The effect of spring grass availability on dry matter intake of early lactation dairy cows

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Abstract
Spring grass availability has a major impact on dry matter intake (DMI) of dairy cows during early lactation. The objective of this study was to investigate the effects of opening farm cover (OFC) on DMI during early lactation. A twelve week experiment, which was split into two 6 week periods (Period 1 (Week 1 – 6) and period 2 (Week 7 – 12), was conducted over a two year period. A high and low OFC were established for two treatment groups; 1253 kg DM/ha (High grass = HG) and 887 kg DM/ha (Low grass = LG). Animals were randomly assigned to either the HG or LG treatment as they calved. Cows on the LG treatment were offered a lower daily herbage allowance (DHA) (10.99 kg DM/cow/day) and were offered silage supplementation at a rate of 3 kg DM/cow/day, while the cows on the HG treatment, were offered a higher DHA (13.98 kg DM/cow/day) with no silage supplementation. Dry matter intake was measured bi-weekly using the n-alkane technique. Silage supplementation on the LG treatment did not significantly affect ($P > 0.05$) total DMI (TDMI), however, the LG cows TDMI was lower than HG cows throughout the experimental period. The inclusion of silage in the diet of early lactation dairy cows, resulted in a significantly ($P < 0.05$) lower grass DMI, milk yield and milk protein concentration. Increasing OFC results in higher DHA which increases grass DMI and milk production.

Introduction
Increased levels of grazed grass in the diet of dairy cows in pasture based systems increases profitability (Finneran et al., 2012). Increased spring herbage availability allows for higher daily herbage allowance (DHA) which has positive effects on early lactation dry matter intake (DMI) and animal performance (Claffey et al., 2019). Intake capacity and milk production are the main drivers of DMI in dairy cows (McEvoy et al., 2009). Dry matter intake is lowest at the beginning of lactation but rapidly increases as milk production increases (Lewis et al., 2011). The diet of dairy cows during early lactation has a major impact on milk production (Kennedy et al., 2007), if animals are restricted during early lactation, it can limit milk yield and can result in a greater negative energy balance (Jouany et al., 2006; Claffey et al., 2019). Dry matter intake is the driving force of how large this energy deficit is for the first 6 weeks of lactation (McGuire et al., 2004). If grass supply is not adequate in spring, supplementation is often required to meet animal and herd demand. Grass silage is the most commonly used supplementary feed in Ireland, however, grass silage is a lower quality feed compared to grazed grass (O' Brien et al., 2018). Silage supplementation can have negative implications for grass DMI (Kennedy et al., 2008) and therefore, milk production (Kennedy et al., 2005) as overall feed quality is reduced. The objective of this study was to assess whether the diet of dairy cows during the first 12 weeks of lactation has an impact on DMI or milk production.

Materials and Methods
The experiment was undertaken over a two year period at the Teagasc, Animals and Grassland Research and Innovation Centre, Moorepark, Fermoy, Ireland. The experiment was carried out from the 1st February to 18th April in year 1 and 1st February to 24th of April in year 2. Two grazing strategies were

established in autumn 2020 and 2021 to create a high (H) and low (L) opening farm cover (OFC = amount of grass available on farm at the beginning of the grazing season) in spring 2021 and 2022. The OFC achieved in year 1 and year 2 were 1080 (H) and 800 (L) kg DM/ha and 1326 (H) and 923 (L) kg DM/ha, respectively. A total of 40 spring-calving Holstein Friesian and Holstein Friesian X Jersey cows (10 primiparous and 30 multiparous) were blocked by calving date, parity, breed, pre-experimental milk production, bodyweight and BCS in year 1 and 2. Cows were randomly assigned to one of two treatments as they calved; High grass (HG; n = 20) and low grass (LG; n = 20) and grazing began on February 1st. Cows grazed in two groups throughout the experiment; cows on the HG treatment were offered 3 kg concentrate and grazed grass made up the rest of the diet while cows on the LG treatment were offered 3 kg concentrate, 3 kg DM of silage and the rest of the diet was made up of grazed grass. Daily herbage allowance (DHA) for each group was determined using pre-grazing herbage mass (> 3.5 cm) within the allocated area (HG = 24 h and LG = 21 h) (Peyraud et al., 1996; McEvoy et al., 2008; Kennedy et al., 2011), and allocations increased when post-grazing sward height was < 3.5 cm. A new allocation of herbage was offered to both treatments after morning and evening milking, however, LG cows were offered silage supplementation indoors after morning milking for 3 h before going outside to graze. Paddocks were grazed in a rotational grazing system, and data presented is from the first (1st February) and second rotation (4th April). Back fences were used on previously grazed area to minimise damage to paddocks. The experimental period was split into two six week periods; Week 1 – week 6 = Period 1 and week 7 – week 12 = Period 2. During periods of inclement weather in period 1, the HG cows had to be housed and silage supplementation was offered, however, the difference in supplementation (+ 3 kg DM/ha) was maintained throughout the experiment. All cows received the same concentrate supplementation during the experiment; 3 kg/cow/day during period 1 and 2 kg/cow/day during period 2. Dry matter intake was measured using the N-alkane technique (Mayes et al., 1986; Dillon and Stakelum, 1989) on 6 occasions over the experimental period. Milk yields were recorded daily and milk composition weekly and bodyweight was also measured weekly. Pre-grazing herbage mass (>3.5 cm) was recorded for each paddock and pre and post-grazing sward heights were recorded daily using a rising plate meter (Jenquip rising plate meter, New Zealand). Data was analysed using PROC MIXED in SAS 9.4 (SAS Institute Inc., Cary, NC, USA, 2002). Treatment, week, period and associated interactions were included as fixed effects, week was included as a random effect and animal was used as the subject.

