Moorepark Dairy Levy Research Update

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Alternative Options for Dairying

Teagasc
Agriculture and Food Development Authority

Introduction

In 2005 the vast majority of the dairy co-ops agreed to an increase in the farmer funded dairy research levy. The farmer funded dairy research levy amounts to approximately to €2.70 per cow per year (approximately €120 per dairy farmer) of which 60% will be used for farm research and 40% for milk processing research. As a consequence of this Teagasc Moorepark in consultation with the dairy industry, put in place a new research programme focused on the development and dissemination of critical technologies for an internationally competitive Irish milk sector. Enhanced dairy farm profitability is the main objective of this new programme. The specific target is to reduce the overall cost of milk production by 2.5 c/litre (9p/gal) and to increase the value of milk ex-farm by 1c/litre (3.5p/gal).

Dr. Pat Dillon, Head of Centre, Moorepark DPRC

The dairy levy fund will be used to fund dairy research projects for the benefit of the Irish dairy industry. Such projects will be economically beneficial to the Irish dairy industry and would not be undertaken normally by other groups because of being too expensive or those making the investment could not capture the benefit. The priority areas for research are (i) Animal breeding and reproduction, (ii) Grassland and grazing, (iii) Milk production systems and economic analysis, (iv) Increasing milk value, (v) Dairy cow health and welfare, and (vi) Regional milk production. In conjunction with Teagasc Advisory Service, Moorepark plans to deliver this programme in collaboration with University College Dublin, the Agricultural Research Institute in Northern Ireland (Hillsborough), Irish Cattle Breeding Federation and with other research institutes abroad. Over the last twelve months a lot of progress has been achieved; identifying the critical areas of research in consultation with all the stakeholders, allocating resources and recruitment of some additional staff to deliver on the agreed programme.

This Open Day allows an opportunity for dairy farmers and the service industry to farming to discuss some of the recent developments in milk production technology with Teagasc Research and Advisory staff. The indoor session will allow an opportunity to discuss new research information relating to innovation in spring grazing management, once daily milking research and the use of extended lactations to reduce the cost of high empty rates on dairy farms. The outdoor session will include an evaluation of alternative feeds for winter feeding of spring-calving dairy cows thereby reducing both variable (feed) and fixed costs (housing, labour and machinery).

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Forage crops for winter grazing, what are the options?

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Summary

- This area of research has only just started at Moorepark and more conclusive recommendations will develop over the next number of years. The research will be considering environmental, animal welfare and cross-compliance aspects of such systems of farming.
- Crops of fodder beet, kale and swedes sown in late April to early July have the potential to produce between 10 and 20 t DM/ha, while crops like stubble turnips and rape sown in late July to mid-August have the potential to produce between 3.5 and 5 t DM/ha.
- Forage brassica crops should be strip grazed to achieve high intake per cow and to optimise crop utilisation. Crop breaks should be long and narrow rather than short and narrow so that all cows have access and minimise crop damage and trampling.
- Cattle should be allowed an adaptation period of at least one week to reduce the risk of acidosis. When feeding brassica crops to livestock, approximately one-third of the diet should be made up of either grass silage, hay or straw to increase fibre intake.
- It is important that dry cows be supplemented with iodine, selenium and copper when fed brassica crops over a long period.
- The economic benefit of growing alternative forages is very much dependent on individual farm circumstances. When housing costs are included for the indoor systems the benefit of the outdoor systems may be a 37% reduction in wintering costs.
- The lower yielding annual crops such as rape and turnips are economically viable if the land cost is low and the cost of reseeding afterwards is not attributed to the feed production costs.
- Deferred grass is economically the most attractive if the land is available at very low cost.

Introduction

The provision and feed-out of winter feed is the biggest cost in our seasonal system of milk production. One strategy to reduce the cost of winter feeding is to utilize feeds which can be grazed in-situ, thereby reducing both variable (harvesting costs) and fixed costs (housing and machinery). Perennial ryegrass, the dominant forage on livestock farms, has limitations for out of season grazing (December and January). The quantity of DM that can be accumulated for winter grazing is limited, and additionally as the quantity accumulates the quality tends to decrease. There are a variety of other crops available, which grow at lower temperatures than perennial ryegrass and can accumulate higher yields without a decline in feeding value.

The objective of this programme is to:

- Determine the impact of agronomic factors on the yield and quality of a range of forages that can be grazed in-situ.
- Quantify the impact of in-situ winter grazing of crops on animal welfare and devise strategies to minimize any negative effect.
- Quantify the impact of in-situ winter grazing of crops on environmental parameters such as nitrate leaching and devise strategies to minimize any negative effect.

The final part of the project will include an economic assessment of the integration of such crops on a whole farm basis.

What are the options?

Crops such as swedes, kale, rape, turnips, forage cereals and short rotation grasses are options. Forage brassicas such as swedes, kale, turnips and rape are used extensively in other grass based dairy and beef industries as a source of cheap, high quality, out of season feed that can be utilized in-situ. Swedes and kale are full season biennial crops usually sown from mid-May to mid-July. The earlier they are sown the higher the utilizable yield. These crops can be grazed from November through to March. The crops of kale and swedes that the cows are currently grazing were sown on June 4 after harvesting a crop of silage. They were sown following ploughing by a one-pass-seeding system.

Rape and stubble turnips are annual crops that need to be sown later than swedes and kale for use during the November to March period. They have a lower yield than either swedes or kale. Rape or stubble turnips offer the advantage of being sown after harvesting cereals in August and therefore provide a low cost winter feed from tillage ground. Although other crops such as short-term ryegrasses and grazed cereals such as forage oats, rye and triticale can be used in a similar manner to brassicas, there is very little information available on their potential in Ireland. There are however, new research programmes in Moorepark evaluating the potential of all these crops.

Forage brassicas were used extensively in Ireland up to the 1960s but began to decline with the introduction and mechanisation of grass conservation. They declined more rapidly in the 1990s following the introduction of area based payments on alternative options such as maize silage and whole crop cereals. Irish technology for growing and utilising brassicas is now lagging behind some of the other grazing based dairy industries such as Australia and New Zealand.

Guidelines on feeding brassicas to cows

Utilisation of forage brassicas

Forage brassica crops are usually strip grazed to achieve high feed intakes and to optimise crop utilisation. Crop 'breaks' should be long and narrow rather than short and wide, so that all cows can have access to the fresh break, and trampling is kept to a minimum. The sowing rate used can influence the crop utilisation. A light sowing rate promotes thicker stems and potentially poor utilisation. A high sowing rate may decrease the proportion of leaf relative to stems. Recommended sowing rates for kale and forage rape crops are 3.5 to 4 kg/ha. For swede crops, recommended sowing rates vary according to method of sowing (ranging from 0.5 to 1.5 kg/ha for direct drill and broadcast respectively).

Feed the right amount of brassicas to cattle

Poor performance by cattle on brassicas is often as a result of overestimating total quantities of feed on offer and/or overestimating crop utilisation. Calculate how much energy each cow requires and take crop cuts to calculate amounts of brassica available per hectare. The most important decision to make when break feeding is the amount of fresh matter offered to the herd each day (i.e. size of the 'break'). Getting the break size too small leads to underfeeding (loss of body condition), while a break size too large will lead to overfeeding and poor utilisation of crop.

Adapt cows gradually to brassica crops over at least one week

This allows adaptation by rumen microbes to the new diet and reduces the risk of other problems, including acidosis. Monitor cows closely during the adaptation period and remove poor performing cows from the herd.

Don't feed brassicas as 100% of the diet

Cattle fed 100% brassicas will not have enough neutral detergent fibre (NDF) in the diet, putting them at risk of rumen acidosis. Effective NDF is defined as NDF present in a physical form that stimulates chewing and therefore rumination. Usually when feeding to livestock, two thirds of the diet is made up of brassicas and the remainder is made up of either round bales of haleage (high dry matter grass silage) or straw. This is an essential part of the diet to provide adequate fibre and reduce digestive upsets. The round bales of straw or haleage can be placed in the field and spaced at regular intervals to allow utilization during the winter while the crop is being strip-grazed without the bales having to be moved.

