# Effect of cutting frequency of four red clover cultivars on forage yield and persistence

Hejduk S.
*Mendel University in Brno, Department of Animal nutrition and grassland management, Zemědělská 1, 613 00 Brno, Czech Republic; hejduk@mendelu.cz*

## Abstract

Red clover (*Trifolium pratense* L) is the most important perennial legume cultivated in Central and Northern Europe. Its lack of persistence is the main limiting factor which hampers its wider use in permanent grassland. Once the plants in the 2nd or 3rd harvest year disappear, the remaining grass sward needs more nitrogen fertilizing, over-seeding or renovation. The aim of this paper was to evaluate the effect of four red clover cultivars and two cutting frequencies on dry matter (DM) yield and clover persistence in mixture with grasses. The highest DM forage yield in the 3rd harvest year and persistence index was achieved by the cultivars Astur and Amos for 3- and 4-cut management, respectively (15.7 vs 16.6 Mg $ha^{-1}$ and 0.82 vs 0.95, respectively). There was a significant interaction between cultivar and cutting frequency in the 3rd harvest year, when only cultivar Amos increased yield and persistence index under 4-cut management. The cultivar Amos, in comparison with other cultivars, demonstrated the best results under more frequent cutting management and should be recommended, in preference, for intensively harvested permanent grasslands and/or leys.

**Keywords:** *Trifolium pratense*, persistence index, forage yield, management

## Introduction

Red clover has more tolerance than lucerne to shallow, acid and wet soils and has better complementarity to grasses. That is the reason this species is increasingly important for sustainable grassland systems, producing high dry matter yields of high quality forage without need for nitrogen fertilization. The main limiting factor that hampers its wider use in permanent grassland is its lack of persistence. Traditionally, red clover-based stands are harvested three times per year. As climate change leads to extension of the growing season and animal performance increases, four and sometimes five cuts per year are more common in some parts of Europe. Some authors (e.g. Sheldrick *et al.*, 1986) report that more frequent harvest leads to weakening of plants and their yields and persistence decline. The aim of this experiment was to compare yields and persistence index of red clover cultivars cut three and four times per year.

## Materials and methods

The trial was established at the Forage Research Station in Vatín (49°15'5"N, 15° 58'15"E), Czech Republic. The site is situated at 540 m.a.s.l., mean annual precipitation and mean annual temperature is 617.5 mm and 6.9 °C, respectively. Soil is slightly acid (pH in $CaCl_2$ 5.48) sandy loam cambisol developed on orthogneiss. Plant-available P was good, K was high and Mg was good (Mehlich III method). $C_{ox}$ and $N_t$ in 0-20 cm of topsoil were 19 and 1.2 g $kg^{-1}$ of dry soil, respectively.

Four varieties of red clover (diploids Start and Lucrum, tetraploids Astur and Amos), which had shown high persistence in a previous experiment (Hejduk and Knot, 2010), were sown on arable land by drilling in parallel rows spaced at 125 mm. The red clover varieties (14 kg seed $ha^{-1}$) were mixed with meadow fescue (4 kg $ha^{-1}$) and timothy (6 kg $ha^{-1}$). The trial was established on 20 June 2011 in a randomized block design with 3 replications for each cultivar and cutting frequency. The size of experimental plot was 1.25×8 m (10 $m^2$). During three production years the stands were harvested three or four times. The first harvests of the four-cuts treatment were performed at bud stage, whereas in the three-cut treatment it was

harvested when 50% of flower heads opened. Dry matter yields were determined after drying the samples at 55 °C. Persistence index was calculated according to Halling *et al.* (2004) as a ratio of DM forage yields in 3rd and 1st harvest years. The experiment was fertilized with 40 and 30 kg P $ha^{-1}$ (Hyperkorn) applied only before the establishment of the trial and in the spring of the first production year. No other fertilizers were used, so the yield of associated grasses was dependent on rhizobial fixation of nitrogen on the roots of red clover. Statistical analyses were performed using repeated measures ANOVA (for evaluation of the whole period) or two-way Anova (for evaluation of the last harvest year) with multiple post-hoc comparisons according to Tukey (*P*-value <0.05). Software Statistica 12 (StatSoft) was used for the analysis.

