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COMPARISONS OF DAIRY COW MANAGEMENT STRATEGIES WHICH DIFFER IN LABOUR INPUTS

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BACKGROUND

Although Northern Ireland dairy herds continue to grow in size, this expansion in cow numbers frequently occurs without additional labour being employed. It is normal for the existing workforce to simply 'take on' the extra workload. In addition, labour costs are increasing, while skilled labour is not always readily available. For these reasons, together with the desire of many farmers to commit more time to family and other non-farming activities, there is considerable interest at present in options to reduce labour inputs on dairy farms.

While the average cost of labour (family plus paid) on Northern Ireland dairy farms is approximately 4 – 5 pence per litre of milk produced, there is a wide range of labour efficiencies on dairy farms. For example, while approximately 13% of farms produce more than 1 million litres milk/labour unit, the average Northern Ireland farm produces just under 700,000 litres milk/labour unit (Greenmount Dairy Benchmarking). In general, labour efficiency improves with increasing herd size.

Increased mechanisation and the development of automated computerised systems will continue to provide options by which labour inputs can be reduced. In addition, the adoption of alternative management strategies may also provide options to reduce labour requirements, or influence the pattern of labour requirements.

To address this issue, a series of studies were undertaken at the Agri-Food and Biosciences Institute, Hillsborough. These studies examined the effects of a number of alternative management strategies on cow performance and labour inputs. The management strategies examined were largely identified during discussions with groups of farmer during visits to Hillsborough. Four different experiments were undertaken, as follows:

Experiment 1
Comparison of daily complete diet feeding and twice weekly 'easy feeding'

Experiment 2
How do grazing cows perform when housed at night and offered grass silage?

Experiment 3
Sowing fertiliser nitrogen less frequently within rotational paddock grazing systems

Experiment 4
A comparison of once versus twice daily milking in late lactation

The main findings of each of these experiments are presented within this booklet.

EXPERIMENT 1
Comparison of daily complete diet feeding and twice weekly 'easy feeding'

Background:
Indoor feeding systems on many farms have become increasingly complex and labour intensive. In addition, the machinery costs associated with some feeding systems can be considerable. However, can simple feeding systems be as effective as more complex systems?

Studies:
Two studies (Year 1 and Year 2) were undertaken to examine the effect of two different indoor feeding systems on cow performance.

Cows:
Year 1 involved first lactation heifers only, while Year 2 involved a mixture of cows and heifers. Each study commenced at calving and ran until turnout (approximately 150 days).

Diets:
In both studies the forage part of the diet was 70% grass silage and 30% maize silage (on a dry matter basis). Concentrate feed levels were approximately 10.0 kg/cow/day in Year 1 and 13.0 kg/cow/day in Year 2. The diets were offered as described below.

Treatments:
In each of the two studies, two treatments were examined, as follows:

1) Daily complete diet feeding: The ration was prepared and offered daily using a complete diet mixer wagon.

2) Twice weekly 'easy feeding': On two occasions each week whole blocks of grass silage and maize silage were placed along a moveable easy-feed barrier. The design of the feed barrier allowed cows to push the barriers out whilst eating their way through the blocks of silage. The concentrate part of the ration was offered using out-of-parlour feed stations.

OUTCOMES

Daily complete diet feeding

Twice-weekly easy feeding

Cow performance:

- Feeding system had no effect on food intake, milk production, milk composition or the condition score of the cows at the end of the winter period in either of Years 1 or 2 (Table 1). Similar findings have been observed in other studies.
- From previous research, cows that are most likely to show a milk yield benefit with complete diet feeding are high yielding (producing more than 28 litres milk/day) and are being offered a diet containing more than 14 kg concentrate/day (approximately 60% concentrates on a dry matter basis).