Results and Discussion

Treatment did not have a significant effect ($P > 0.05$) on total DMI (TDMI) in period 1 or 2. However, the LG cows TDMI was 0.57 kg DM/cow/day lower than the HG cows throughout the experiment. Previous studies have reported a greater TDMI when *ad lib* silage supplementation was offered compared to cows offered a grass only diet (Philips et al., 1985; Kennedy et al., 2011), however, cows in the current study were only offered 3 kg/cow/day, and therefore, it did not increase TDMI. There was a treatment by week interaction ($P < 0.001$) for TDMI; The HG and LG cows TDMI increased by + 1.14 and + 1.26 kg DM/cow/week, respectively. This is similar to the findings of Lewis et al. (2011) who reported that DMI increases by approximately 1 kg DM per week for the first 8 weeks of lactation, however, the DMI measured in week 1 of lactation in the current study was greater to that reported by Lewis et al., (2011), at 11.56 kg DM/cow/day compared to 9 kg DM/cow/day, respectively. The LG cows had a higher weekly increase in TDMI as their intakes were lower compared to HG cows at the beginning of lactation. The inclusion of silage significantly reduced grass DMI (GDMI) in period 1 and 2. The HG cows' GDMI was 2.1 and 4.4 kg DM/cow/day greater compared to the LG cows in period 1 and 2, respectively. This is similar to the findings of Phillips et al. (1985) and Kennedy et al. (2011) who reported that cows offered grass silage had a significantly lower GDMI.

Higher GDMI significantly ($P < 0.05$) increased milk yield and milk solids for the HG cows in period 2; +1.8 and 0.43 kg/cow/day, respectively. This is due to the higher quality and digestibility of spring grass compared to grass silage (O' Brien at al., 2018). Previous studies have reported a similar reduction

in milk yield with the inclusion of grass silage due to reduced nutritive quality (Phillips et al., 1985; Ferris and Petterson, 2005). The inclusion of grass silage also significantly reduced protein concentration in period 2 (-0.21 kg/cow/day) due to a reduction in the crude protein concentration of grass silage compared to grazed grass (Kennedy et al., 2011). Treatment did not significantly impact bodyweight (BW) during the experiment, which was not unexpected as TDMI was similar for the two groups. However, the HG cows had higher BW throughout the experimental period as HG cows were 12 and 20 kg heavier than LG cows in period 1 and 2, respectively. This is similar to previous studies who reported that cows offered a higher DHA during early lactation had higher bodyweights compared to cows offered a lower DHA (Kennedy et al., 2007, Claffey et al., 2019).

Table 1. Effect of the high grass (HG) and low grass (LG) treatment on pre-grazing herbage mass, post-grazing sward height, daily herbage allowance (DHA), grass, silage and total daily dry matter intake (DMI), milk yield and bodyweight during period 1 and 2.

	Period 1		**Period 2**				**P-Value**	
	HG	**LG**	**HG**	**LG**	**SE**	**Trt**	**Week**	**Trt*week**
Pre-grazing herbage mass (kg DM/ha)	1540	1168	2105	2041	19.00	<0.001	<0.001	<0.001
Post-grazing height (cm)	4.17	4.16	4.11	3.91	0.02	NS	NS	NS
Daily herbage allowance (kg DM/cow/day)	11.28	8.21	15.18	12.38	0.05	0.016	<0.001	<0.001
Grass DMI (kg DM/cow/day)	8.35	6.23	15.22	10.81	0.30	<0.001	<0.001	<0.001
Silage DMI (kg DM/cow/day)	2.5	4.32	0.0	3.78	0.19	0.02	<0.001	NS
Total intake (kg DM/cow/day)	13.55	13.25	17.02	16.39	0.35	NS	<0.001	<0.001
Milk Yield (kg/cow/day)	21.8	21.9	25.2	23.4	0.68	NS	<0.001	0.04
Milk Solids (kg/cow/day)	1.83	1.85	2.43	2.00	0.17	NS	<0.001	0.02
Bodyweight (kg)	495	483	499	479	9.18	NS	NS	NS

Conclusions

Silage supplementation in early lactation reduces the quality of feed offered to cows in pasture based systems. It has a negative impact on grass DMI, milk yield, milk protein concentration and milk solids yield. Increasing spring grass availability allows for greater DHA for cows during early lactation which reduces the need for silage supplementation. If silage supplementation is required to meet the herds demand during early lactation, it should be offered during the first six weeks of lactation (Period 1) as there are less negative implications on cow performance.