## Results and discussion

Ageing of stands significantly reduced yields and number of plants. There were no significant differences among cultivars and cutting frequencies in yield and plant density when all three harvest years were calculated (Figure 1). Significant interactions of cultivar × cutting frequency and year cultivar × cutting frequency were associated with the cultivar Amos. This clover produced significantly the highest yield in the 3rd harvest year under the 4-cuts treatment. Under the 3-cuts treatment the yield and persistence index were the lowest. In this experiment, the DM yield of the red clover cultivars ranged from 15.5 to 20.6 Mg $ha^{-1}$ in year 1, from 11.3 to 16.9 Mg $ha^{-1}$ in year 2 and from 8.9 Mg $ha^{-1}$ to 17.8 Mg $ha^{-1}$ in year 3.

Cultivars with the highest values of persistence index should be those with a higher persistence and better disease resistance (Halling *et al.*, 2004). Marshall *et al.* (2012) found almost identical persistence index under 3-cuts management in Wales (quite low: 0.60) for cultivar Amos as to that found in this trial. In the country of origin (Czech Republic), cultivar Amos has been suffering greatly from *Fusarium* attack in recent years. For this reason it is no longer considered as a persistent cultivar. In central Europe, dieback of red clover plants can be attributed to fungi of the genera *Fusarium*, viruses and the mammal pest *Microtus arvalis*.

Surprisingly, in the 4-cuts management, cultivar Amos demonstrated much better results than under 3-cuts management in terms of yield and persistence index. This could be attributed to a higher susceptibility to lodging or to the microclimate in the stand under three cut management.

The development of DM yields and density of plants in stands over 3 harvest years are described in Table 1. There is a consistent decrease of yield and number of plants for both harvest managements over the period of ageing of the stands.

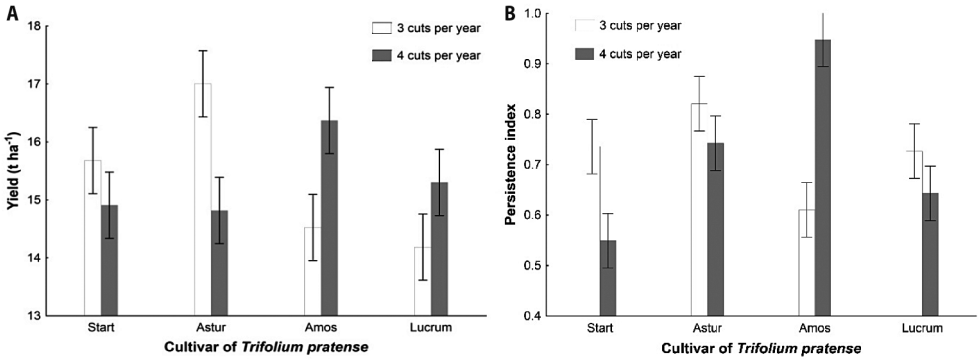


Figure 1. Effect of cultivar and cutting frequency on (A) yield and (B) persistence index. The abscisae at bars show standard deviations.

Table 1. Development of yields (Mg ha$^{-1}$ DM) and stand density (plants m$^{-2}$) within three harvest years (data derived from all four cultivars).[1]

| | Dry matter yield | | Number of plants on 1 m$^2$ | |
|---|---|---|---|---|
| | 3 cuts | 4 cuts | 3 cuts | 4 cuts |
| 2012 | 18.0 a | 18.3 a | 158 a | 149 a |
| 2013 | 15.1 b | 14.6 b | 124 b | 116 b |
| 2014 | 13.0 c | 13.1 c | 67 c | 73 c |
| Average | 15.3 | 15.3 | 116 | 113 |

[1]Values with a different letter in a row are significantly different ($P<0.05$).

## Conclusions

Increased cutting frequency of red clover stands is not directly linked to a decrease of yield and stand persistence. The cultivar Amos produced higher DM yield at higher cutting frequency in the 3$^{rd}$ harvest year and this variety can be used in preference for more intensive systems. There is no known explanation or specific trait connected with the interaction of this cultivar but 4-cut plots of cultivar Amos are visually greener and more vigorous than the others, even in autumn and early spring periods. Higher cutting frequency is linked with higher forage quality and lower risk of lodging. If forage DM yield is not reduced, the stand also has higher yield of protein, metabolisable energy and other nutrients per unit area.

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