Feeding time:

- Feeding times were calculated as the time taken each week to feed a 100 cow dairy herd.
- Feeding times were 3 hours 29 minutes/week for the daily complete diet treatment, and 2 hours 36 minutes/week for the twice weekly easy-feed system.
- Another way to look at this is that 78 minutes were required for feeding silage on two occasions each week with the easy-feed system, compared with approximately 30 minutes every day with the complete diet system.
- These calculated feeding times will of course be influenced by many factors, including the layout of the farm, machinery available and the distance between silos and the feed passage.

CONCLUSIONS

These two studies illustrate that a simple feeding system in which the silage part of the diet is offered twice weekly, can give similar performance to a more complex system involving daily feeding.

Table 1 Effect of feeding system on average cow performance over the winter period, and on the calculated feeding time

	Daily complete diet	Twice-weekly easy-feed
Year 1 (Heifers)		
Dry matter intake (kg/day)	17.6	17.0
Milk yield (litres/day)	28.4	29.6
Fat (%)	3.94	3.85
Protein (%)	3.35	3.41
Condition score at end of study	2.4	2.3
Year 2 (Cows and heifers)		
Dry matter intake (kg/day)	18.7	18.5
Milk yield (litres/day)	30.0	30.6
Fat (%)	4.18	4.02
Protein (%)	3.39	3.39
Condition score at end of study	2.5	2.5
Calculated feeding time per week/100 cows	**3 hours, 29 minutes**	**2 hours, 36 minutes**

Practical issues:

- It is sometimes argued that it is not possible to feed two different types of forages unless a mixer wagon is used. However, in the current study two forages (grass silage and maize silage) were offered in separate blocks along side an easy-feed barrier. No problems were observed even though the cows often preferentially selected the maize silage before the grass silage.

- The two systems differed in many other respects, including the machinery required, the flexibility to incorporate by-product ingredients into the rations, the need for electronic out-of-parlour feeders, and in terms of feed passage design. Nevertheless, it is clear from these studies that there are options for feeding cows, even with mixed forages, which achieve good performance and reduce labour inputs.

- The successful operation of the twice-weekly easy-feed system is dependent on maintaining a clean-cut, undisturbed silo face, and ensuring that blocks of silage are not disturbed when deposited along the feed barrier.

- If heating at the silo face has occurred before blocks are removed, or if blocks are disturbed while being placed along the feed barrier, then silage quality will deteriorate rapidly during the 3 – 4 day period that silage remains at the feed barrier. As such, a block cutter rather than a silage grab is a key component of the easy-feed system described.

EXPERIMENT 2
How do grazing cows perform when housed at night and offered grass silage?

Background:
If grazed grass is the cheapest feed available, why even consider night-time housing during the summer? There are a number of possible reasons:

I. With increasing herd size, the grazing platform (i.e. the fields that cows can easily access) on many farms is no longer large enough for both day and night time grazing.
II. On fragmented farms, walking cows to and from paddocks twice daily has become increasingly difficult and dangerous due to increasing volumes of traffic.
III. To maintain cow performance many high input farms already house cows at night and offer silage/concentrate mixes. But concentrates are expensive!

Studies:
Two studies (Year 1 and Year 2) were undertaken to examine the effects of two different summer management systems on cow performance.

Cows:
Year 1 involved first lactation heifers only, while Year 2 involved a mixture of cows and heifers. All cows were winter calving, and were in mid-late lactation when the studies were undertaken.

Diets:
In both studies the forage part of the diet was 70% grass silage and 30% maize silage (on a dry matter basis). Concentrate feed levels were approximately 10.0 kg/cow/day in Year 1 and 13.0 kg/cow/day in Year 2. The diets were offered as described below.

Treatments:
Two treatments were examined:

1) Full-time grazing: cows grazed by both day and night
2) Part-time grazing: cows grazed by day and were housed at night and offered grass silage

During these studies concentrates were offered in the milking parlour at a flat rate of 3.0 kg/cow/day.

The grazing area offered each day with the part-time grazing system was approximately 40% less than with the full time grazing system. This was designed so that residual sward heights with both systems were similar (approximately 6.0 cm).

