Duration is important in the effect of pasture allowance restriction on subsequent milk production, in early lactation

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Abstract

In pasture-based dairy systems, feed supply can be limited in early spring due to inadequate pasture growth. The objective of this experiment was to investigate if different pasture allowances offered to early lactation grazing dairy cows, for different durations, influenced milk production. Cows were offered one of four pasture allowances (60, 80, 100 or 120% of intake capacity) for either 2 or 6 weeks. Once the 2- and 6-week time durations had elapsed, the cows in all treatments were offered 100% of intake capacity. At the end of the first 2 weeks of the experiment, milk yield was significantly different between all four allowances (18.5, 19.8, 21.4 and 23.1 kg cow^{-1} day^{-1} for 60, 80, 100 and 120% treatments, respectively). During weeks 7-10 there were no differences in milk yield between the 2-week treatments (23.5 kg cow^{-1} day^{-1}). Milk yield of the 60×6 treatment was lower than the 100×6 and 120×6 treatments, but was similar to the 80×6 treatment. The 80×6 treatment was similar to the 100×6 treatment, but different to the 120×6 treatment. The 100×6 and 120×6 treatments were similar to each other. This indicates that differences in pasture allowance imposed for a 6-week period affected subsequent production and the data suggest that in early lactation the effect of pasture allowance on milk yield depends on the amplitude and the duration of the treatment application.

Keywords: pasture allowance, early lactation, dairy cow

Introduction

There is little grass growth over winter in Ireland (Hurtado-Uria *et al.*, 2013), which may result in limited feed supply during early spring in intensive grazing systems. In the post-quota era, increased herd sizes and stocking rates on farms may further deplete the availability of grass in spring. Restricting pasture allowance (PA), by altering post-grazing height, for a ten-week period in early lactation has previously been shown to reduce immediate milk production but cumulative milk production was unaffected (Ganche *et al.*, 2013) as the amplitude and the duration of the restriction were not overly severe. The objective of this experiment was to investigate if different PA, offered for varying time durations to grazing dairy cows during early lactation influenced milk production.

Materials and methods

96 dairy cows (41 primiparous and 55 multiparous) were assigned to a randomised complete block design with a 4×2 factorial arrangement of treatments from 25 March to 27 November 2014. Cows were balanced on calving date (17 February, standard deviation (s.d.) 15.5 d), breed (Holstein-Friesian, n=52; Jersey × Holstein-Friesian, n=38; Norwegian Red, n=6), lactation number (2.4, s.d. 1.61) and production variables from the two weeks prior to the start of the experiment: milk yield (22.6, s.d. 4.20 kg d^{-1}), milk fat (55.8, s.d. 9.18 g kg^{-1}), milk protein (34.5, s.d. 3.00 g kg^{-1}) and milk lactose (46.9, s.d. 1.87 g kg^{-1}) concentrations, milk solids yield (2.03, s.d. 0.408 kg d^{-1}), bodyweight (BW; 469, s.d. 68.2 kg) and body condition score (BCS; 3.09, s.d. 0.193). Cows were then randomly assigned to one of four PA (60, 80, 100 or 120% of intake capacity; IC) for either 2 or 6 weeks. Once the 2- and 6-week time durations had elapsed, the cows in all treatments were offered 100% of their IC. Intake capacity was calculated using the equation of Faverdin *et al.* (2011) based on age, parity, days in milk, BW, BCS and potential milk

yield. Fresh pasture areas were offered after each milking while treatments were being imposed and on a 24-hour basis thereafter. Pre- and post-grazing sward heights were measured daily using a rising plate meter (diameter 355 mm and 3.2 kg m^{-2}; Jenquip, Fielding, New-Zealand). Herbage mass (HM; >3.5 cm) was measured twice weekly by cutting 6 strips (120 m^2) per grazing area. Pasture allowance (>3.5 cm) for the 60, 80 and 120% treatments were calculated based on the IC of the 100%×6 weeks treatment. As HM was similar between treatments daily area allocations were different between treatments. Milk yield was recorded daily and milk composition was measured weekly. Data were analysed using covariate analysis and mixed models in SAS v9.3. Terms for parity, breed, allowance, duration and the interaction of allowance and duration were included. Pre-experimental values were used as covariates in the model.

