The development of yield and digestibility of a grass mixture during primary growth and regrowth

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Abstract

Development of yield and digestibility of grass leys was studied in Maaninka, Finland during the 2014 growing season. A field plot of 8 ha was sown in 2013 using a mixture of timothy (*Phleum pratense* L.), meadow fescue (*Festuca pratensis* Huds.) and perennial ryegrass (*Lolium perenne* L.). The field was divided into two sectors according to the timing of the first harvest. The early first cut was taken on 10 June and the late first cut on 23 June. Four sampling points were used per sector. Samples were taken around the first cut and during the regrowth approximately every fifth day. Digestibility of grass (D-value) was determined by near-infrared spectrometry. The primary cut produced higher dry matter yield than the regrowth. A low grass growth rate during the regrowth was partly compensated for by using a long growing period. The D-value of grass decreased almost at the same rate in both the primary growth and the beginning of the regrowth period. The D-value of regrowth increased at the end of growing period. Thus the rate of decrease of the D-value of the regrowth depends on the observation period.

Keywords: grass, D-value, growth model, harvest timing, yield

Introduction

Comparisons between different harvesting strategies require information about changes in grass growth rate and digestibility. These changes depend on the timing of harvest and the period of the growing season, as well as forage species. Time-series studies are needed to explore parameters for grass growth models. The development of yield and digestibility of grass leys was studied in Maaninka (63°08' N, 27°19' E), Finland during the 2014 growing season. This paper reports on part of a larger milk production study, results of which will be reported elsewhere.

Materials and methods

An 8-ha field plot was sown in 2013 using a mixture of timothy (*Phleum pratense* L.), meadow fescue (*Festuca pratensis* Huds.) and perennial ryegrass (*Lolium perenne* L.). The field was divided into two sectors according to the timing of the first harvest. The early first cut was taken on 10 June and the late first cut on 23 June. There were four separate sampling points per sector. Two subsamples (2×0.25 m^2) were taken from each sampling point before and after the early (E) and late (L) harvest approximately every fifth day. The development of the regrowth of E (ER) and the regrowth of L (LR) were also studied by taking samples by a similar procedure to the primary growth sampling. Dates of first and last sampling and the number of sampling dates in each time series (E, L, ER, EL) are presented in Table 1.

The yield and dry matter content (DM) were measured from both subsamples and the average was used. Grass digestibility (D-value; g digestible organic matter in DM) was determined with near-infrared spectrometry (Valio Ltd, Seinäjoki, Finland). The growth-affected temperature sum (growing degree days, GDD, °C d, the base 5 °C) was measured by the Finnish Meteorological Institute weather station at Maaninka. The GDD for treatments E and L was calculated by starting from the beginning of the growing season and for the ER and LR from the day of the first harvests.

Table 1. The first and the last sampling dates, growth-affected temperature sums (GDD) and the number of sampling times of each time series.

	First sampling		Last sampling		Sampling times
	Date	GDD, °C d	Date	GDD, °C d	
E	9 June	286	18 June	343	3
L	13 June	323	4 July	447	5
ER	7 July	194	8 August	695	7
LR	21 July	315	12 September	943	11

Statistical analysis was performed by analysis of covariance using the Mixed procedure of SAS 9.3. The model contained continuous terms GDD and GDD^2, a categorical term time series and the interaction-term of GDD and time series.

Results and discussion

GDD and GDD^2 significantly explained the DM yield. The first DM yield measurement for E was missed, therefore E remained without reliable information about grass growth rate. However, the growth rate of E should be similar to that of L because of the same growing history. The primary yield increased until the last sampling date on 4 July (Figure 1) owing to the relatively low growth rate, 129 kg DM d^{-1} compared to 191 kg DM d^{-1} reported earlier for Finland (Rinne *et al.*, 2010). The lower accumulation of GDD (-90 °C d between 13 June and 4 July) compared to long-term average can explain the difference.