OUTCOMES

Cow performance:

- The results in Years 1 and 2 were quite different (Table 2). Housing cows at night increased milk yields by 1.4 kg/day in Year 1, but reduced milk yields by 1.6 kg/day in Year 2.
- These different milk yield responses were due to differences in silage quality and grazing conditions. In Year 1 grazing conditions were difficult, while silage quality was excellent. In Year 2 grazing conditions were ideal, while silage was of a medium quality.
- Treatment had no effect on milk fat content. However, milk protein content increased with full time grazing in each of Years 1 and 2, thus confirming the benefits of grazing in terms of milk composition.
- It is important to note that cows housed at night did not receive additional concentrates, and that these studies simply compared replacing grazed grass with grass silage.
- When housed overnight each cow produced an average of 5.3 gallons of slurry (24 litres).

Stocking rates:

- Across the two experiments, mean stocking rates on the grazing platform were 4.8 and 7.8 cows per hectare with the full time grazing and part time grazing systems respectively.
- Housing cows at night reduced the area required for grazing by approximately 40%, compared to a full time grazing system.
- However, when housed overnight cows consumed on average 6.1 kg silage DM. When the additional land for silage production is taken into account, overall stocking rates during the experiments did not differ between treatments.

Table 2 Cow performance and calculated times associated with a full-time grazing system and a part-time grazing system

	Full-Time Grazing	Part-Time Grazing	Difference (compared to full-time grazing)
Year 1 (Heifers)			
Milk yield (litres/day)	17.2	18.6	+ 1.4kg
Fat (%)	4.22	4.10	
Protein (%)	3.54	3.35	- 0.19%
Condition score at end of study	2.4	2.3	
Silage intake (kg DM/cow/day)	0	6.6	+ 6.6kg
Margin over feed costs (£/cow/day)†	£2.30	£2.18	
Year 2 (Cows and heifers)			
Milk yield (litres/day)	20.0	18.4	- 1.6kg
Fat (%)	4.24	4.14	
Protein (%)	3.58	3.34	- 0.24%
Condition score at end of study	2.6	2.5	
Silage intake (kg DM/cow/day)	0	5.6	+ 5.6kg
Margin over feed costs (£/cow/day)†	£2.87	£2.15	
Weekly time requirement associated with each system (per 100 cows)‡	7 hours, 10 minutes	6 hours, 53 minutes	

† *Margin over feed costs assumes: milk value = 22 ppl; concentrates cost = £190/t; silage cost = £120/t DM; grass cost = £99/t DM.*

‡ *Droving cows, feeding, sowing fertiliser, and spreading slurry, but excludes time associated with making extra silage*

Labour requirements:

- Housing cows at night will reduce the time required for droving and pasture management. However, housing cows at night will increase labour requirements associated with making extra silage, feeding silage, managing the feed barrier and silage pit, keeping cubicles clean, and spreading slurry.
- Times associated with each of the two systems were calculated for a 100-cow dairy herd for one week, and found to be similar for both systems (approximately 7 hours/week). However, this did not include work associated with silage production for the cows housed at night.

Economics:

- In each of Years 1 and 2, Margin over Feed Costs were higher with cows managed on the full-time grazing system. This occurred even though milk yield was lower with the full-time grazing system in Year 1.

CONCLUSIONS

While full-time grazing improved milk protein content, the milk yield response was influenced by the quality of the silage on offer, and the grazing conditions encountered. Although specific circumstances may force some farmers to adopt night time housing, replacing grazed grass with night time feeding of silage is unlikely to improved margins in most situations.

EXPERIMENT 3
Sowing fertiliser nitrogen less frequently within rotational paddock grazing systems

Background:
Sowing fertiliser on grazing paddocks is a routine task on most dairy farms, with fertiliser normally spread within a couple of days of each paddock having been grazed. However, this practice normally results in fertiliser being sown on a number of occasions each week, and this has implications for labour requirements.

To reduce labour inputs, some farmers have started to spread fertiliser less frequently, and in extreme situations, fertiliser is sown across the entire dairy cow grazing area on a single occasion once ever three or four weeks ('blanket spreading').

