Improving Fertility in the High Yielding Dairy Cow

Paul Robinson

December 2010
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>My Subject</td>
<td>1</td>
</tr>
<tr>
<td>Background to my Study</td>
<td>2</td>
</tr>
<tr>
<td>Study aims and objectives</td>
<td>3</td>
</tr>
<tr>
<td>Poor fertility is not just the high yielding cow</td>
<td>4</td>
</tr>
<tr>
<td>Fertility Key Performance Indicators (KPI's)</td>
<td>5</td>
</tr>
<tr>
<td>Saudi Arabian Systems</td>
<td>7</td>
</tr>
<tr>
<td>Feeding</td>
<td>8</td>
</tr>
<tr>
<td>Health benefits</td>
<td>9</td>
</tr>
<tr>
<td>Cow longevity and breeding</td>
<td>9</td>
</tr>
<tr>
<td>Summary</td>
<td>10</td>
</tr>
<tr>
<td>North American Dairy Production</td>
<td>11</td>
</tr>
<tr>
<td>Synchronisation programs</td>
<td>12</td>
</tr>
<tr>
<td>Transition Cow Index</td>
<td>13</td>
</tr>
<tr>
<td>An Approach to Investigating a Herd Reproductive Performance Problem</td>
<td>14</td>
</tr>
<tr>
<td>The Miner Institute</td>
<td>15</td>
</tr>
<tr>
<td>Chaput Family Farms, Vermont</td>
<td>16</td>
</tr>
<tr>
<td>Green Mountain Dairy, Vermont</td>
<td>16</td>
</tr>
<tr>
<td>Changing breeds for improved fertility?</td>
<td>17</td>
</tr>
<tr>
<td>Breeding for fertility</td>
<td>18</td>
</tr>
<tr>
<td>Mystic Valley Holsteins</td>
<td>18</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
</tr>
<tr>
<td>Sweden’s Dairy Health Impact</td>
<td>20</td>
</tr>
<tr>
<td>Olof Janson – Kartorps Sateri</td>
<td>21</td>
</tr>
<tr>
<td>Kartorps rations</td>
<td>20</td>
</tr>
<tr>
<td>Swedish breeding programme</td>
<td>24</td>
</tr>
<tr>
<td>Sweden summary</td>
<td>25</td>
</tr>
<tr>
<td>Welfare and its relationship to health and reproduction</td>
<td>26</td>
</tr>
<tr>
<td>Summary of EFSA report</td>
<td>26</td>
</tr>
<tr>
<td>Conclusions</td>
<td>28</td>
</tr>
<tr>
<td>The modern herdsperson</td>
<td>29</td>
</tr>
<tr>
<td>Future focus</td>
<td>31</td>
</tr>
</tbody>
</table>
Acknowledgements

Bibliography

References

Appendix 1 – Al Safi diet

Appendix 2 – Mystic Valley diet

Appendix 3 – Craves Dairy TCI (DairyCOMP 305)

Appendix 4 – DairyCOMP 305 printout 1

Appendix 5 – DairyCOMP 305 printout 2

Appendix 6 – Sweden key milk production figures

Appendix 7 – Nordic Total Merit

Appendix 8 – Comparison of Index for production, conformation and health

Appendix 9 – List of Tables and Figures

Postscript

The views in this report are entirely my own and do not necessarily represent the views of The Nuffield Farming Scholarship Trust, or my sponsor, or any other sponsoring body
INTRODUCTION

I was brought up on the family’s South Pennines dairy farm milking 32 cows 1100ft above sea level. I left home at 16 to pursue my dairy cow passion and went to milk cows in Carmarthen, South Wales.

Since then I have milked and managed herds from 70 to 600 cows from Suffolk to Cumbria.

I graduated from Newcastle University with a BSc(Hons) and am currently a consultant working for Kingshay.

Outside work, my wife Rachel and I are busy guiding our 5 young children.

MY SUBJECT

The subject is that of managing fertility in the high yielding dairy cow, but this could apply to all cows as fertility has been falling at all yield levels. The subject has been studied, discussed and researched for the past 20 years, but problems continue to appear and milk yields continue to increase. This study will hopefully pull together the experiences of cow enthusiasts managing and working with different herd sizes in different climates.
BACKGROUND TO MY STUDY

Dairy cow genetics have accelerated over the past 25 years. Many type traits have improved, but the biggest genetic gains have been seen in milk yields. Increased milk yields have also been helped by improved management and nutrition. This increase in yield has come at a price. Cow longevity has been reduced and therefore culling rate has increased. Possibly the worst impact of higher yields has been significantly poorer fertility. Table 1 shows the milk yield versus fertility trend over previous years.