Typically, on commercial farms the regrowth yield is lower compared to the first cut. This is a consequence of low grass growth rate in the second cut, which was 80 kg DM d^{-1} in this study. The slope of L differed from the slopes of ER and LR (P=0.002) and the yield increase reached a plateau at 6,000 kg DM ha^{-1} in LR, whereas the increase in L did not have a break point. Thus L would produce maximal DM yield during the growing season. A low growth rate during the regrowth would be compensated by a long growing period so that the yield of the first and second cuts would be comparable, despite the timing of harvest in the first cut (Figure 1), if the timing of harvest stays within reasonable limits.

The D-value decreased on average by -2.6 g d^{-1} in treatments E and L, which is low compared with the value of -5 g d^{-1} reported by Rinne *et al.* (2010). This is a consistent result with the low growth rate of L. According to Rinne *et al.* (2010) the GDD gives a relatively good estimate for changes in D-value of the grass (R^2=0.82). Exceptionally cool weather in June and/or the presence of perennial ryegrass in the mixture could have slowed down the rate of decrease of D value in the first cut.

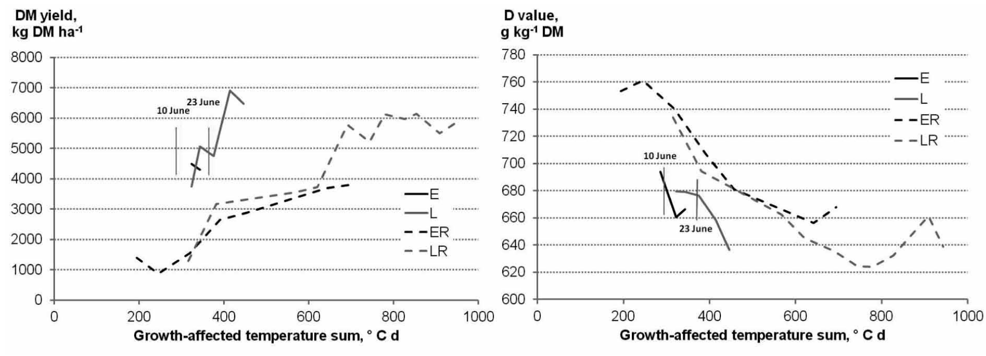

Figure 1. The effect of growth-affected temperature sum (°C d) on grass dry matter (DM) yield and D-value. The vertical lines represents harvesting dates of early (E) and late (L) first cut. R = regrowth yield.

At the beginning of the regrowth period the decrease in grass D-value, -3.4 g d^{-1}, was exceptionally high compared to the average of -1.2 g d^{-1} reported by Kuoppala (2010) for regrowth of timothy or timothy-meadow fescue swards. The slopes of series between primary and regrowth did not differ (not significant). The change in D-value was quadratic ($P<0.001$ for GDD^2) showing an increase at the end of season and the average decrease was -1.8 g d^{-1} during the regrowth sampling period. At the end of the growing season the changes in both yield and digestibility of the grass are moderate; at this period growing tillers and senescence counterbalance each other.

Conclusions

The primary cut produced higher DM yield compared with that of the regrowth. A low daily grass-growth rate during regrowth was partly compensated by a long growing period. The D-value of grass decreased almost at the same rate in both the primary growth and at the beginning of the regrowth period. The D-value of regrowth increased at the end of the growing period. Thus the rate of decrease of D-value of the regrowth depends on the observation period.

References

Rinne M., Pitkänen T., Nyholm L., Nousiainen J. and Huhtanen P. (2010) Nurmiheinien ensimmäisen sadon sulavuuden ja sadon määrän mallit nurmirehuntuotannon hallintaan. In: Hopponen A. (eds) *Maataloustieteen päivät 2010, 12.-13.1.2010 Viikki, Helsinki: esitelmät, posterit. Suomen maataloustieteellisen seuran tiedote 26.* 9 p.

Kuoppala K. (2010) *Influence of harvesting strategy on nutrient supply and production of dairy cows consuming diets based on grass and red clover silage.* PhD thesis. MTT Science 11. MTT Agrifood Research Finland, Jokioinen, Finland, 99 pp.