Studies using small plots in the Republic of Ireland have indicated that this practice has little effect on total grass production during the growing season. However, the impact of this practice on cow performance has never been examined.

Studies:
Two studies (Year 1 and Year 2) were undertaken to examine the effect of reducing the frequency of sowing fertiliser nitrogen during the grazing season, on cow performance.

Cows:
Each study involved mid lactation winter calving dairy cows.

Treatments:
Within each study cows grazed within a rotational paddock grazing system (rotation length between 20 – 28 days). Two treatments were examined, as follows:

1) Regular sowing: This involved sowing fertiliser on paddocks within two or three days of each paddock having been grazed (fertiliser sown three times/week).

2) Less frequent sowing: This involved sowing fertiliser on ALL paddocks once every 3–4 weeks (depending on the length of the grazing rotation).

Total fertiliser application rates over the season were 360 kg nitrogen per hectare in Year 1 and 250 kg nitrogen per hectare in Year 2. The Year 1 study was undertaken before the Nitrates Directive was introduced.

All cows were offered 3.0 kg of concentrate per day.

OUTCOMES

Cow performance:

- Frequency of sowing fertiliser had no effect on either milk yield or milk composition during the grazing period, or on the body condition score of the cows at the end of the experiment (Table 3).
- Based on these results it would appear that sowing fertiliser infrequently had no negative effect on cow performance.

Labour:

- The process of sowing fertiliser involves filling the sower with fertiliser, travelling to the paddock, sowing the fertiliser, and travelling back to the farm. In addition, the fertiliser sower may have to be removed and reattached to the tractor many times throughout the season.
- Sowing fertiliser less frequently reduces the time spent travelling to and from fields, and may reduce the number of occasions when the fertiliser sower must be removed and reattached to the tractor.
- For a 100-cow herd, sowing fertiliser on three occasions each week required a total of 1 hour 48 minutes/week (36 minutes on each occasion). With the less frequent sowing, 4 hours and 37 minutes was required to spread fertiliser on a single occasion once every three weeks (average of 1 hour, 23 minutes/week).
- While the saving in time with less frequent sowing is relatively small (20%), the work load is split very differently with each of the two systems. In addition, less frequent sowing could open up the possibility of using a contractor to spread fertiliser on all grazing paddocks once every 3 – 4 weeks. Contractors are already being used by some dairy farmers (especially in the Republic of Ireland) to spread fertiliser on grazing ground.

Table 3 Effect of frequency of sowing fertiliser nitrogen on cow performance, and on the time taken to sow fertiliser each week

	Frequent sowing	Less frequent sowing
Year 1		
Milk yield (litres/day)	25.1	25.5
Fat (%)	4.06	4.02
Protein (%)	3.45	3.44
Condition score at end of study	2.5	2.5
Pre-grazing sward height (cm)	10.5	11.2
Post-grazing sward height (cm)	4.9	4.9
Year 2		
Milk yield (litres/day)	25.1	25.5
Fat (%)	3.97	3.87
Protein (%)	3.33	3.32
Condition score at end of study	2.3	2.3
Pre-grazing sward height (cm)	10.6	10.5
Post-grazing sward height (cm)	5.0	4.9
Fertiliser sowing time/week (100 cow herd)	1 hour, 48 minutes	1 hour, 23 minutes

Practical issues:

- While there is a possibility that grass growth may be slightly reduced with less frequent applications of fertiliser nitrogen, a reduction in milk output is unlikely to be observed unless herbage utilisation rates are extremely high.
- When sowing fertiliser across all paddocks on a single occasion during each grazing cycle, pay close attention to the weather forecast. Heavy rain after sowing will increase the risk of nitrogen losses across the entire area.
- Sowing fertiliser on fewer occasions is likely to result in more accurate sowing rates, and improved records of where and when fertiliser is sown.
- The bio-security implications of using a contractor to sow fertiliser on grazing paddocks needs to be considered.
- When sowing fertiliser in paddocks shortly before grazing, care needs to be taken to ensure that spillages do not occur as this could lead to nitrate poisoning in livestock.