Mineral supplementation

Dry cows eating winter brassica crops may suffer from either primary iodine deficiency (not enough iodine in the feed) and/or secondary iodine deficiencies (caused by compounds called goitrogens blocking the uptake of iodine by the thyroid gland). In the absence of goitrogens, 0.5 mg iodine/kg DM is considered sufficient to meet the iodine requirements of all ruminants but, in the presence of goitrogens, iodine requirements may increase to 2 mg iodine/kg DM intake. Iodine deficiency may extend the duration of pregnancy and increase risk of stillbirths and poor viability of newborn stock. Typical supplementation rates are 15-25 mg iodine/cow/day, however, check with your veterinarian or nutritionist for rates suitable for your situation.

Copper deficiency may also be seen in cattle that are fed brassicas for prolonged periods of time. Pregnant cows in late gestation are at particular risk of copper deficiency because the calf preferentially accumulates liver copper reserves during the last few weeks of pregnancy. Brassicas contain low concentrations of copper, typically ranging from 3-8 mg/kg DM. High sulphur levels in brassicas further challenge uptake of copper from the gut. Copper status may be 'topped up' at drying off with the use of copper injections or oral copper 'bullets'. Again, follow the advice of your veterinarian or nutritionist.

Costs of alternative feeds

The costs associated with the provision and feed-out of winter feed for a spring calving herd over the dry cow period were compared using 10 alternative wintering strategies. Three systems entailed the housing of animals (feeding of maize silage, grass silage and whole crop wheat), while seven entailed out-wintering systems, grazing in-situ (fodder beet, kale, swedes, westerwolds, stubble turnips, deferred grass and rape) requiring no housing. Where included, the costs associated with slurry storage were included in all systems as it is a requirement under the Nitrates Directive.
Yield and utilisation assumptions were based on on-going experiments carried out in Moorepark and other research centres nationally and internationally. The analysis was carried out for seven different scenarios.

- Scenario A: Feed costs per cow per week excluding a land reseeding charge post crop removal i.e. the crop is built into a reseeding program or is grown on tillage ground.
- Scenario B: Similar to A but with a reseeding cost included in the analysis.
- Scenario C: Similar to A but with no land charge included in the analysis.
- Scenario D: Similar to A but with a labour cost for all scenarios and a slurry spreading cost in the systems where the animals are kept indoors included.
- Scenario E: Similar to D but with costs of full conventional housing and slurry storage for the indoor treatments and slurry storage alone for the outdoor treatments included.
- Scenario F: Similar to D but with the conventional housing and slurry storage receiving grant aid of 60% of the construction costs.
- Scenario G: Similar to D but with low cost housing and slurry storage included in the analysis.

Table 1 shows the assumptions used in the economic analysis of the wintering systems. The opportunity cost of land was assumed to be €262/ha. The amount varied for each system as shown in **Table 2** (due to the proportion of the year allocated to the crop). Fertiliser and reseeding costs are based on the most up to date figures available. Baled silage is included in the diet where forage crops are fed at a cost of €20 per bale and is included in the feed budget at 3 kg DM per day. Housing construction costs are included in the analysis based on a net cost to the farmer of €1,900, €800, €760, €320, €250 and €125 per cow, for conventional housing, conventional slurry storage, conventional housing with a grant, conventional slurry storage with a grant, low cost housing, and low cost slurry storage, respectively.
The slurry spreading (€0.5) and labour costs (€1.6) were €2.1/cow/week for the cows that were housed and €1.6/cow/week for labour for the cows on the forage crops (Table2).

Economic conclusions

The economic benefit of growing alternative forages is very much dependent on individual farm circumstances. In almost all scenarios the cheapest wintering systems are based on the higher yielding crops such as swedes, kale and fodder beet. However, where the full costs of annual reseeding are included, fodder beet is the only alternative that is cheaper than grass silage (Scenario B). When housing costs are included for the indoor systems, the benefit to the outdoor systems is up to a 37% reduction in wintering costs (Scenarios E, F, G). The lower yielding annual crops such as rape and turnips are economically viable if the land cost is low and the cost of reseeding afterwards is not attributed to the feed production costs. Deferred grass is economically the most attractive if the land is available at very low cost (Scenario C).

The analysis shown compares the costs of different systems on a weekly basis. To demonstrate the annual effects of the wintering systems on farm profitability, kale and two cut grass silage are compared in scenario A (no reseeding) on a 100 cow herd over a twelve week winter to determine the over all difference in farm costs between the treatments. The weekly cost of kale and two cut grass silage is €6.5 and €7.5, which in a 100 cow herd would amount to €650 and €750, respectively. Therefore over a 12 week winter the costs would be €7,800 and €9,000 for the kale and the two cut grass silage, respectively, showing a saving of €1,200 for the kale over the two cut grass silage. These annual calculations can be completed for all the scenarios for all the wintering systems.

Table 1: Assumptions used in the analysis

	Default	
Opportunity cost of land (€/ha)	262	
Fertilizer (€/kg)	N= 0.66, P= 1.26 and K= 0.37	
Reseeding costs (€/ha)	450	
Baled silage cost (€/bale)	20	
Conventional housing (€/cow/week)	No grant 8.9	With grant 3.5
Conventional slurry storage (€/cow/week)	No grant 3.6	With grant 1.6
Low cost housing (€/cow/week)	1.4	
Low cost slurry storage (€/cow/week)	0.7	
Cow weight (kg)	600	

Table 2: Winter feed and accommodation costs for 10 alternative wintering strategies (weekly)

Scenario	Maize silage	Grass silage	Wholecrop wheat	Fodder beet grazed	Kale	Swedes	Annual ryegrass	Turnips	Deferred grass	Rape
Yield (t DM/ha)	15.5	10.5	10	18	10	12	3	5	2.8	4.2
Proportion utilized	0.82	0.75	0.9	0.7	0.7	0.7	0.7	0.7	0.6	0.70
UFL/kg DM	0.80	0.772	0.64	1.12	1.05	1.12	0.95	1.12	0.85	1.05
Materials and contractor €/ha	1,165	606	857	873	338	557	260	319	61	329
Proportion of land charge included	1.0	0.7	0.7	1.0	1.0	1.0	0.4	0.4	0.4	0.4
Wintering capacity per ha (cows)	16.2	9.7	9.2	29.2	15.2	19.0	3.0	8.1	2.1	6.4
Land charge (€)	262	183	175	262	262	262	105	105	105	105
All other costs (€/ha)	312	218	208	312	312	312	125	125	125	125
Total cost per hectare (€)	1,477	824	1,065	1,185	650	869	384	444	185	454
A Feed costs per cow per week (€)	8.0	7.5	10.2	6.4	6.5	6.7	11.3	7.6	7.6	9.0
B Feed costs (full reseeding €/week)	10.5	8.1	14.6	7.7	9.2	8.8	24.8	12.6	11.4	15.3
C Feed costs (no land charge €/week)	6.6	5.8	8.5	5.6	5.0	5.5	8.2	6.5	3.3	7.6
D Total costs/cow/week excluding housing costs (€)	10.1	9.6	12.3	8.0	8.1	8.3	12.9	9.2	9.2	10.6
E Total costs/cow/week including conventional housing (€)	19.0	18.4	21.2	11.6	11.7	11.9	16.5	12.8	12.8	14.2
F Total costs/cow/week including conventional housing less grant (€)	13.6	13.1	15.8	9.6	9.8	9.9	14.5	10.8	10.8	12.2
G Total costs/cow/week including low cost housing (€)	11.5	11.0	13.7	8.7	8.8	9.0	13.6	9.9	9.9	11.3

Extending the grazing season in the autumn and winter

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Summary

- Swards for grazing during winter (November to February) should have approximately 2.0-2.5 t DM/ha, with 65-70% green leaf content.
- Optinum autumn closing dates for winter grazing vary across the country.
- To provide grass for winter grazing in the Moorepark region:
    - Swards should be rested from early September for grass in late November.
    - Swards should be rested from mid to late September for grass in December and January.
    - Swards should be rested from early October for grass in February.
- To provide grass for winter grazing in the Grange region:
    - Autumn closing dates are approximately three weeks earlier than in the Moorepark region.
    - Swards should be rested from late August for grass in late November.
    - Swards should be rested from early September for grass in December and January.
    - Swards should be rested from late September for grass in February.
- Swards containing 65-70% green leaf material will have 72%+ DMD.
- The effect of winter grazing on spring growth is variable.
    - At Moorepark, swards closed on October 10 had 0.4t DM/ha more in early April than those closed on August 10. Delaying winter grazing from November 20 to February 20 resulted in an average decrease in DM yield of 0.9 t DM/ha in early April (with paddocks closed in August/September).
    - At Grange, there was no significant effect of autumn closing date and winter grazing date on subsequent DM yield in early April.
- The provision of herbage for winter grazing is possible, however, its utilisation may be challenging due to weather conditions and soil type.
- Flexibility within the system is necessary to ensure that damage to pastures is not significant.