References

Claffey, A., Delaby, L., Galvin, N., Boland, T.M. & Egan, M., (2019). The effect of spring grass availability and grazing rotation length on the production and quality of herbage and milk in early spring. *The Journal of Agricultural Science* 157, 434–448.

Dillon, P., & Stakelum, G. (1989). Herbage and dosed alkanes as a grass measurement technique for dairy cows. *Irish Journal of Agricultural Research*, *28*, 104.

Mayes, R. W., Lamb, C. S., & Colgrove, P. M. (1986). The use of dosed and herbage n-alkanes as markers for the determination of herbage intake. *The Journal of Agricultural Science,* 107(1), 161-170.

McEvoy, M., Kennedy, E., Murphy, J. P., Boland, T. M., Delaby, L., & O' Donovan, M. (2008). The Effect of Herbage Allowance and Concentrate Supplementation on Milk Production Performance and Dry Matter Intake of Spring-Calving Dairy Cows in Early Lactation. *Journal of Dairy Science*, *91*(1), 1258-1269.

McEvoy, M., Delaby, L., Kennedy, E., Boland, T. M., & O'Donovan, M. (2009). Early lactation dairy cows: Development of equations to predict intake and milk performance at grazing. *Livestock Science*, *122*(2-3), 214-221.

McGuire, M. A., Theurer, M., Vicini, J. L., & Crooker, B. (2004). Controlling energy balance in early lactation. *Advances in Dairy Technology*, *16*, 241-252.

Ferris, C. P. & Patterson, D. C. (2005). A comparison of a full time grazing and a partial storage feeding system for dairy cows. Page 165 in F. P. O'Mara, R. J. Wilkins, L. T. Mannetje, D. K. Lovett, P. A. M. Rogers, and T. M. Boland. Proc. XXth Int. Grassld. Congress, Dublin, Ireland

Finneran, E., Crosson, P., O'Kiely, P., Shalloo, L., Forristal, D. & Wallace, M. (2012) Stochastic simulation of the cost of home-produced feeds for ruminant livestock systems. *The Journal of Agricultural Science* **150**,123–139.

Jouany, J.-P., (2006). Optimizing rumen functions in the close-up transition period and early lactation to drive dry matter intake and energy balance in cows. *Animal Reproduction Science 96*, 250–264.

Kennedy, E., O'Donovan, M., Murphy, J.-P., Delaby, L. & O'Mara, F. (2005). Effects of grass pasture and concentrate-based feeding systems for spring-calving dairy cows in early spring on performance during lactation. *Grass and Forage Science 60*, 310–318.

Kennedy, E., O'Donovan, M., O'Mara, F.P., Murphy, J.P. & Delaby, L. (2007). The Effect of Early-Lactation Feeding Strategy on the Lactation Performance of Spring-Calving Dairy Cows. *Journal of Dairy Science 90*, 3060–3070.

Kennedy, E., Curran, J., Mayes, B., Mcevoy, M., Murphy, J.P. & O'Donovan, M. (2011). Restricting dairy cow access time to pasture in early lactation: the effects on milk production, grazing behaviour and dry matter intake. *Animal 5*, 1805–1813.

Lewis, E., O'Donovan, M., Kennedy, E., O'Neill, B., & Shalloo, L. (2011). Feeding the dairy cow in spring: supplementation requirements and responses. In *Proceedings of Teagasc National Dairy Conference 'The Irish Dairy Industry: To* (pp. 71-81).

O'Brien, D., Moran, B. & Shalloo, L. (2018). A national methodology to quantify the diet of grazing dairy cows. *Journal of Dairy Science* 101, 8595–8604.

Peyraud, J., Comeron, E., Wade, M. & Lemaire, G (1996). The effect of daily herbage allowance, herbage mass and animal factors upon herbage intake by grazing dairy cows. *Annales de zootechnie*, 45 (3), pp.201-217.

Phillips, C.J.C. & Leaver, J.D., (1985). Supplementary feeding of forage to grazing dairy cows. 2. Offering grass silage in early and late season. *Grass and Forage Science 40*, 193–199.