CONCLUSIONS

While sowing fertiliser less frequently during the grazing season had no effect on cow performance, precautions do need to be taken.

EXPERIMENT 4
A comparison of once- versus twice-daily milking in late lactation

Background:
Approximately 33% of the daily labour input on dairy farms is associated with the milking routine, namely moving cows to and from the parlour, milking the herd, and 'washing up' (Moorepark survey, 2001). Therefore it is unsurprising that there is considerable interest in options to reduce labour inputs associated with milking. Once-daily-milking (ODM) is one option by which labour requirements can be reduced.

Studies:
Two separate studies were undertaken to examine the effect of ODM in late lactation on dairy cow performance.

Cows:
Study 1 involved autumn calving cows that were an average of 232 days calved (range: 165 – 265 days). The study started on 10 June.

Study 2 involved spring calving cows that were an average of 240 days calved (range: 173 – 277 days). The study started on 18 October.

Treatments:
These studies involved two treatments, as follows:

1) Once-daily milking (ODM): Cows milked once daily
2) Twice-daily milking (TDM): Cows milked twice daily

Management:
Half of the cows in each study were milked once daily (in the morning), while the remaining cows were milked twice daily, as per normal practice. In study 1, cows grazed within a paddock grazing system. In study 2, cows were housed indoors and offered a grass silage-based diet. The period of ODM lasted for a mean of 79 and 66 days in Studies 1 and 2, respectively.

OUTCOMES

Cow performance:

- Both spring and autumn calving cows showed a similar response to ODM in late lactation (Table 4).
- ODM in late lactation reduced milk output by approximately 24%. The actual loss in milk output was 285 litres/cow in Study 1 and 173 litres/cow in Study 2. When considered within the context of a 7000 litre lactation, these losses were relatively minor.
- The reduction in milk yield was partially compensated for by increased milk fat and milk protein contents with cows on the ODM treatment.
- Somatic cell counts (SCC) were much higher with cows milked once daily. Indeed, SCC's were in excess of 400, 000 per ml with ODM in both studies, and this is clearly unacceptable.
- However, Figure 1 highlights that high SCC's were a particular problem with cows which had a high SCC prior to the start of ODM (dashed red line). To overcome this problem, cows with high cell counts should be dried off before ODM starts.
- Within these studies, ODM had very little effect on the condition score of cows at the end of the lactation.
- ODM in late lactation had no effect on either milk yield or SCC in the following lactation.

Figure 1 Effect of milking frequency on somatic cell count for cows with either a high or low SCC at the start of the experiment

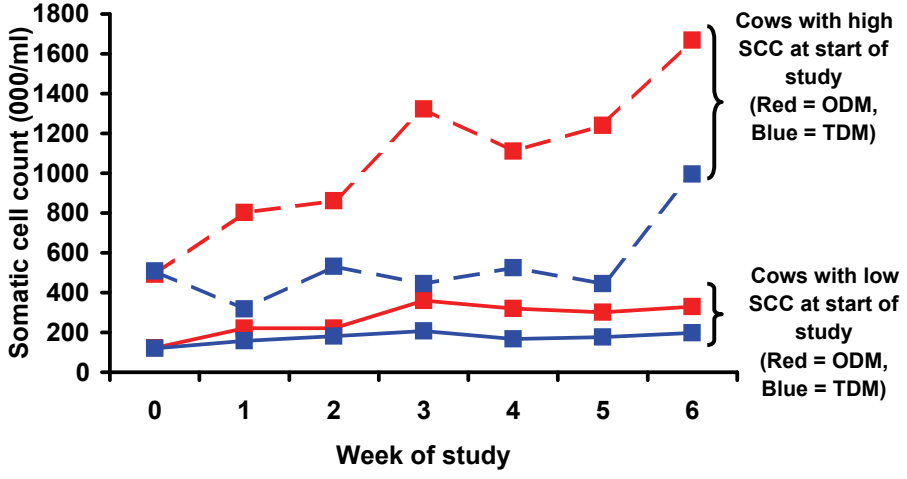

Table 4 The performance of cows milked either once-daily or twice-daily in late lactation