Results and discussion

The mean PA for the 60, 80, 100 and 120% treatments for weeks 1 and 2 were 8.1, 10.7, 13.4 and 16.0 kg DM cow^{-1} day^{-1}, respectively (P<0.001). This resulted in post-grazing heights (PGH) of 2.6, 3.1, 3.7 and 4.2 cm, respectively (P<0.001). The mean PA and PGH during weeks 3-6 were 8.7, 11.6, 14.4, 17.5 kg DM cow^{-1} day^{-1} and 2.8, 3.3, 3.9, 4.3 cm for the 60, 80, 100 and 120% 6-week treatments. Pasture allowance and PGH for the 2-week treatment, which was grazed as a single herd during weeks 3-6, were 14.3 kg DM ha^{-1} and 3.8 cm, respectively.

During the first two weeks of the experiment the effect on milk yield of offering different PA was evident as all treatments were different to each other (P<0.001). The 60% cows had the lowest milk yield (18.5 kg cow^{-1} day^{-1}), while the 120% cows had the highest milk yield (23.1 kg cow^{-1} day^{-1}). The 80% and 100% were intermediate but different to the other two treatments and to each other (19.8 and 21.4 kg cow^{-1} day^{-1}, respectively).

There was a significant effect of the interaction between PA and duration on milk yield during weeks 3-6 (P<0.001) and weeks 7-10 (P<0.01; Table 1). Average milk yield during weeks 3-6 was similar for the 2-week treatments (22.3 kg cow^{-1} day^{-1}) indicating no carryover effect of PA. The 60×6 and 80×6 treatments were similar but lower than the 100×6 and 120×6 treatments, as expected because PA treatments were still being imposed. The 100×6 and 120×6 treatments also differed significantly from each other. During weeks 7-10 there were no differences in milk yield between the 2-week treatments (23.5 kg cow^{-1} day^{-1}). Milk yield of the 60×6 treatment was lower than the 100×6 and 120×6 treatments but was similar to the 80×6 treatment. The 80×6 treatment was similar to the 100×6 treatment but different to the 120x6 treatment. The 100×6 and 120×6 treatments were similar to each other. These effects indicated that differences in PA imposed for a 6-week period affected subsequent production. This carryover effect was not observed when treatments were applied for 2 weeks.

The four 2-week treatments had a similar cumulative 10-week milk yield (1,482 kg cow^{-1}), but cows offered 60% of IC for 6 weeks had a reduced cumulative 10-week milk yield compared with those offered 100 or 120% of IC for 6 weeks. The 80×6 treatment, while similar to the 100×6 treatment, was lower than the 120×6 treatment. Cows offered 100 or 120% of IC for 6 weeks in early lactation also had similar cumulative 10-week milk yield.

Table 1. Milk yield of early lactation dairy cows offered 1 of 4 pasture allowances for either 2 or 6 weeks.[1,2]

	60×2	80×2	100×2	120×2	60×6	80×6	100×6	120×6	SED	PA	D	PA × D
Wk 3-6 (kg day^{-1})	22.2^{a}	22.6^{ac}	21.8^{a}	22.8^{ac}	18.7^{b}	19.4^{b}	22.1^{a}	24.3^{c}	0.99	0.001	0.019	0.001
Wk 7-10 (kg day^{-1})	24.1^{ac}	24.5^{ac}	22.2^{ab}	23.1^{ac}	20.2^{b}	22.2^{ab}	23.2^{ac}	25.6^{c}	1.25	0.118	0.305	0.003
Wk 1-10 (kg)	$1,463^{ac}$	$1,509^{ac}$	$1,444^{ab}$	$1,512^{ac}$	$1,265^{b}$	$1,342^{ab}$	$1,472^{ac}$	$1,617^{c}$	65.0	0.001	0.088	0.005

[1] Pasture allowances (PA) 60, 80, 100 or 120% of intake capacity; D = duration; SED = standard error of the difference; Wk = week.

[2] 60×2; 60% of intake capacity for 2 weeks (intake capacity × duration for all treatments).

Conclusions

In early lactation, milk yield recovers immediately after short-term (i.e. 2-week) PA restrictions. Restricting PA for a 6-week period can, however, affect cumulative milk yield for at least 4 weeks after the restriction is removed.

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References

Faverdin P., Baratte C., Delagarde R., and Peyraud J.L. (2011) GrazeIn: a model of herbage intake and milk production for grazing dairy cows. 1. Prediction of intake capacity, voluntary intake and milk production during lactation. *Grass and Forage Science* 66, 29-44.

Ganche E., Delaby L., O'Donovan M., Boland T.M., and Kennedy E. (2013) Direct and carryover effect of post-grazing sward height on total lactation dairy cow performance. *Animal* 7, 1390-1400.

Hurtado-Uria C., Hennessy D., Shalloo L., Schulte R.P.O., Delaby L., and O'Connor D. (2013) Evaluation of three grass growth models to predict grass growth in Ireland. *Journal of Agricultural Science* 151, 91-104.