The effect of harvest timing on the amount and the quality of total yield of grass silage per growing season

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Introduction The harvest timing during the growing season affects notably the amount and the quality of grass silage both in the first and the second harvest. It is important to understand the sum influences of all cuts in order to succeed in cattle feeding rationing.

Material and methods The experiment was conducted at MTT Maaninka (63º08’N, 27º19’E) and MTT Ruukki (64º40’N, 25º00’E), Finland, during the growing seasons 2009–2011. The study included four grass silage (timothy–meadow fescue at Maaninka and pure timothy at Ruukki) harvesting strategies: A early (target D-value 690 g kg^{-1} DM), B delayed (650 g kg^{-1} DM), C late (620 g kg^{-1} DM) in the first harvest combined with one regrowth cut, and D three harvests (target D-value 690 g kg^{-1} DM in the first harvest) per growing season. In strategies A–C the second cut was harvested in August. In strategy D the second cut was harvested at the end of July and the third cut at the end of September or early in October. Neutral detergent fiber (NDF), organic matter solubility (*in vitro*), crude protein (CP) and ash were determined in the Animal Production laboratory at MTT. ME yield was calculated in GJ as DM yield * 0,016 * D-value in g kg DM^{-1}/1000 as presented in MTT 2012. Non-fiber carbohydrates (NFC) were calculated by 1000 – (NDF + CP +ash + crude fat) (NRC 2001). The fat content was estimated using Finnish feed tables (MTT 2012). NDF and NFC contents for the total yield were calculated by weighting the values by the DM yields of the cuts.

The analyses were performed using the *Mixed* procedure of the SAS 9.2. Maaninka and Ruukki were analyzed separately. Harvesting strategy, year and their interaction were the fixed effects while replicate and replicate × year interaction were the random effects. Year was used as a repeated measurement with Toepliz or Compound Symmetry-covariance structure.

Results and discussion Delaying the first cut increased both the dry matter (DM) and the metabolized energy (ME) yield (Table 1) but it decreased the grass digestibility. The changes in the first cut were partly reversed in the second cut. Delaying the first cut decreased the DM yield-weighted D-value of the total yield by 40 g kg^{-1} DM (682 → 646 g kg^{-1} DM at Maaninka, p<0.001; 686 → 643 g kg^{-1} DM at Ruukki, p<0.001). The low D-value of the silage requires an increasing amount of concentrate supplementation in the diet to maintain constant milk yield (Kuoppala et al. 2008). High proportion of concentrate increases the risk of feeding disorders which decreases the feasibility of low D–value silages in practise. The strategy D produced as high ME yield as the strategy C and as high DM yield as the strategy B at Ruukki. At Maaninka, though, the strategy D produced only as high ME and DM yield as the strategy A. The strategy D produced the highest D-value: 706 g kg^{-1} DM at Maaninka and 703 g kg^{-1} DM at Ruukki. Success of the strategy D varied a lot between experiment places and between years, which emphasizes the importance of the field and weather conditions when choosing the best harvest timing strategy. The proportion of NDF in the yield of the first cut increased while delaying the harvest (580 → 630 g kg^{-1} DM at Maaninka, p<0.001; 552 → 630 g kg^{-1} DM at Ruukki, p<0.001). Because there were no differences between the NDF contents in the second cut, the NDF content in the first cut dominated the average value of the total yield (Table 1). The proportion of NDF in the total yield was the lowest in the strategy D, because the NDF content in the third cut was low (about 500 g kg^{-1} DM).

According to the feed tables (MTT 2012), the NFC content decreases when delaying the first cut. However, in our experiments the change in the grass NFC content depended on the location of the experiment. Delaying the first cut decreased its NFC content at Ruukki (170 → 157 g kg^{-1} DM, p<0.001) but increased it at Maaninka (131 → 176 g kg^{-1} DM, p<0.001). The reason for the increase in NFC was the rapid decrease in CP at the same time. The moderate decrease in the grass CP content at Ruukki could be a consequence of organic soil type. However, the relatively small change in the NFC content in the silage does not have a large influence on the diet of dairy cattle, where the majority of the NFC originates from concentrated feed.

Table 1. Dry matter (DM) yield, metabolized energy (ME) yield and the amount of neutral detergent fiber (NDF) in the total yield of the growing season for different harvest timing strategies.

	Maaninka			Ruukki		
	DM yield	ME yield	NDF	DM yield	ME yield	NDF
	kg DM ha^{-1}	GJ ha^{-1}	g kg^{-1} DM	kg DM ha^{-1}	GJ ha^{-1}	g kg^{-1} DM
A Early	8901 a	97.2 a	577 a	8919 a	97.8 a	568 a
B Delayed	9513 b	101.7 b	601 b	10904 b	115.3 b	599 b
C Late	10216 c	105.4 c	606 b	12268 c	126.3 c	613 c
D Three harvests	8708 a	98.1 a	560 c	11239 b	126.0 c	545 d
SEM	92.0	1.00	2.7	134.5	1.50	2.1
p-values						
Harvest timing strategy	***	***	***	***	***	***
Year	***	**	*	**	o	***
Interaction	**	**	**	***	***	**

SEM = standard error mean
Values marked with the same letter do not differ (Tukey's test).

Conclusions Delaying the first harvest increased both the total DM and ME yield per hectare but simultaneously the average digestibility of the total yield decreased. The three harvests strategy produced the most digestible yield, but the success of the third cut depends on the soil type and the weather conditions. An average of 8 % increase in the ME yield between the early and the late harvest at Maaninka was not remarkable when taking into account the increased challenges in the feeding rationing for the dairy cows. In contrast, the 30 % increment in the grass yield at Ruukki was considerable. The NDF content increased while delaying the first cut, but changes of the grass NFC contents change were variable. The results show that it is important to take into account all the cuts when considering the timing of the first cut.

References

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