Table 1 - UK Fertility Trends

<table>
<thead>
<tr>
<th></th>
<th>1993</th>
<th>2002</th>
<th>2005</th>
<th>2007</th>
<th>Target</th>
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</thead>
<tbody>
<tr>
<td>Herd Size</td>
<td>109</td>
<td>121</td>
<td>130</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>Yield/cow</td>
<td>5974</td>
<td>7138</td>
<td>7705</td>
<td>7648</td>
<td></td>
</tr>
<tr>
<td>Heat detection Rate</td>
<td>71%</td>
<td>57%</td>
<td>46%</td>
<td>45%</td>
<td>75 – 80%</td>
</tr>
<tr>
<td>Days to first service</td>
<td>71</td>
<td>95</td>
<td>99</td>
<td>101</td>
<td>60</td>
</tr>
<tr>
<td>Conception rate</td>
<td>45%</td>
<td>40%</td>
<td>39%</td>
<td>37%</td>
<td>45 – 50%</td>
</tr>
<tr>
<td>Calving index</td>
<td>382</td>
<td>411</td>
<td>420</td>
<td>425</td>
<td>380</td>
</tr>
</tbody>
</table>

Source: Kingshay Dairy Manager, NMR, Esslemont R.J.

I trained in DIY AI in 1985 and have seen my own AI conception rate drop from 66% to 47% in 2005. Whilst milk production can have a clear relationship to poor fertility there are many other causal factors. It is clear that many 9,000 litre+ herds have poor fertility and records suggest that many lower yielding herds have equally poor results. In some herds poor fertility is actually holding production back. This decline in fertility is significantly affecting the profitability of many dairy farms and must be improved.
STUDY AIMS AND OBJECTIVES

+ To evaluate fertility of the high yielding cow in extreme environments
+ Focus on fertility improvement in different situations
+ To isolate management criteria which promote good fertility
+ Transfer knowledge and experience to as wide an audience as possible within the UK and worldwide.

I travelled to Saudi Arabia, North America and Sweden.

The aim of this study is to assess if the decline in fertility is still continuing or whether it will level out and start to improve.

- Milk yields are still rising although not as steeply as during the past 20 years.
- Improving dairy cow fertility can easily be achieved by changing breed or cross breeding.
- More extensive systems have lower production and achieve efficiencies by producing as much milk from forage as possible. This type of system does not suit all farms due to restrictions such as land base, soil type or farm layout.
- Many British dairy units are based on a high output high input system using appropriate genetics.

The Holstein is the predominant UK breed. It is noted for its extreme production traits, but more recently criticised for its poor longevity, which can often be attributed to poor fertility, mastitis resistance and fitness traits. The author’s personal feeling is that the Holstein has been wrongly targeted and on the contrary has been the reason for a large number of successful dairy units across the world. Diana Allen (Scholar 2005) has already highlighted in a previous Nuffield report (*Relationship between cow comfort, nutrition and performance*) that welfare standards for cows and particularly the Holstein cow is often poor in many dairy units. In effect dairy units have not caught up with this extreme production animal.

My study focuses on high producing animals in more extreme environments than our own UK conditions.

The most extreme environment I visited was Saudi Arabia.

This visit was followed by a tour of North America and concluded with a visit to Sweden.
POOR FERTILITY IS NOT JUST THE HIGH YIELDING COW

The reduction in the fertility of dairy cows is not just specific to the Holstein cow. New Zealand has seen a 10% reduction in phenotypic fertility over the past 30 years (Price, McNaughton and Burke. 2008). In New Zealand the fertility of Holsteins is good compared to other countries. However the reduction in fertility has led to New Zealand adopting the Australian ‘In calf programme’ which focuses on calving pattern, age, health, heat detection, AI technique and bull management as well as a range of other fertility risk factors.