Introduction

Grazed grass is the cheapest feed source for milk production in Ireland. Grass is traditionally the sole source of feed for dairy cows from April to October/November, with silage (grass and/or other) and concentrates being fed during the other months of the year. Grass growth is highly seasonal with a peak occurring in May/June and little or no growth from November to February. As a result of this seasonality, there is inadequate grass growth from

November to March to meet daily feed demand on dairy farms with moderate to high stocking rates (2.2 to 2.5 LU ha^{-1}). On dairy farms, with low stocking rates (2 LU ha^{-1}), there is potential to defer some of the grass grown in the autumn for grazing during late autumn and winter (November to February). One way of achieving this is to increase rotation length in late summer and autumn, when herbage availability is likely to exceed demand, and defer the grazing of this grass until the winter.

Providing grass for winter grazing

A study was undertaken at Teagasc Moorepark and Grange to examine the effects of autumn closing and winter grazing dates on winter and spring DM yield. There were four autumn closing dates (August 10, September 1, September 20 and October 10) and four winter grazing dates (November 20, December 20, January 20 and February 20). Swards were then grazed every four weeks from early April until mid-July. Pre-grazing DM yield was measured on each autumn closing date, each winter grazing date and at each grazing from April to July. Sward composition (proportion of leaf, stem and dead material) was measured on each winter grazing date. Winter pre-grazing pasture was analysed for crude protein content and DMD.

Winter DM yield

The results suggest that the optimum yield to carry into the winter is approximately 2-2.5 t DM/ha; carrying greater yields will result in excessive losses of DM over the winter period. Swards with approximately 2.0 t DM/ha will have 65-70% green leaf material, i.e., 1.3-1.4 t green leaf DM/ha. To achieve these yields, optinum autumn closing dates vary from south to north. To provide grass for winter grazing in the Moorepark region, swards should be rested from early September for grass in late November, rested from mid to late September for grass in December and January, and rested from early October for grass in February. To provide grass for winter grazing in the Grange region, autumn closing dates are approximately three weeks earlier than in the Moorepark region; late August for grass in late November, early September for grass in December and January, and rested from late September for grass in February. Swards closed on October 10 at Moorepark had pre-grazing DM yields of 1.32 t DM/ha on November 20, compared to only 0.65 t DM/ha at Grange. By late February there was 1.58 t DM/ha available for grazing at Moorepark but only 0.81 t DM/ha at Grange on these swards.

Most of the DM yield present in the sward during the winter is carried over from the autumn as there is little or no grass growth during the winter. Swards with high herbage mass at the start of the winter will lose DM yield as the winter progresses. This is because leaf death is faster than new leaf growth. Swards closed before mid-September at Moorepark and before the start of September at Grange will lose 50% of their November yield by February. On these swards DM yield decreases by between 15 and 20 kg DM/ha/day at Grange and Moorepark, respectively, for each days delay in grazing from November 20 to February 20. Green leaf content decreases over the winter, as leaf death occurs on swards closed in early autumn, to approximately 50% by late February.

Table 1: Average winter DM yield and green leaf content of swards closed on one of four dates in autumn and grazed on one of four dates during winter at Moorepark

	Winter DM Yield (t DM/ha)				Green leaf (proportion of DM yield)			
	20-Nov	20-Dec	20-Jan	20-Feb	20-Nov	20-Dec	20-Jan	20-Feb
10 August	3.96	2.60	2.09	1.98	0.38	0.40	0.40	0.44
01 September	3.38	1.99	1.66	1.49	0.46	0.44	0.54	0.50
20 September	2.46	1.97	1.72	1.75	0.69	0.60	0.57	0.58
10 October	1.32	1.57	1.34	1.58	0.79	0.66	0.74	0.65

Table 2 : Average winter DM yield and green leaf content of swards closed on one of four dates in autumn and grazed on one of four dates during winter at Grange

	Winter DM Yield (t DM/ha)				Green leaf (proportion of DM yield)			
	20-Nov	20-Dec	20-Jan	20-Feb	20-Nov	20-Dec	20-Jan	20-Feb
10 August	3.21	2.65	2.27	1.75	0.61	0.51	0.44	0.44
01 September	2.53	2.45	1.91	1.44	0.67	0.60	0.53	0.48
20 September	1.55	1.80	1.43	1.14	0.84	0.72	0.68	0.65
10 October	0.65	0.99	0.76	0.81	0.84	0.80	0.77	0.77

Crude protein and dry matter digestibility

In general, the crude protein content of autumn grown grass grazed during the winter is high. Grass on swards closed on optinum autumn closing dates at Moorepark (September 20 to October 10) and at Grange (September 1 to 20) had an average crude protein content of 24% over the winter (Table 3). This is higher than the average crude protein in silage in Ireland (14.5%).

Table 3: Mean winter crude protein content (g/kg DM) of grass on swards closed on one of four dates in autumn and grazed on one of four dates during winter at Moorepark and Grange

	Moorepark				Grange			
	20-Nov	20-Dec	20-Jan	20-Feb	20-Nov	20-Dec	20-Jan	20-Feb
10 August	189	213	219	225	210	220	217	224
01 September	213	236	236	233	231	234	245	230
20 September	220	226	238	245	254	244	255	243
10 October	235	227	251	242	262	250	269	246

Dry matter digestibility (DMD) of swards decreased over the winter especially on those with very early autumn closing dates and delayed winter grazing. However, average DMD of swards closed on optinum autumn closing dates at Moorepark (September 20 to October 10) and at Grange (September 1 to 20) had an average DMD of 74% over the winter (Table 4).

Table 4 : Mean winter DMD (g/kg DM) of grass on swards closed on one of four dates in autumn and grazed on one of four dates during winter at Moorepark and Grange

	Moorepark				Grange			
	20-Nov	20-Dec	20-Jan	20-Feb	20-Nov	20-Dec	20-Jan	20-Feb
10 August	725	656	656	658	715	662	627	631
01 September	759	685	681	719	740	700	675	681
20 September	803	732	715	775	791	741	737	735
10 October	809	732	725	770	769	728	760	756

Effect of winter grazing on early spring grass DM yield

Early spring DM yield was only affected by autumn closing date and winter grazing date at Moorepark. There were no effects on spring DM yield at Grange (Table 5). Swards closed on October 10 at Moorepark had 0.4t DM/ha more in early April than those closed on August 10. Delaying winter grazing from November 20 to February 20 resulted in an average decrease in DM yield of 0.9t DM/ha in early April at Moorepark (with paddocks closed in August/September).

Table 5 : Average spring (early April) DM yield (t DM/ha) on swards closed on one of four dates in autumn and grazed on one of four dates during winter at Moorepark and at Grange

	Moorepark				Grange			
	20-Nov	20-Dec	20-Jan	20-Feb	20-Nov	20-Dec	20-Jan	20-Feb
10 August	1.8	1.3	0.9	0.9	0.6	0.6	0.5	0.8
01 September	1.9	1.1	0.9	1.1	0.7	0.6	0.5	0.6
20 September	2.1	1.5	1.1	1.1	0.6	0.6	0.6	0.7
10 October	2.1	1.4	1.4	1.3	0.6	0.6	0.6	0.6

Grazing management

Planning to provide grass for winter grazing has to begin in late August at Grange and early September at Moorepark. Swards should be closed in the order in which they will be grazed during the winter to help avoid large loss of DM yield, accumulations of dead material, reductions in DMD and reductions in spring growth. Winter grazed swards will be last grazed in the first rotation in spring. It is also important to manage the remainder of the grassland area to ensure adequate grass is available in early spring.

