal* 92, 466-471.

Lantinga E.A., Deenen P.J.A.G. and van Keulen H. (1999). Herbage and animal production responses to fertilizer nitrogen in perennial ryegrass swards. II. Rotational grazing and cutting. *Netherlands Journal of Agricultural Sciences*, 47, 243-261.

Rotz C.A., Taube F., Russelle M.P., Oenema J., Sanderson M.A. and Wachendorf M. (2005). Whole-farm perspectives of nutrient flows in grassland agriculture. *Crop Science* 45, 2139-2159.

Søegaard K. (2009). Nitrogen fertilization of grass/clover swards under cutting or grazing by dairy cows. *Acta Agriculturae Scendinavica Section B – Soil and Plant Science* 59, 139-150.