Reproduction failure as a reason for culling is currently 43% compared to 23% in 1973 (XU et al, 2003). This could be due to breeding for more production and type traits such as udder conformation. Anoestrus rates have increased from 7% to 20% in the same period (Fielden and Macmillan, 1973. Rhodes et al 2003). Overall conception rates stood at 65% in the mid 1970s and were at 55% in 2003.
FERTILITY KEY PERFORMANCE INDICATORS (KPIs)

The KPIs used when evaluating fertility can be different depending on the type of system and yield level of the cow. The KPIs used in the following summary are not definitive and merely reflects common usage. The farmer/manager's choice of KPIs used will depend upon the recording processes in place. Computer recording systems can go into detailed analysis, but the end figures are only as good as the input.

Table 2 – Typical fertility performance indicators

The typical KPIs used in New Zealand for a spring block calving herd are shown below:

LEVEL 1
Overall reproductive performance

<table>
<thead>
<tr>
<th>KPI</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of herd pregnant by 6 weeks</td>
<td>&gt;78%</td>
</tr>
<tr>
<td>% of herd non pregnant by 9 weeks</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>% of herd non pregnant by 15 weeks</td>
<td>&lt;3%</td>
</tr>
</tbody>
</table>

LEVEL 2 – The drivers

<table>
<thead>
<tr>
<th>KPI</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 week submission rate (SR)</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>1st service conception rate (CR)</td>
<td>&gt;60%</td>
</tr>
<tr>
<td>2 to 24 day non return rate</td>
<td>&gt;70%</td>
</tr>
</tbody>
</table>

LEVEL 3 – Drivers of SR and CR

Heat detection

<table>
<thead>
<tr>
<th>KPI</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 week SR for mature early calved cows</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>% normal returns (18 to 24 days)</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>Calving spread</td>
<td>&gt; 60% by 3wks, &gt;87% 6wks, &gt;90% 9wks</td>
</tr>
</tbody>
</table>

The figures above are taken from ‘Fertility in Dairy Cows bridging the gaps’ a BSAS publication 2008.

Typical KPIs for a UK 8,000 litre plus dairy herd

<table>
<thead>
<tr>
<th>KPI</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to first service</td>
<td>61 to 75 days</td>
</tr>
<tr>
<td>Calving to conception (days)</td>
<td>86 to 110 days</td>
</tr>
<tr>
<td>Conception rate</td>
<td>&gt;57%</td>
</tr>
<tr>
<td>Heat detection rate</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>% served by 80 days</td>
<td>&gt;75%</td>
</tr>
</tbody>
</table>
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% in calf by 100 days  >65%
% not in calf by 200 days <6%

In addition to the details in the above charts a good source of reference for UK fertility KPIs is the MDC PD+ fertility improvement programme. This folder has been compiled by a number of industry experts.
SAUDI ARABIAN SYSTEMS

When considering countries to visit with reference to dairy cow fertility, it was important to see areas where in theory cows were under more pressure than in UK systems. Saudi Arabia is renowned for having large dairy units in extreme environments. These cows are grouped in large numbers and have yields in excess of 11,000 litres per cow.

Photograph 1 – Al Safi dairy

Saudi Arabia as a country can be difficult to enter but, thanks to Kingshay chairman, Robert Lawton, I was introduced to his brother John. John had been working in Saudi for approximately 30 years and within a month of contacting him he had arranged for me to stay on the Al Safi dairy unit which milks 22,000 cows. Due to the huge scale of the enterprise I spent 2 weeks on the same unit looking at the different enterprises. Al Safi is listed in the Guinness book of world records for being the largest integrated dairy unit in the world.

Photograph 2 – Double 60 parlour

Al Safi dairy is situated 120km south East of Riyadh near Al Kharj. The farm utilises approximately 6,000ha on 2 sites. 22,000 cows are milked through 13 parlours and daily production can reach 650,000 litres/day. One parlour was capable of milking 500 cows per hour and this is shown in photograph 2. There are a total of 38,000 livestock on the farm including replacement heifers. All the milk is processed on site through the Danone milk factory.

The cows are in 7 separate units ranging from 2,250 cows to 4,200 cows. Each unit has a dedicated team of staff. A total of 1300 staff work on site including the Danone staff.

Experience of UK fertility problems suggests that 22,000 cows on one farm producing 11,500 litres per head per year in nearly 50°C heat with no grazing, sounds like a fertility and welfare disaster.