Although the provision of herbage for winter grazing is possible, utilisation may be challenging due to weather conditions, especially rainfall, and soil type. In wet conditions, and heavy soil types, utilisation may be as low as 50%, but in dry weather, with good underfoot conditions, up to 80% utilisation may be achieved, particularly in swards with 70%+ green leaf content. Depending on climatic and soil conditions, grazing between November and February with heavy animals, e.g., dairy cows and fattening cattle, may not be feasible in all parts of the country. However, grazing lighter animals, e.g., weanlings, over the winter is possible. Winter herbage should be strip grazed so that daily herbage allowances can be rationed. Back fencing should be used to minimise damage to the sward. Flexibility within the system is necessary to ensure that damage to pastures is not significant. A reseeding cost should also be included in the economic assessment of the value of winter grazing as some swards may require reseeding to ensure optimum productivity during the subsequent grazing season.

Early spring grazing management

Michael O'Donovan and Emer Kennedy

Summary

- For early spring grazing a farm cover of 650-700kg DM/ha should be targeted at turnout. The available grass cover should be budgeted to finish the first rotation between April 10 and 20 with a farm cover of >750kg DM/ha.
- A response of approximately 15 kg DM/kg N can be expected from Nitrogen applied in mid to late January in southern parts of the country.
- Cows outdoors from mid February to early April offered a 80:20 grazed grass concentrate diet produced similar milk yield with higher protein yield and content compared to cows offered a 40:60 grass silage concentrate diet indoors.
- In rotation 1, a daily herbage allowance of 13 kg DM/cow/day (with 2 to 4 kg concentrate supplementation) allowed high milk production performance. In subsequent rotations, daily herbage allowance must be increased in line with increased herd intake requirement to achieve high animal "production performance" through lactation.
- Early grazed swards had similar grass growth potential compared to later grazed swards, but were capable of sustaining higher milk yields and grass intake in subsequent grazing rotations due to higher sward quality.
- A feed budget (grazing strategy) should be planned and updated regularly to facilitate grass demand (grazing stocking rate and daily herbage allowance) and monitor supply (farm cover and grass growth) throughout the spring period.
- When modelled on a whole farm basis, early grazing will generate an increased profit of €2.70 /cow/day for each extra day at grass. This is achieved through higher animal performance with a lower feed cost.

Introduction

The spring calving cow's diet in early lactation can be made up of grazed grass, grass silage, maize silage or concentrate. Grazed grass is the cheapest of these feeds. Additionally, in recent years the cost of grass silage has increased relative to grazed grass. A number of studies have also shown that grazed grass is superior in feeding value compared to grass silage in terms of milk production and protein content. At a stocking rate of 2.5 cows/ha (1 cow/ac) a daily grass growth rate of greater than 40kg DM/ha/day is required to adequately feed a herd of cows offered grass only. In most areas of Ireland this growth rate will not be reached until mid to late April. Therefore, the primary grazing management objective up until mid-April is to provide access to grazed grass for lactating cows as early as possible and to budget the available grass until grass growth increases sufficiently to meet daily herd demand. Two studies were carried out at Moorepark during the 2004 and 2005 spring period to quantify the benefit of including grazed grass in the diet of early spring calving dairy cows immediately post-calving and establish the response to both grass allowance and concentrate supplementation.

Benefit of early turnout to pasture in spring

The objective of this research was to quantify the benefit of turning freshly calved dairy cows, to grass full-time on a low level of concentrate supplementation in early February compared to cows that remained indoors full-time for seven weeks, on ad-lib grass silage plus a high level of concentrate supplementation. A herd of 64 spring-calving Holstein-Friesian dairy cows (mean calving date, February 2) were allocated to one of these two feeding systems between February 16 and April 4, 2004. Over the seven week period the cows on the early spring grazing system were offered a daily grass allowance of 15 kg DM plus 3 kg of concentrates, while the cows in the indoor feeding system were offered a complete diet of 40% grass silage (8.6 kg DM/cow/day) and 60% concentrate feed (11.1 kg DM/cow/day). Table 1 shows the milk production/composition and intake of the two groups of cows from February 16 to April 4. There was no difference in milk yield (28.3 vs. 27.3 kg/day) between the two systems but the cows from the early spring grazing system produced milk of lower fat content (38.6 vs. 41.6 g/kg) and higher protein content (33.6 vs. 30.7 g/kg) compared to the cows in the indoor feeding system. The cows in both feeding systems achieved similar total DM intakes (measured during the sixth week of the study) at approximately 15.5 kg DM/cow/day, while, there were large differences in the composition of the diets (Table 1). Feeding system had no significant effect on live-weight gain or condition score, however the cows on the indoor feeding system were on average 18 kg heavier in early April.

The cows on the early spring grazing system continued to maintain a higher milk protein concentration and higher grass dry matter intake than the cows on the indoor feeding system into the months of June and July.

The results of this study highlight the large benefits (both nutritionally and financially) of including grazed grass in the diet of spring calving dairy cows in early lactation. When modelled on a whole farm basis, early grazing will generate an increased profitability of €2.70 /cow/day for each extra day at grass, through higher animal performance and lower feed cost.

Table 1: The effect of system (early spring grazing; indoor feeding) on the milk production/performance of spring-calving dairy cows in early lactation

	Early spring grazing	Indoor feeding
Milk yield (kg/day)	28.3	27.3
Milk fat concentration (g/kg)	38.6	41.6
Milk protein concentration (g/kg)	33.6	30.7
SCM yield (kg/day)	26.6	25.9
Live weight (kg)	498.9	517.2
Liveweight gain (kg/day)	+0.20	+0.03
Body condition score	2.87	2.92
Intake (kg DM/cow/day)		
Grass	12.9	-
Silage	-	5.7
Concentrates	2.8	9.6
Total intake	15.7	15.3

Benefit of early grazing in spring on grass DM production, sward quality and milk production potential in the late spring /early summer period

The objective of this study was to evaluate the milk production potential achievable from swards with an early and a delayed spring grazing. Two swards were established, one that was previously grazed once from February 16 until April 4 and the other had not been grazed since the previous October/ November. This study commenced on April 12 and continued until July 3 during which four 21 day rotations were completed. The cows were on grass only for the duration of the experiment. Each of the swards were grazed at two stocking rates, 5.5 and 4.5 cows/ha on the early grazed swards, and 5.9 and 5.5 cows/ha on the late grazed swards. The grass intake and milk production results are presented in Table 2.

Table 2 : Effect of initial grazing date and stocking rate on milk yield and composition from mid-April to early July

	Early grazed swards		Late grazed swards	
Stocking rate (cows/ha)	5.50	4.50	5.90	5.50
Grass intake (kg DM/cow/day)	16.30	17.50	15.20	16.70
Milk production				
Milk yield (kg/day)	22.70	24.50	20.90	22.40
Fat (%)	3.89	3.78	4.00	3.78
Protein (%)	3.29	3.41	3.21	3.27

The cows on the early grazed swards at a stocking rate of 4.5 cows/ha achieved the highest yield of milk, fat and protein, highest protein content and grass matter intake. There was no difference in animal performance between the cows grazing the early and late grazed swards stocked at 5.5 cows/ha, even though the early grazed swards had already been grazed once that spring. The results of the present study suggest that swards grazed early in spring have increased milk production, grass DM intake and herbage utilisation potential in early summer.

Effect of daily herbage allowance and concentrate level on the milk production performance of spring calving cows in spring

The objective of this study was to establish the milk production responses of spring calving dairy cows in early lactation to daily herbage allowance (>4cm) and concentrate supplementation level. On February 21, 2005, 66 spring calving dairy cows (30 first lactation and 36 greater than first lactation) in early lactation (mean calving date – February 7) were randomly assigned to six treatment groups. The treatment groups included three herbage allowances (13, 16, and 19 kg DM/cow/day >4cm) and two concentrate supplementation levels (0 and 4 kg of concentrate supplementation daily). The cows continued on treatment from February 21 to April 10.

<u>The six treatments were (on a daily basis)</u>
Daily grass allowance of 13 kg DM/cow plus 0 kg conc. (L0)
Daily grass allowance of 13 kg DM/cow plus 4 kg conc. (L4)
Daily grass allowance of 16 kg DM/cow plus 0 kg conc. (M0)
Daily grass allowance of 16 kg DM/cow plus 4 kg conc. (M4)
Daily grass allowance of 19 kg DM/cow plus 0 kg conc. (H0)
Daily grass allowance of 19 kg DM/cow plus 4 kg conc. (H4)

The average pre-grazing yield was 1,896kg DM/ha (>4cm). Mean pre-grazing sward height was 12.1cm, while post grazing sward height was 3.3, 3.7, 4.0, 4.5, 4.7 and 5.2cm, for the L0, L4, M0, M4, H0 and H4 treatments, respectively. The mean grazing area allocation for the low daily grass allowance (13.0 kg DM/ha), medium daily grass allowance (16.0 kg DM/ha) and high daily grass allowance (19.0 kg DM/ha) groups was 817, 951, 1177 m^2/cow/day. This equates to a stocking rate of 2.2, 2.6 and 3.0 cows/ha, respectively, during the first rotation.

