

# Type of grass influences clover proportion and production of grass-clover leys

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## Abstract

Inclusion of red clover (*Trifolium pratense*) in grasslands improves productivity. However, poor persistence, particularly under high fertilization rates, is a major limitation for wider utilization. Earlier observations indicated that the type of grass may influence the grass-clover balance, besides, e.g. cutting strategy. In a field experiment we investigated clover proportions and production of five different grass mixtures in combination with red and white clover (*T. repens*): (1) *Lolium perenne*; (2) *L. boucheanum* + *L. perenne*; (3) *Festulolium* + *L. perenne* + *L. boucheanum* + *Phleum pratense* subsp. *pratense*; (4) *L. perenne* + *Festulolium*; (5) *Festuca arundinacea* + *P. pratense*. The experiment was carried out for three years at two locations (sandy and clay soil) at high fertilization levels (254 and 306 kg N-total ha<sup>-1</sup> year<sup>-1</sup> from animal manure). Results indicate that red clover can be relatively persistent, with an average of 43% red clover in the DM-production in both the second and third year. Mixtures containing *L. boucheanum* showed significantly lower clover proportions. Protein production per hectare was strongly and positively related to the red clover proportion in the sward. These results show that grass species influence the productivity and clover proportions in grass-clover swards. The best performing mixtures under the given conditions include *Festulolium* or *F. arundinacea*.

**Keywords:** red clover, persistence, grass mixture, high input systems

## Introduction

In Dutch agriculture red clover (*Trifolium pratense*) is recently becoming more popular because of its high yield potential under cutting regimes. However, rapid decline of red clover proportions and poor persistence are major limitations for its wider utilization. Besides the clover variety (Boller *et al.*, 2008) cutting strategy also influences the proportion of clover and persistence of red clover (Eriksen *et al.*, 2013; Søegaard, 2013). Incidental observations with hybrid ryegrass (*Lolium boucheanum*) and tall fescue (*Festuca arundinacea*) have indicated that the type of grass might also have a major effect on the proportion of clover and the persistence of red clover in grass-clover swards. To investigate this effect five different grass mixtures were sown in combination with red and white clover (*T. pratense* and *T. repens* respectively).

## Materials and methods

In early September 2011 grass-clover mixtures were sown on two commercially managed fields, on sandy soil and clay soil, as part of a larger trial to compare pure grass and grass-clover (Rietberg *et al.*, 2015). Swards were fertilized three times per year with 254 (sand) and 306 (clay) kg N-total ha<sup>-1</sup> year<sup>-1</sup> from injected dairy cattle slurry. Mixtures comprised 7 and 3 kg ha<sup>-1</sup> of red and white clover, respectively, and were sown together with the five grass mixtures (specifically selected for cutting regimes) at commercially advised seeding rates (Table 1). The mixtures were sown in duplicate per location.

Due to financial limitations in 2012 only dry matter (DM) yield was measured and on only one location (clay soil). In 2013 and 2014, in the 2<sup>nd</sup> and 3<sup>rd</sup> years of the experiment, the plots were harvested for silage four and five times, respectively. DM yield was determined by cutting a strip of 0.81×5 m with a two-wheel tractor per plot. After weighing the fresh biomass, two sub-samples of ca. 300 g were taken for the analysis of nutritive value by near infrared spectrometry at a commercial lab and for botanical

composition (hand separation and subsequent drying at 70 °C for 24 h). Results were tested by analysis of variance (ANOVA with location as block; least significant differences) and regression analysis (generalized linear model procedure with n=40) using GenStat 13.3.

## Results and discussion

All mixtures were well established at the beginning of the first production year. Mean clover proportions in the sward and yields of the next two years are summarized in Table 1. The proportions of red and white clover were significantly affected by the grass mixture, with lowest proportions in the mixtures with hybrid ryegrass. This tall-growing grass negatively affected the red clover proportion, particularly on the clay location, where the first two cuts of mixture B were very heavy (>6 Mg DM ha<sup>-1</sup> cut<sup>-1</sup>) in 2012, due to unfavourable weather conditions that delayed the cuts. Particularly in mixture B, the hybrid ryegrass also prevented white clover from spreading more effectively in the plots with lowest clover proportions, even though grass production seemed sometimes limited by low N-availability (reflected in crude protein contents of less than 130 g kg DM<sup>-1</sup> of some cuts in 2013). The proportion of red clover was highest in mixture E, possibly due to the near disappearance of *Phleum pratense* from all plots during the first growing season.