If the UK average conception rate is 40% at 7,500 litres per cow, the conception rate of a cow producing 11,500 litres on a 3 times a day system with such large numbers should in theory be much lower. Table 3 (overleaf) shows some basic fertility figures, which on reflection are very good.
Table 3 – Al Safi Dairy

<table>
<thead>
<tr>
<th>Herd Size</th>
<th>Yield/Cow (litres)</th>
<th>Calving Index</th>
<th>Culling %</th>
<th>Conception Rate (%)</th>
<th>Av Days in Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>21,700</td>
<td>11,510</td>
<td>407</td>
<td>25</td>
<td>35</td>
<td>185</td>
</tr>
</tbody>
</table>

Before analysing the reasons behind this, you must take account of the consistent 40 to 50 degree heat which can reduce conception rates by 5 to 10%.

The whole system runs on strict protocols or standard operating procedures. There will be very few dairy units which have such rigid protocols as Saudi dairy units. The staff follow these religiously.

**Feeding**

The cattle diets are mixed at a central point and distributed accordingly. The total mixed ration (TMR) area is currently being developed to incorporate 12 times 34m³ standalone diet feeders as shown in pictures 3 and 4. The feed is distributed down 17 miles of feed barrier by 4 lorries with Kirby bodies. Feeding takes place virtually 24 hours per day and at least 5 groups are being fed every hour. An example diet is shown in appendix 1. These diets are specifically formulated for desert conditions where intakes can be compromised. Note the overall dry matter of the ration at 60% after the inclusion of 7 litres of water per cow diets.

**Photograph 3 – TMR feeders**

**Photograph 4 – TMR feeders**

Dairy Farming in Al kharj has very different problems to farming in the UK. Firstly the heat is relentless and can reach 50⁰ centigrade during the summers and there is only 80mm of rain during winter. This can cause heat stress on the lactating animals, but a comprehensive Koral Cooling system (fans and spray jets) works well and significantly reduces the impact particularly in the collecting yards. Before the Koral Coolers were installed the herd could lose up to 30 cows per day due to heat stress, hence the huge incinerator. Deaths due to heat stress are now minimal.
Heat stress will reduce dry matter intakes and in turn this will reduce body condition which will ultimately impact on fertility. Conception rates can drop by 5% - 10% during the hottest times of the year. Some of the negative effects of temperature during service are reduced by cooling the cows before Artificial Insemination (AI).

The downer cow is particularly at risk of heat stress and death if action is not taken swiftly. Calvings are monitored intensely and there is the added benefit of having a dedicated vet for every 2,000 cows.

Health Benefits

Milking cows in such dry conditions can have significant cow health benefits. Some diseases, which are prevalent in the UK, are only expressed at low levels at Al Safi. Mastitis levels run at less than 1%. Hoof condition and locomotion are exceptionally good. There is no dermatitis or slurry heel. This is probably attributable to dry rations, good structural fibre and low levels of liquid slurry. I spent a night with the foot trimmers and never saw a solar ulcer. One key aspect of health stood out, rumen health was excellent. Dung consistency, 70 chews pre cud and less than 1% recorded cases of displaced abomasums were clear evidence of good rumen function.

Cow longevity and breeding

It had been suggested that cows did not last in Saudi Arabia and this could be true for some dairy units. Al Safi has a reasonably good cow longevity record. Safi cows average 3.5 lactations per cow. This is compared with a UK average estimate of 3.1 lactations per cow according to National Milk Records (NMR). The replacement rate was down to 23% on one unit and Safi sold approximately 1,000 heifers to a neighbouring company in 2008. The manager of Unit 110 took pride in showing records of cows born between 1996 and 1999. If records of cow longevity were not evidence enough, a quick walk through the herd highlighted thousands of cows in good health as shown in photographs 5 and 6.

Photograph 5 – Cow health

Photograph 6 – Cow type
Fertility is inbred into Safi cows due to the culling policy. Cows are permitted a maximum of 4 services to become pregnant; after that they are allocated as barren. The main reason for culling cows is for not being in calf and this removes inherent poor breeders from the system. The breeding policy focuses on positive functional traits. Due to the numbers and risk of inbreeding a different breeding line is used every year. There could be a clear case for using a mating program such a World Wide Sires WMS mating program. This would correctively mate individual cows and eliminate inbreeding.

**Summary - Saudi Arabia**

The Al Safi experience has been unique and has fulfilled a long term ambition. Some of the systems cannot be replicated in UK conditions and some may not be appropriate or profitable, but there are lessons to be learnt.

The success of this massive unit comes from years of pioneering experience. Back in the 1970s and 1980s no company was milking as many cows and what makes it more remarkable is the extreme environment.