Herds offered both medium and high levels of daily grass allowance/cow had a higher milk yield, protein yield and bodyweight (Table 3). Concentrate supplementation had a positive effect on milk (28.8 vs. 25.4 kg cow/day), solid corrected milk (26.3 vs. 22.5kg cow/day), fat (1,108 vs. 1,022 g/day), protein (942 vs. 835g/day) and lactose yield (1,418 vs. 1,222g/day), lactose content (49.3 vs. 48.3g/kg) and bodyweight (501 vs. 494kg).

Table 3 : The effect of daily herbage allowance and supplementation level on dairy cow milk production in early spring (February 21–April 10)

	13 kg DM	16 kg DM	19 kg DM	0-Conc.	4-Conc.
Milk yield (kg)	26.4	27.3	27.6	25.4	28.8
Fat content (g/kg)	39.6	40.0	38.4	40.0	38.7
Protein content (g/kg)	32.6	33.2	33.0	32.7	33.2
Lactose content (g/kg)	48.8	48.9	48.7	48.3	49.3
Bodyweight (kg)	489.0	498.0	505.0	494.0	501.0

During the early grazing season (February-April) a balance must be found between feeding the cow adequately to sustain high animal performance and conditioning the sward for late spring/summer grazing. In the first rotation, allocating a low daily herbage allowance had no effect on animal production. In subsequent rotations, daily herbage allowance needs to be increased in line with animal feed demand, without compromising the post grazing residuals. The response to concentrate supplementation in early lactation was high and stimulated higher milk production levels for the remainder of lactation.

The provision of early spring grass

Closing date in the autumn, timing and level of spring nitrogen are the two most important management factors influencing the supply of grass in early spring. Date of initial spring nitrogen application will largely depend on location and soil type. On free draining soils in the south of Ireland initial spring nitrogen application should commence from mid to late January. The optimum date for initial spring nitrogen in the midlands is early/mid February, while further north it is late February. A recent three year study at Moorepark obtained a response of 16kg DM/kg N in early March to nitrogen applied in mid January. The initial application should be applied at a rate of 30 kg N/ha, with a second application of 30 to 50 kg N/ha in early March depending on grass requirement. Urea is just as effective as CAN for early grass, with the advantage that it is less prone to leaching and has a lower cost per unit.

The management of early spring grass

Farm specific factors requiring consideration when making grazing decisions at this time of the year include: grass cover, stocking rate, spring growth rates, calving pattern. Table 4 illustrates key target grass covers for a farm stocked at 2.5 cows/ha, with a mean calving date of February 10 and a grazing season beginning in early February. The targets described are based on the entire grazing area being available in early spring with first cut silage taken on 40% of the farm from silage ground closed from April 10. This example is based on a calving pattern of 36% calved by February 14, 70% calved by March 1 and 90% calved by March 14.

Table 4 : Target grass covers for spring

Date	Stocking rate (LU/ha)	Target average farm cover kg DM/ha	Target cover per cow kg DM/cow	Event
20 January	-	600	-	Opening spring cover
07 February	2.0	660	331	Cows out to grass by day
14 March	2.6	880	342	Cows out full time
09 May	4.2	990	236	Supply exceeds demand

The aim at this period is to maximise the amount of grazed grass in the cows' diet while at the same time having a farm grass cover of >900 kg DM/ha by late April. With very variable spring grass growth rates, weekly monitoring will be required and decisive action must be taken in order to achieve these targets. At Moorepark, early grazing is further facilitated by grazing a proportion of silage ground twice (immediately at turnout and again in early April) before closing this area for silage. During the first rotation, paddocks must be grazed out to a target post-grazing height of 4.5cm. This grazing severity can be achieved comfortably without detriment to animal performance when cows are supplemented with 2-4kg of concentrate DM. This ensures high quality regrowth will be available for the subsequent rotations including the breeding season (April 20 to July 15).

The following key targets should be used during the spring:

- A farm cover >600 kg DM/ha in mid January (with paddocks closed in rotation from mid October the previous autumn).
- A feed budget (grazing strategy) should be planned and updated regularly to facilitate grass demand (grazing stocking rate and daily herbage allowance) and monitor supply (farm cover and grass growth) throughout the spring period.
- The available grass supply should be budgeted with the first grazing rotation finishing between April 10 and 20.
- Target post-grazing height of 4.5cm ensuring high grass utilisation.
- Good grazing management practices such as block grazing and a good farm road network will reduce the risk of soil damage during this period.
- Grazing management must be flexible during this period, on/off grazing can be successfully used as a method of reducing soil damage during periods of excessive rainfall.

Milking routine modifications to reduce labour input

Bernadette O'Brien and David Gleeson

Summary

- **Once daily milking throughout lactation**
  - Reduced lactation milk yield by 26% (4,437 versus 6,013 kg/cow) and milk solids by 20% (351 versus 437 kg/cow) in 2004.
  - Reduced first lactation heifer milk yield by 31% (2,664 versus 3,870 kg/cow) and milk solids by 27% (206 versus 284 kg/cow) in 2005.
  - Had no significant effect on SCC levels.
  - Improved live-weight and body condition score at end of lactation.
  - Results suggest improved reproductive performance in 2004 and similar trends in 2005.
  - This study requires to be repeated over a number of years.

- **Milking intervals of 16:8h and 12:12h were compared for a four week period (April 16 to May 14)**
  - Daily milk production, milk protein and lactose contents and SCC level of milk from cows was similar for both 16:8h and 12:12h milking interval.
  - Milk fat content was reduced (-0.17%) with the 12:12h interval.

- **Once daily milking at end of lactation**
  - Reduced milk yield by 29%.
  - Increased milk fat concentration by 0.43%.
  - Increased milk protein concentration by 0.29%.
  - No effect on milk lactose concentration or SCC level.

- **Thirteen times weekly milking (omitting the Sunday evening milking) compared to twice daily milking every day**
  - Had no effect on milk yield or composition.
  - Maximum SCC observed during the trial was 270×10^3 cells/ml.

Introduction

The milking process accounts for more than one-third of daily labour input in a dairy enterprise. Additionally, the milking task is normally undertaken over a minimum of ten months of the year. Thus, modifications to the milking process routine could have a significant impact on reducing time spent at milking. There are different mechanisms by which labour associated with the milking process may be reduced. Milking cows twice a day is a time-constraining task for dairy farmers. Once a day milking may offer a major opportunity to improve labour output and reduce costs. If once daily milking was proven as a satisfactory alternative to the normal twice daily milking regime, reduced milking frequency could have the following potential benefits for different sectors of dairy farmers: (i) increased labour productivity and reduced costs (including that of hired labour); (ii) permit the uptake of alternative employment or alternative business interests; (iii) improved management of large herds in terms of milking time and cow walking distance on fragmented land bases; (iv) ease of work in terms of ergonomics, together with shorter time input to the dairying operation; and (vi) an easier lifestyle. However, such a potential alternative system should be critically examined from both management and economic viewpoints. Other milking routine modifications to reduce labour input may include once daily milking at the end of lactation, 13-times weekly milking (omitting Sunday evening milking from mid-lactation onwards) or changing milking interval from a 12:12h to a 16:8h interval.

Once daily milking throughout lactation

In 2004, sixty spring-calving, pluriparous (greater than first lactation) Holstein-Friesian cows were assigned to an arrangement of treatments after calving; twice a day (TAD) milking on a high or low nutrition level; once a day (OAD) milking on a high or low nutrition levels. High and low nutrition levels were defined by concentrate offered while cows were indoors on grass silage after calving (7 and 4 kg, respectively), by a combination of concentrate offered (4 and 1 kg, respectively) and post-grazing height (75 and 55 mm, respectively) during the first 26 days at pasture (March 22 to April 16), by post-grazing height (75 and 55 mm, respectively), during the main grazing season (April 17 to October 2), and by a combination of concentrate offered (3 and 1 kg, respectively) and post-grazing height (75 and 55 mm, respectively) during the late grazing period (October 3 to November 27). Cows on the high and low nutrition levels received a total of 420 kg and 137 kg of concentrate per cow, respectively, throughout lactation. Mean calving date was March 11. Cows were bred by one AI technician during a 13-week breeding season commencing on April 26, 2004. A strict drying-off policy was adhered to, where milking ceased for cows on reaching a milk yield of 7 kg per day or a time interval of 10 weeks to calving.