The proportions of clover were similar in the two years of measurement, with 43% of red clover and 8-9% white clover, and no general interaction between grass mixture and year was apparent. However, while in most mixtures the proportions of clover increased slightly, the proportion of red clover decreased significantly in the mixture E (-16% in DM;  $P < 0.05$ ), due to the spread of grasses, partly by hybrid ryegrass which spontaneously seeded itself into the very open sward of these plots.

Yields and nutritive values were all higher for the clay location compared with the sand location (e.g. 1 Mg DM, 281 kg crude protein and 137 kg available intestinally digestible protein ha<sup>-1</sup> year<sup>-1</sup>), while clover proportion in the sward was lower (-16% in DM). Due to favourable weather conditions, yields were higher in 2014 than in 2013 (+3.2 Mg DM, +304 kg of available intestinally digestible protein and +830 kg crude protein ha<sup>-1</sup> year<sup>-1</sup>), but no interaction between grass mixture and year was apparent. Yields were significantly affected by the grass mixtures, with highest yields for the mixtures including *Festulolium* or tall fescue.

Regression analysis showed a significant effect of the red clover proportion on protein yields (+ 19.3 kg ha<sup>-1</sup> year<sup>-1</sup> crude protein and +4.7 kg ha<sup>-1</sup> year<sup>-1</sup> of available intestinally digestible protein per percent of red clover;  $P < 0.001$ , n=40). The proportion of red clover explained 24 and 11% of the total variance for crude protein and intestinally digestible protein, respectively. Year had a large effect explaining 59 and 66%, respectively, while the location effect was relatively small with 1 and 7% of the total variance

Table 1. Grass seed rates in mixtures with red and white clover, clover proportions, dry matter yields, protein content and protein yields. Means of two locations and two years (2013 and 2014).

Treat-ment and seed rate of grass (kg ha <sup>-1</sup> )	Proportion in seed (weight %)					Red clover (% of DM)	White clover (% of DM)	DM yield (Mg ha <sup>-1</sup> y <sup>-1</sup> )	CP content (g kg DM <sup>-1</sup> )	CP yield (kg ha <sup>-1</sup> y <sup>-1</sup> )	DVE yield (kg ha <sup>-1</sup> y <sup>-1</sup> )
	Lp	Lb	Fest	Fa	Pp						
A (40)	100					45 ab	11 a	12.2 c	211 ab	2,588 c	1,012 b
B (50)	40	60				26 c	3 b	12.4 bc	175 d	2,187 d	909 c
C (40)	30	25	35		10	37 b	5 b	13.1 ab	198 c	2,612 cb	1,037 b
D (40)	65		35			49 a	8 ab	13.4 a	210 b	2,810 ab	1,071 ab
E (60)				85	15	54 a	11 a	13.7 a	217 a	2,972 a	1,115 a

<sup>1</sup> Lp = *Lolium perenne*; Lb = *Lolium boucheanum*; Fest = *Festulolium*; Fa = *Festuca arundinacea*; Pp = *Phleum pratense*; DM = dry matter; CP = crude protein; DVE = Dutch measure for available intestinally digestible protein. Values with different letters within each column are significantly different (least significant difference,  $P < 0.05$ ).

explained, and no interactions were apparent. The effect on DM yield was not significant, mainly due to mixture A in which perennial ryegrass and white clover dominate, both having a relatively modest production capacity but high nutritive value.

## Conclusions

The companion grass mixture affects protein production and clover proportion of grass-clover mixtures. Highest protein production is obtained with productive grass mixtures which can still support sufficiently high red clover proportions under the given agro-ecological conditions. Results indicate that red clover can be relatively persistent in the first three years, even under high fertilization rates. Mixtures containing highly productive, tall-growing hybrid ryegrass negatively affect clover proportions in the sward. These results show that selecting appropriate grass species can be an important strategy to increase the productivity and clover proportions in grass-clover swards. The choice for a specific grass mixture depends on the objective but under given agro-ecological conditions the best performing mixtures include *Festulolium* or tall fescue.

## Acknowledgements

This project was co-financed by the Dutch Ministry of Economic Affairs, who is end responsible for the Rural Development Programme for the Netherlands (POP2); The European Agricultural Fund for Rural Development (EAFRD): 'Europe invests in its rural areas'. Mts. Grootkoerkamp, mts. Buys, AgrifirmFeed and Barenbrug are gratefully acknowledged for their contributions to the project.

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Volume 20  
Grassland Science in Europe