High staffing levels and protocols which are strictly adhered to are important drivers. The staff have specific jobs and specialise in their area. There are opportunities for staff to progress within the business and take on more responsibility. Considering the numbers of staff there seemed to be a positive atmosphere with workers taking a pride in their farm.

The much maligned Holstein cow has played a major role in achieving phenomenal milk outputs in the most challenging of conditions.

Fertility management is multi-faceted, but the main reasons behind the success at Al Safi are:

- Dry open diets, which promote good rumen health
- A heat detection rate of 72% through visual observation
- Good herd health with a full vaccination program
- The low levels of liquid slurry leading to dry hard hooves
- Very low numbers of lame cows
- Mastitis levels running below 1% in the herd
- High staffing levels
- Comprehensive protocols
- Dedicated management team
- Cows bred to be fertile
- On site vets
NORTH AMERICAN DAIRY PRODUCTION

I visited a number of dairy units whilst in the USA, varying from 32 cows to 8,000 cows. Most were Holsteins, with a few Jersey, Swedish Red and Brown Swiss mixed in. These were tough financial times for dairy farmers considering they were getting as low as $10/cwt of milk (15p/litre). The US government had taken 150,000 cows out of the system to try to kick start the milk price. Many US dairies are high cost systems and were under severe financial pressure, but still invited me on their farms despite having more pressing problems to think about.

Photograph 7 – Indianhead Holsteins

I started my tour by visiting some of the pedigree Holstein breeders. These tended to be smaller family farms who sold heifers and embryos as a second income stream. One farm was spending $40,000 per year on flushing cows and suggested he was easily getting a return from that. Although I saw some well-bred, well looked after cows (Photograph 7) I quickly became aware that I may not get the fertility information I required. I then focused on larger commercial units who used dairy com 305 to get the benchmark fertility data.

North American Holstein genetics have had an influence worldwide in terms of increasing milk production, but have also had a negative effect on some fitness traits such as rump structure and loin strength. Yields keep pushing up and many herds are producing more than 14,000 litres per cow. This means that these herds are producing 45 litres per cow in milk every day of the year. This has to have an impact on fertility. Conception rates have been as low as 20% in some herds and this is not sustainable.

Nigel Cook at Wisconsin Madison Vet School did suggest that the fall in fertility was slowing and some herds were seeing improvements. BST (bovine somatotropin) is still in the background driving some production, but this is becoming less acceptable. Deans Foods are one of the biggest milk buyers and they do not want BST milk and nor do the cheese processors.

Photograph 8 – Sand bed cubicles

The main drivers of progress in fertility were:

• synchronisation programmes
• increased space
• sand bed cubicles which increases lying time
• a move to less extreme genetics, in terms of stature and angularity.
Many herds were using synchronisation programs and were seeing some exceptional results. One particular herd’s results are shown in table 4.

**Table 4 – G and B Brown herd results (DairyCOMP 305)**

<table>
<thead>
<tr>
<th>Herd Size</th>
<th>Yield/cow/yr (litres)</th>
<th>Calving Index</th>
<th>Culling %</th>
<th>Conception Rate (%)</th>
<th>Av Days in Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>548</td>
<td>14061</td>
<td>405</td>
<td>26</td>
<td>44</td>
<td>184</td>
</tr>
</tbody>
</table>

**Synchronisation programmes**

Specific use of hormones such as oestrogen is common in the UK particularly in higher yielding cows. The use of hormones to treat anoestrus cows and cycling cows can be a useful management tool. Oestrus synchronisation for large groups is usually used only for maiden heifers or for recipients on a flushing programme. These programmes on the whole only synchronise oestrus and not ovulation. The main commercial synchronisation programme available in the UK is the Intercept programme which does synchronise ovulation. This programme is known as Ovsynch in the USA.

The University of Wisconsin, Madison, has further developed synchronisation programmes to synchronise ovulation and use these in conjunction with fixed timed AI. These programmes are being increasingly used to improve fertility and tighten calving intervals. Bovine Somatotrophin Treatment (BST) is still used in the USA, but is becoming less sustainable as milk processors such as Deans Foods choose not to buy BST milk.

Tables 5, 6 and 7 show the typical timeline of the synchronisation programmes. All three systems rely on fixed time AI rather than observation.