In 2005, the study design incorporated similar milking and nutrition treatments, however each treatment group included 10 pluriparous cows and 8 first lactation heifers.

In 2004, both OAD milking and a low nutrition level reduced milk yield and yield of milk solids compared to TAD milking and a high nutrition level, respectively, (Table 1). Fat and protein contents of milk were increased with OAD compared to TAD milking. Fat content was not affected by nutrition level, but protein content was reduced at the low compared to the high nutrition level. Milk lactose content was not significantly affected by milking frequency or nutrition level. Milk yield was 26% lower, while milk solids yield was 20% lower with OAD milking compared to TAD milking. Cow live-weight at the end of lactation was higher with OAD milking and with the high nutrition level. Cow BCS at the end of lactation was also higher with OAD milking and with the high nutrition level. Grass removed per cow (measured on a group basis) during the main grazing season (April 17 to October 2) was recorded as 19.7, 19.0, 15.4 and 14.9 kg DM/cow/day, respectively. Thus, grass removed per cow was reduced by a similar level (3-4 %) by OAD milking at both nutrition levels.Preliminary production results for the 2005 study are shown in Tables 2 and 3.

Table 1: Effect of milking frequency and nutrition level on milk production, live-weight and body condition score (BCS) of cows in 2004

	Milking frequency		Nutrition level	
	TAD	OAD	High	Low
Milk yield (kg/cow)	6,013	4,437	5,669	4,780
Milk solids yield (kg/cow)	437	351	429	359
Fat (%)	3.99	4.40	4.17	4.22
Protein (%)	3.29	3.53	3.46	3.36
Lactose (%)	4.55	4.52	4.55	4.52
Live-weight at 275 DIM[1] (kg)	627	678	680	624
BCS at 275 DIM	2.73	3.49	3.31	2.92

[1]Days in milk

The trends observed for the 2005 study were similar to those of the previous study. However, the magnitude of change due to milking frequency and nutrition level was greater for heifers than for cows. Milk yield was 31% lower, while milk solids yield was 27% lower for heifers milked OAD compared to those milked TAD.

Table 2: Preliminary results (cumulative to December 18, 2005) of the effect of milking frequency and nutrition level on milk production, live-weight and body condition score (BCS) of pluriparous cows (2005)

	Milking frequency		Nutrition level	
	TAD	OAD	High	Low
Milk yield (kg/cow)	5,892	4,724	5,847	4,770
Milk solids yield (kg/cow)	416	373	434	355
Fat (%)	3.82	4.38	4.08	4.11
Protein (%)	3.27	3.53	3.42	3.39
Lactose (%)	4.60	4.53	4.57	4.57
Live-weight (kg)	630	684	682	633
BCS	2.7	3.2	3.1	2.8

Table 3: Preliminary results (cumulative to 18 December, 2005) of the effect of milking frequency and nutrition level on milk production, live-weight and body condition score (BCS) of first lactation heifers (2005)

	Milking frequency		Nutrition level	
	TAD	OAD	High	Low
Milk yield (kg/cow)	3870	2664	3654	2881
Milk solids yield (kg/cow)	284	206	277	213
Fat (%)	4.03	4.22	4.20	4.05
Protein (%)	3.33	3.55	3.47	3.40
Lactose (%)	4.71	4.67	4.69	4.69
Live-weight (kg)	508	546	540	515
BCS	2.6	3.0	2.9	2.7

Table 4 shows the effect of milking frequency and nutrition level on reproductive performance in 2004. The onset of ovarian cyclicity was evaluated by two measurements – the number of days to commencement of luteal activity (CLA) and the proportion of cows that had commenced luteal activity pre-MSD (mating start date). OAD milked cows tended to have an earlier CLA and a greater proportion of them had commenced luteal activity pre-MSD compared to TAD milked cows. Submission rate in the first three weeks after MSD and first service conception rate were not significantly affected by either milking frequency or nutrition level. However, the overall pregnancy rate was higher with OAD and the high nutrition level compared to TAD milking and a low nutrition level, respectively. Reproductive performance results for the 2005 study showed similar trends. Caution must be exercised with these results involving limited experimental units, and these measurements need to be repeated. However, preliminary conclusions suggest no detrimental effects and some possible beneficial effects of once daily milking on reproductive performance.

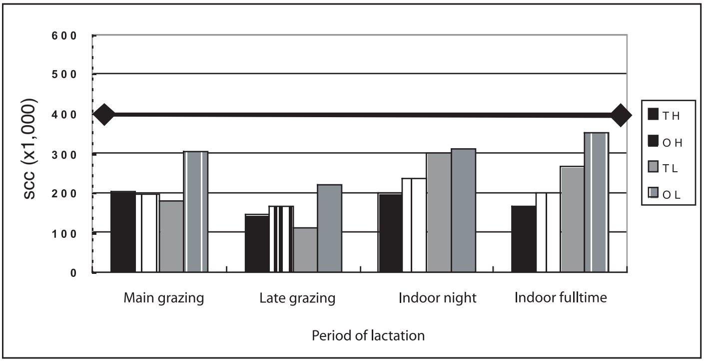
Table 4: Effect of milking frequency and nutrition level on reproductive performance indicators of cows in 2004

	Milking frequency		Nutrition level	
	TAD	OAD	High	Low
CLA [a]	30.4	25.3	27.6	28.1
Cows with CLA pre MSD [b] (%)	60	87	73	73
Submission rate (21 d) (%)	63	73	63	73
First service conception rate (%)	50	40	50	50
Overall pregnancy rate (%)	73	90	93	70

[a] CLA=commencement of luteal activity based on milk progesterone,
[b] MSD=mating start date

In 2004, the incidence of new mastitis infections was similar for TAD and OAD milked cows at 19 and 18 cases, respectively. While mean SCC in all treatment groups was considerably below the EU standard of $400x10^3$ cells/ml, some increase in milk SCC of OAD compared to TAD milked cows was observed, particularly with the low nutritional level and when cows were in late lactation (Figure 1). The strict drying-off policy may have assisted in maintaining late lactation milk SCC within the EU standard.

Figure 1: Effect of milking frequency and nutrition level on mean somatic cell count (SCC) during various stages of lactation



Thus, milk yield was reduced by OAD milking and by a low nutrition level. Increased concentrations of fat and protein together with improved live-weight and body condition score at the end of lactation were observed with OAD milking. OAD cows had better reproductive performance than TAD cows. Finally, OAD milking may provide an alternative management option on-farm, but this strategy needs to be repeated using first lactation animals and over successive lactations.

Milking intervals of 16:8h compared to 12:12h

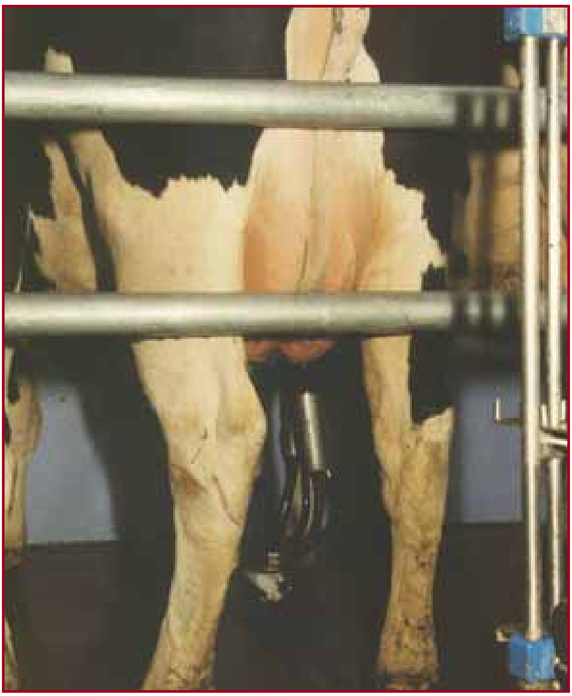
This study was undertaken to investigate the effect of 16:8h milking interval compared to equal milking interval (12:12h) on milk yield, milk composition and somatic cell count in early lactation. Sixty-six spring calving dairy cows were assigned to either12:12h or 16:8h milking interval for four weeks from April 16 to May 14. Pre-experimental milk yield was 23 kg/cow/day with an average milk production in the previous lactation of 5,037 kg/cow. There was no difference between the 16:8h and 12:12h milking interval in daily yield milk (25.1 vs. 25.0 kg/cow/day), protein (0.823 vs. 0.820 kg/cow/day), lactose (1.134 vs. 1.141 kg/cow/day) and SCC. Daily milk fat yield (0.867 vs. 0.825 kg/cow/day) and concentration (3.47% vs. 3.30%) were higher by the 16:8h milking interval. These results suggest that cows with an average daily milk production of 25 kg (or total lactation yield of approximately 5,000 kg) milked on a 16:8h milking interval will produce similar daily milk yields as cows milked on a 12:12h milking interval.