	Once-daily milking	Twice-daily milking
Study 1: Autumn calving cows		
Litres of milk produced during study (79 days)	939	1224
Milk yield (litres/day)	11.9	15.4
Fat (%)	4.71	4.33
Protein (%)	3.86	3.62
Fat + protein yield (kg/day)	1.00	1.23
Somatic cell count (000/ml)	460	225
Condition score at drying off	2.5	2.4
Value of milk produced during Study 1 (£/cow)	£239	£294
Study 2: Spring calving cows		
Litres of milk produced during study (66 days)	574	747
Milk yield (litres/day)	8.4	10.7
Fat (%)	4.92	4.47
Protein (%)	3.88	3.62
Fat + protein yield (kg/day)	0.73	0.86
Somatic cell count (000/ml)	492	273
Condition score at drying off	2.5	2.4
Value of milk produced during Study 2 (£/cow)	£149	£181

Economic impact of once-daily milking in late lactation:

- At a milk price of 22 pence per litre, the value of milk lost with ODM in Study 1 was £55 per cow (average of 79 days) while the value of milk lost in Study 2 was £32 per cow (average of 66 days).

- The economics of adopting ODM will depend on many farm factors. On a farm where modern facilities allow large numbers of animals to be milked quickly, and where late lactation milk yields are high, the reduction in labour requirement associated with ODM is unlikely to compensate for the loss in milk yield.

- However, on a farm where milk yields in late lactation are low, and where milking time is prolonged due to poor milking facilities, then it may make economic sense to milk cows once daily.

Practical considerations

- ODM is likely to be most applicable in herds with a relatively tight calving pattern, as this will enable the whole herd to be placed on a ODM regime. ODM is more difficult with a spread calving pattern.

- On many farms ODM is adopted to improving lifestyle, with farmers making a conscious decision that the loss in milk production is more than compensated for by the 'lifestyle benefits' that once-daily milking provides.

CONCLUSIONS

Once-daily milking in late lactation will normally reduce milk yield by approximately 24%, but will increase milk fat and milk protein content. However, when ODM is imposed on cows with high somatic cell counts, the cell counts of these cows will often increase dramatically.

Full details of the experiments undertaken

Full details of each of the four experiments presented within this report have been published within the following Scientific Journals:

Experiment 1

Ferris, C.P., Frost, J.P., Binnie, R.C. and Patterson, D.C. (2006) Dairy cow performance and labour inputs associated with two silage feeding systems. Grass and Forage Science, 61: 304-314.

Experiment 2

Ferris, C.P., Binnie, R.C., Frost, J.P. and Patterson, D.C. (2008) Effect of offering silage during housing at night on the performance of grazing dairy cows and on labour requirements. Grass and Forage Science, 63: 138-151.

Experiment 3

Ferris C.P., McCoy M.A. and Patterson D.C. (2008) Effect of frequency of application of inorganic nitrogen fertiliser within a rotational paddock-grazing system on the performance of dairy cows and inputs of labour. Grass and Forage Science, 63: 270-279.

Experiment 4

Ferris, C.P., Frost, J.P., Mayne, C.S., McCoy, M.A. and Kilpatrick, D.J. (2008) A comparison of the direct and residual response of dairy cows to once or twice-daily milking, in late lactation. Livestock Science, 114: 305-314.

DISCLAIMER: The Northern Ireland Agricultural Research and Development Council (AgriSearch) has provided funding for this project but has not conducted the research. AgriSearch shall not in any event be liable for loss, damage or injury suffered directly or indirectly in relation to the report or the research on which it is based.

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17 DAIRY
Comparisons of Dairy Cow Management Strategies which Differ in Labour Inputs

For further information or to request a copy of the full scientific report detailing the experimental tests and statistical analysis contact:

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