**Table 5 – Ovsynch/Intercept programme**

<table>
<thead>
<tr>
<th></th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
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<tbody>
<tr>
<td>Week 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2</td>
<td></td>
<td></td>
<td></td>
<td>GnRH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td></td>
<td></td>
<td>PGF</td>
<td></td>
<td>GnRH (pm)</td>
<td></td>
<td>Timed AI (am)</td>
</tr>
</tbody>
</table>

**Table 6 – Presynch + Ovsynch programme**

<table>
<thead>
<tr>
<th></th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td></td>
<td></td>
<td>PGF</td>
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<td></td>
<td></td>
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<tr>
<td>Week 2</td>
<td></td>
<td></td>
<td></td>
<td>PGF</td>
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<tr>
<td>Week 3</td>
<td></td>
<td></td>
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<td>PGF</td>
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<tr>
<td>Week 4</td>
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<td></td>
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<tr>
<td>Week 5</td>
<td></td>
<td></td>
<td>GnRH</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Week 6</td>
<td></td>
<td></td>
<td>PGF</td>
<td></td>
<td>GnRH (pm)</td>
<td></td>
<td>Timed AI (am)</td>
</tr>
</tbody>
</table>

**Table 7 – Double Ovsynch programme see overleaf**
Improving Fertility in the High Yielding Dairy Cow
A Nuffield Farming Scholarships Trust report by Paul Robinson

Table 7 – Double Ovsynch programme

<table>
<thead>
<tr>
<th></th>
<th>SUN</th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
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<tbody>
<tr>
<td>Week 1</td>
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<tr>
<td>Week 2</td>
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<td>GnRH</td>
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<td>GnRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GnRH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PGF</td>
<td>GnRH (pm)</td>
<td>Timed AI (am)</td>
</tr>
</tbody>
</table>

Note: PGF – Prostaglandin F2α (e.g., Estrumate)
GnRH – Gonadotropin Releasing Hormone (e.g., Receptal, Fertagyl)

Each programme reaches conclusion with fixed timed AI, 16 hours after the last injection of GnRH. Initial results on 2 farms suggested an 8% improvement in conception rate by using Double Ovsynch compared to Presynch + Ovsynch. To many UK farmers this may not seem to be a sustainable option, but it works. It has also been suggested that conception rates are better from observed heats than timed AI and this would point towards an improvement in heat detection before trying synchronisation programmes.

Transition Cow Index (TCI)

There is a big emphasis on the transition cow and its management. The Veterinary department at University of Madison, Wisconsin, have developed an index to assess each herd’s effectiveness in transition management. This Transition Cow Index (TCI) focuses on body condition score change, days to peak yield and a number of other key factors.

The transition period covers 3 weeks before calving and 3 weeks after calving. During this period the cow changes from maintaining pregnancy to full milk production. This period puts hormonal and metabolic stress on the cow. The onset of common diseases also takes place during this period and these are listed in table 8 showing the median days in milk (DIM).

Table 8 – The onset of common dairy diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Median DIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Fever</td>
<td>2</td>
</tr>
<tr>
<td>Retained Placenta</td>
<td>2</td>
</tr>
<tr>
<td>Metritis</td>
<td>8</td>
</tr>
<tr>
<td>Off Feed</td>
<td>16</td>
</tr>
<tr>
<td>LDA</td>
<td>18</td>
</tr>
<tr>
<td>Ketosis</td>
<td>25</td>
</tr>
<tr>
<td>Clinical Mastitis</td>
<td>26</td>
</tr>
<tr>
<td>Enteritis</td>
<td>28</td>
</tr>
</tbody>
</table>
The TCI is calculated by using a cow’s previous lactation to predict the next lactation (Expected Production). The first milk recording (5 to 40 DIM) is recorded and a Projected Production is calculated. The TCI is the Projected Production \textit{minus} the Expected Production. An example TCI is shown in Appendix 3. A positive figure suggests good transition management. The TCI could be an excellent tool in fine tuning transition cow management.

**An Approach to Investigating a Herd Reproductive Performance Problem - Nigel B Cook MRCVS**

Nigel Cook was born and educated in England. He has been working as a vet for the University of Wisconsin, Madison, for a number of years. Nigel worked with Alta Genetics and the Dairy Science Department at the University of Wisconsin to develop an approach to trouble shooting herd reproduction performance. The following summarises the steps taken to analyse herd level performance.