Once daily milking at end of lactation

Forty-eight spring calving dairy cows were assigned to either OAD or TAD from October 4 to December 19, or from 228 days in lactation to end of lactation. Milk production on the OAD cows was reduced by 29% (458 vs. 641 kg/cow), however milk fat and protein concentrations were increased by 0.43% and 0.29%, respectively. Milk lactose concentration and SCC level were similar for both treatments.

Thirteen times weekly milking (omitting the Sunday evening milking) compared to twice daily milking every day in late lactation

Forty-eight spring calving dairy cows were assigned to either 13-times weekly milking (omitting Sunday evening milking) or 14-times weekly milking from October 4 to December 19, or from 228 days in lactation to end of lactation. Cumulative milk production, milk composition and SCC level were similar for both 13-times weekly milking or 14-times weekly milking.



The role of extended lactation to reduce the cost of high empty rates in seasonal spring calving dairy herds

Stephen Butler, Laurence Shalloo and John Murphy

Summary

- Average lactation length was 20 months, with only a minority of the cows capable of lactating for 22 months (approx. 15%).
- Average milk production in ‘normal’ lactation (up to December 1) was 6,254 kg of milk, 467 kg of fat plus protein (4.04% fat and 3.42% protein) in 264 days, while in the extended lactation average milk production was 4,932 kg of milk, 406 kg of fat plus protein (4.35% fat and 3.87% protein) in 330 days.
- Proportion of milk and milk solids produced in the extended lactation period relative to the normal lactation period was not affected by milk production potential of the cow. However, the higher producing cows were capable of producing the equivalent of two 6,500kg lactations during an extended two year calving interval.
- Fertility in Year 2 was approximately similar to that observed on farms practising one year calving intervals. As all these cows failed to conceive during the first breeding season, fertility was markedly improved in the second breeding season. However, if fertility was poorer than what we observed, the profitability of the system would be reduced.
- A 365-day calving interval remains the most profitable system. Recycled cows have a lower cost than replacement heifers, regardless of milk production potential. Higher producing cows are more profitable than lower producing cows.
- The higher the ratio of milk produced in the extended period relative to the first, the more attractive extended lactation becomes. Suitability is contingent on achieving high milk production over a long lactation and becoming pregnant in the second breeding season.

Introduction

The use of artificial insemination in conjunction with intensive genetic selection programmes has resulted in marked increases in the productive efficiency of dairy cows. Genetic improvement for milk production has seen remarkable increases, particularly from the 1970s onwards, and this improvement is continuing in a linear fashion. Increased milk production has been associated with a decline in reproductive performance, and though this topic is an area of intense research, the underlying basis of the compromised fertility remains poorly understood. Higher milk production is achieved by higher dry matter intake and preferential partitioning of nutrients to the mammary gland at the expense of body reserves. High producing cows mobilise body condition in early lactation, and continue further into lactation before beginning to repartition nutrients to body reserves. This is believed to be antagonistic to the biological signals necessary for a successful pregnancy. It is clear that the continuing trend of increasing genetic potential for milk production is associated with a progressive reduction in reproductive performance (lower conception rate to a given service, more empty cows, etc.).

Efficient seasonal grass based systems of production require compact calving coinciding with turnout to pasture, necessitating good reproductive performance in a breeding season of similar duration to the desired calving period. A breeding season of 13 weeks is generally advised, though poor fertility is resulting in breeding seasons being extended to 15 weeks and beyond. A high empty rate is prevalent on many dairy farms (up to 40%), representing a major source of financial loss due to the large disparity between the value of a cull cow and the cost of either rearing or purchasing a replacement. A 305-day lactation is generally recognised as the optimum lactation length, allowing a 12 month calving interval, with 10 months of high milk production and a two month dry period. However, modern high producing cows continue to have high milk production at 305 days, the time of typical dry off. Potential milk production beyond 305 days in milk, when not pregnant, is largely unexplored under a seasonal pasture-based system of production. A study was undertaken at Moorepark to address the following questions: (i) Can cows lactate for 22 months and calve every 2 years? (ii) What is the milk potential of cows in the extended lactation compared to the first 305 days? (iii) Would they have good reproductive performance in the second year of lactation? And, (iv) Would it be profitable?

Experiment outline

Forty-six spring-calving cows that had failed to become pregnant during the breeding season (average 2.8 services/cow; range = 1-6) were assembled from the Moorepark herd in December 2004 (average 264 days in milk; range 197-313). Cows were paired on the basis of parity, milk production, bodyweight and body condition score (BCS). They were then randomly assigned to receive either low (3kg/cow/day) or high (6kg/cow/day) level of concentrate supplementation over the winter feeding period, plus a 50:50 grass silage: maize silage diet was offered ad-lib. Cows were turned out to pasture on March 31, and from then until the end of lactation were offered 1kg of concentrate per day. The breeding season began on April 18 and finished on July 18. Cows were on average 405 days in milk on the mating start date (range 336 – 452). Pregnancy diagnosis was carried out at approximately 30 and 60 days post breeding. Cows were dried off when milk yields went below 5 kg, or if they were within two months of calving. Also at the end of the lactation, cows were ranked on the basis of cumulative milk solids production (regardless of previous feeding treatment) and divided into three groups (R1, R2, R3).

Milk production

The profile of total lactation milk yield and composition in response to high or low winter feeding is illustrated in Figure 1, and cumulative production is summarized in Table 1. Milk yield was higher in the first year than in the second (6,253 kg vs. 4,932 kg), and composition of fat and protein was higher in the second year than in the first (4.04% fat and 3.42% protein vs. 4.35% fat and 3.87% protein in years 1 and 2, respectively). Milk protein concentration rose steadily from about week 8 (approx. 3.2%) until the end of lactation (approx. 4.2%). Milk fat concentration displayed greater fluctuation, but remained at roughly the same concentration throughout the extended period (approx. 4.5%). Milk lactose concentration declined with advancing stage of lactation, averaging 4.4% during the extended period, and was generally above 4.2%. A significant increase in milk production, milk fat yield and milk protein yield was observed in response to higher concentrate feeding over the winter (Table 1). The relative milk production (kg of fat plus protein) in the second year was 81% and 93% for low and high feeding groups respectively.

Figure 1. Profile of (A) milk yield, (B) milk fat percentage, (C) milk protein percentage, and (D) milk lactose percentage in cows offered low or high levels of feeding over the winter feeding period.