**Top Level Monitors**

These could be described as Key Performance Indicators (KPIs) which are measurable and can easily be benchmarked to compare herds. The numbers are typically based on a 12 month period, but attention is also focused on the last three months' performance, with an emphasis on solving present and not historical problems. All data is collected using Dairy Com 305.

**Top Level Monitors**

1. Voluntary Waiting Period (VWP)
2. Service rate
3. Pregnancy Rate
4. % Re-breeding 3-17 days
5. Conception Rate (CR) to all breeding, first and repeat synchronised breedings and to standing heat and seasonal changes

**The Voluntary Waiting Period (VWP)**

The Voluntary Waiting Period (VWP) has a variety of different interpretations including Days In Milk (DIM) at the first breeding, the DIM at the first synchronization shot and the DIM of the first artificial insemination (AI). The VWP in this case is defined as the DIM at which the 95\textsuperscript{th} percentile of the first breeding is determined. The voluntary waiting period can fluctuate between herds, but is generally between 50 and 80 days particularly in synchronisation programs.

**Service Rate**

The service rate typically ranges from 47 to 67\%, with an average of 57\% for all year round calving.

**Pregnancy Rate**

Pregnancy Rate (PR) has become one of the most widely used KPIs on North American dairy units. The PR is a small number and often variation can seem insignificant. The fact is that a 1 to 2 point variation can indicate a large difference in reproduction performance. It is important not to confuse this with the UK pregnancy rate which analyses the number of pregnancies from the number of services. The
USA 21-day pregnancy rate takes into account all cows available for service in any one period and how many cows were pregnant. For example 10 cows are synchronised, 8 are served and 4 are in calf giving, a conception rate of 50%, but a pregnancy rate of 40% because only 8 out of 10 cows were served. This pregnancy rate is a function of heat detection rate/submission rate and conception rate.

% Re-breeding at 3-17 day intervals
This should be kept below 10%. There are a number of reasons for high rebreeds in this period. The main reason for this in the UK would be poor heat detection. In the USA another reason could be synchronisation failure.
Conception rate is universally recognised as the total number of cows that conceive divided by the number of services, times 100. There are variations in calculation as to which cows are included in the equation.

Secondary Level Monitors
Service Rate Issues
If service rate is poor the investigation will cover the following:
1. First breeding recruitment
2. Re-synchronisation
3. Role of heat detection

New York State and Vermont
Most of the visits were arranged by Paradox Nutrition’s Mary Beth D’Ondarza. Mary Beth frequently writes in Hoard’s Dairyman.

The Miner Institute
Photograph 9 – The Miner Institute
Agricultural Research in the UK has been in decline for a number of years. We have seen the closure of many Experimental Husbandry Farms (EHFs) as funding has been cut. It was therefore refreshing to visit the Miner Institute in Chazy, New York State.
Heart’s Delight Farm was set up in 1903 by the wealthy businessman William H Miner and now covers more than 12,000 acres. The farm was developed to show best practice and provide a practical learning environment for students. This ethos continues today and high level research is combined with education. There is a very useful website and monthly newsletters covering relevant topics.

Katie Ballard is the Director of Research and specialises in reproductive physiology. A recent study has been on improving the conception rate of sexed semen. A summary of this article can be found in a previous Farm Report.
Other work includes the use of intra-vaginal probiotics. This study was undertaken by Heather Dann and showed some very significant results including a reduction in mastitis, cell counts and lameness. The main improvements were increased Dry Matter Intakes (DMIs) and a reduction in the days calving to conception from 145 days to 93 days! Probiotics were administered once a week from 2 weeks before calving to 8 weeks after calving.

**Chaput Farms, Vermont**

If ever there was a case for highlighting what impact an excellent Herd Manager can have, Chaput Farms would be high on the list. Chaput Farms are close to the Canadian border in Vermont. Approximately 850 cows are milked three times a day through a 32:32 rapid exit parlour. The facilities were functional and a new dry cow yard was nearing completion. The main focus of the farm was the development of a bio digester which has now been commissioned in October 2010. The owners had a hands off management style which had led to poor performance in the hands of a lower quality herdsman.

The Herd Manager is Eric Schneider. Eric is a true cow enthusiast and applied every attention to detail in less than favourable circumstances. What made Eric more remarkable was that he is registered legally blind. He reads cow records with a magnifying glass and has a telescope to recognise cows in the yards. His focus and knowledge of the performance figures was as good as any you will find.

The improvement over three years has added another $600,000 to the output. A basic comparison is shown in table 9.