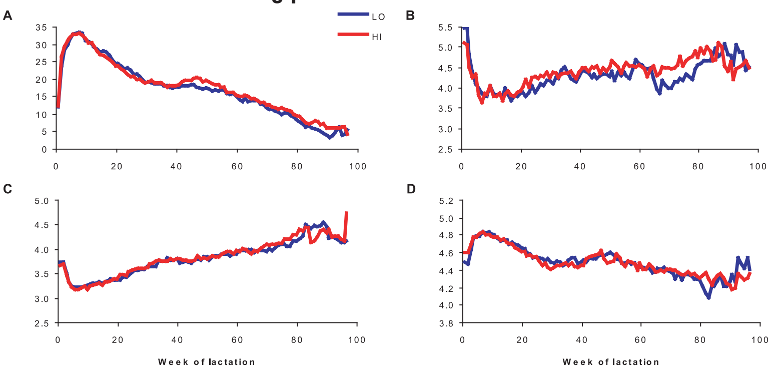


Table 1: Summary of milk production by winter feeding treatment

	Low	High	SEM	P
Calving to end Nov `04				
Cumulative milk yield (kg)	6,332	6,176	260	NS
Cumulative milk fat (kgs)	256	250	10	NS
Cumulative milk protein (kgs)	217	211	9.8	NS
Number of days in milk	266	261	7.3	NS
Dec `04 to dry off				
Cumulative milk yield (kg)	4,686	5,177	173	0.05
Cumulative milk fat (kgs)	200	230	8.6	0.02
Cumulative milk protein (kgs)	181	201	6.1	0.03
Number of days in milk	327	332	7.3	NS
Proportion of 1st period produced in 2nd period				
Milk yield	0.74	0.84	0.05	NS
Milk fat	0.78	0.92	0.06	NS
Milk protein	0.83	0.95	0.06	NS

NS = no significant difference

Figure 2: Profile of (A) milk yield, (B) milk fat percentage, (C) milk protein percentage, and (D) milk lactose percentage in cows separated into three ranks on the basis of cumulative milk solids production.

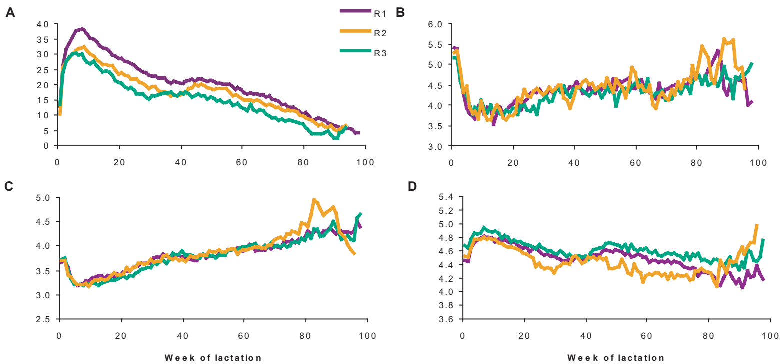


Table 2: Summary of milk production by rank

	R1	R2	R3	SEM	P
Calving to end Nov `04					
Milk yield (kg)	7,287[a]	6,267[b]	5,273[c]	308	<0.001
Milk fat (kg)	296[a]	253[b]	212[c]	11.1	<0.001
Milk protein (kg)	253[a]	213[b]	179[c]	11.2	<0.001
Number of days in milk	266	276	250	8.7	NS
Dec `04 to dry off					
Milk yield (kg)	5,738[a]	4,836[b]	4,266[b]	241	<0.001
Milk fat (kg)	254[a]	206[b]	186[b]	10.5	<0.001
Milk protein (kg)	222[a]	187[b]	164[b]	8.0	<0.001
Number of days in milk	349[a]	333[a]	308[b]	8.0	0.002
Proportion of 1st period produced in 2nd period					
Milk yield	0.79	0.77	0.81	0.07	NS
Milk fat	0.86	0.81	0.88	0.07	NS
Milk protein	0.88	0.88	0.92	0.08	NS

abc Within row means not sharing a common superscript differ at least $P < 0.05$.

Marked variation was observed in the number of days in milk and the cumulative milk production of the cows. Lactation length averaged 593 days (range 475–677). Across all cows, 15% had lactations >660 days, and 46% had lactations >600 days. Cumulative milk yield averaged 11,185 kg (range 7,920–16,357 kg) and cumulative milk solids averaged 872 kg (range 590–1,187 kg).

When cows were divided into three groups based on cumulative milk solids production, the highest yielding group (R1) had the highest milk production (kgs of milk fat and protein) in both the normal (549 kg) and the extended periods of lactation (476 kg), whereas the lowest yielding group (R3) had the lowest in both the normal (391 kg) extended periods (350 kg) (Figure 2 and Table 2). However, proportion of milk produced (kg of fat plus protein) in the extended lactation period was similar for all three milk production groups, being 87%, 84% and 90% for the highest, average and lowest milk production groups respectively. The total milk production of R1 cows was approximately equivalent to two lactations of 6,500 kg at 4.2% fat and 3.5% protein.

Average somatic cell count (SCC) in the normal lactation period was 116,000/ml, and 274,000/ml in the extended period. Highest SCCs were observed in the latest stages of lactation when milk yields were lowest (average 381,000/ml). Two cows were omitted from the SCC analysis that had persistent high cell counts, and in a normal farm situation would have been culled.

Reproductive performance

There was no effect of winter concentrate feeding level or rank on reproductive performance. Conception rate to first service was 52% (24/46), with 2.1 services per conception (82/39). Overall pregnancy rate was 85% (39/46).

Economic analysis

The Moorepark Dairy Systems Model was used to analyse the effects of extending the calving interval to 24 months on profitability per cow. The model farm was assumed to have 40 ha, 468,000 kg of milk quota with costs and prices included based on post full decoupling (Table 3). The profitability of a system where cows were milked for 305-days was compared with an extended lactation with a calving interval of 24 months. The costs associated with a 305-day lactation are compared to extending the calving interval in Table 4. On average the profitability of the extended period was €330 less per cow than the initial 305 day period. Assuming that 22.5% of the extended lactation cows are culled at the end of the second lactation this increases the average difference in profitability to €420 per cow, having taken into consideration the higher cull cow value.

Using the above data it is possible to decide whether it is better financially to cull cows not pregnant at the end of the first lactation or to milk them on for an extended lactation. In the present analysis, if a cow was culled at the end of her first lactation she had a value of €270. When this €270 is added onto the €420 lost from recycling, the total cost of the animal coming into the herd is €690, which compares very favourably with costs of a replacement heifer entering the herd at €1,319. There are only very minor differences between the different ranks and treatments in the costs associated with the recycled animals entering the herd as replacement animals.

Table 3: Assumptions used in the model farm

	Year 1	Extended Year 2
Farm size (ha)	40	40
Quota (kg)	468,000	468,000
Reference fat (g/kg)	36	36
Gross milk price (c/kg)	22.3	22.3
Price protein to fat	2	2
Replacement heifer price (€)	1,319	1,319
Reference cull cow price (€)	270	550
Reference male calf price (€)	108	108
Labour cost per unit (€)	22,800	22,800
Labour requirements per cow/year (hr)	42	35
Concentrate costs (€/tonne)	180	180
Opportunity cost of land (€/ha)	262	262

Table 4 : Costs associated with a cow that milks in the first 305 day period and the cow that is extended

	Average		Rank 1		Rank 3		Low winter feeding		High winter feeding	
	305 day	Extension	305 day	Extension	305 day	Extension	305 day	Extension	305 day	Extension
Receipts										
Milk	1,622	1,100	1,897	1,370	1,372	921	1,644	1,083	1,599	1,117
Livestock	147	121	147	121	147	121	147	121	147	121
Total receipts	1,768	1,221	2,044	1,490	1,518	1,042	1,791	1,204	1,746	1,238
Variable costs										
Concentrates	124	81	182	104	124	104	124	58	124	104
Fertilizer, lime and reseeding	135	107	142	115	123	95	137	106	133	108
Land rental	-34	-5	-53	-18	-21	5	-35	1	-33	-10
Machinery hire	10	9	10	9	10	9	10	9	10	9
Silage making	82	92	87	97	76	83	84	91	80	92
Vet, AI and medicine	105	94	105	94	105	94	105	94	105	94
Total variable costs	422	377	474	401	417	389	425	358	419	396
Fixed costs										
Car use, water and electricity	78	50	90	60	66	40	79	47	76	53
Labour	414	345	414	345	414	345	414	345	414	345
Machinery operation and repair	53	38	60	43	47	33	54	36	53	39
Phone	7	5	8	5	6	4	7	4	7	5
Insurance, A/Cs, T'Port, sundries	43	36	43	36	43	36	43	36	43	36
Interest repayments- term loan	118	88	124	94	112	84	119	87	117	90
Total fixed costs	713	561	739	583	687	541	715	555	710	568
Depreciation:										
Buildings	152	139	161	130	143	115	153	153	151	125
Machinery	62	53	72	49	52	33	63	63	61	43
Total costs	1348	1130	1445	1162	1300	1078	1355	1128	1340	1132
Net profit/loss	421	91	599	328	219	-37	436	76	406	106