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>L milk/cow/day</td>
<td>23.5</td>
<td>34</td>
</tr>
<tr>
<td>Submission rate %</td>
<td>34</td>
<td>68</td>
</tr>
<tr>
<td>Preg rate %</td>
<td>7</td>
<td>34</td>
</tr>
</tbody>
</table>

A dedicated and proactive herdsman is invaluable to herd performance. This and good nutrition are the two main reasons for such an improvement in performance.

**Green Mountain Dairy – Sheldon, Vermont**

Milk production and future fertility start during the heifer rearing period. In large herds the heifer rearing unit can and should be an enterprise in itself.

Green Mountain Dairy is owned by Brian and Bill Rowell and was set up in 1999. The farm milks 1050 cows and has a purpose built heifer rearing unit which housed 700 heifers from 3 months to calving. Unfortunately the fertility KPIs were not available for this farm on the day, but Green Mountain Dairy has recently been recognised by receiving a Dairy Reproduction Council award for excellent reproductive performance.

*See overleaf for photos of Green Mountain Dairy.*
Changing breed for improved fertility?

Crossbreeding and lower producing breeds than the Holstein will give immediate improvement in fertility traits, but a move to this should be carefully considered. A chance visit to a dairy in Michigan is an example of why a change in breed may or may not be the answer. The identity of this farm will remain anonymous.

This dairy had been pure Holstein for decades. On a three times a day system the milk yield per cow had been approaching 11,500 litres. Fertility had been good, but started to get progressively worse. This in turn was holding back milk production. The owner decided to use some different breeds to improve fertility and make management easier. Each breed was being recorded independently to measure milk yield and fertility in an attempt to ascertain which breed was most suitable for the farming system.

Photograph 12 – Jersey, Norwegian Red and Holstein

On arriving the first cow seen was a Holstein cow in less than perfect body condition and it’s true that all farms have some of these. Moving through the cows at the feed fence the different breeds were obvious and some were in very good health, see photograph 12. The two cowmen were milking and when asked which breed they thought worked the best, both said that they were just cows! From a personal viewpoint, when a cow becomes just a cow you should forget the Holstein because it is not just a cow.

On closer inspection the cow track to the grazing area was very rough and likely to cause trauma to cow’s feet. The feed barrier had originally been in the correct position, but was now broken and had been replaced with a mains electric fence. A number of calluses were apparent particularly on the larger Holstein cows. Some cubicles had been broken and were left where they had fallen. The building was noticeably dark with poor airflow.

The situation described is not just seen on this farm, but is present on many farms worldwide including the UK. The main problem on this farm was not the breed, but a loss of
Photograph 13 – Neck callus, broken feed fence and electric wire

Breeding for fertility

The relatively new fertility indices give an opportunity to breed for fertility. The heritability of fertility traits is low at 0.16 (optimistic) compared to 0.42 for stature, but is still worth considering for sire selection. When looking at fertility traits it is clear to see that the fertility index has a negative correlation with increasing milk yield, i.e. most bulls with a positive fertility index have a lower index for milk yield. It is important to consider fertility as part of the selection process, but keep focused on other traits which are equally important.

Focus on breeding a durable Holstein cow, a cow that is wide from chest to rump. It should be open ribbed giving size and not stature. Good legs and feet are paramount for intensive, mainly housed, systems. Most bulls will be positive for milk yield so this does not have to be a primary consideration therefore giving an opportunity to focus on type traits.

For the future a trait which is currently not covered is the ability of the cow to moderate body condition. With the correct environment and nutrition some cows have the ability to maintain body condition year in year out and this has got to improve fertility.

Mystic Valley Holsteins

One of the last visits in the USA was to Mystic Valley Holsteins. Mitch Breunig milks 420 cows on a purely commercial system. He also bred a bull called Toystory which has been used worldwide and even here in the UK. Our second eldest daughter showed a Toystory calf at a local show. The cows at Mystic Valley were strong and open ribbed with plenty of width.

Mitch had been working with the University of Wisconsin Madison on the double ovsynch programme with some good results. The fertility figures are shown in table 10.

Table 10 – Mystic Valley fertility KPIs

<table>
<thead>
<tr>
<th>Herd Size</th>
<th>Yield/cow/yr (litres)</th>
<th>Calving Index</th>
<th>Culling %</th>
<th>Conception Rate (%)</th>
<th>Av Days in Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>420</td>
<td>13155</td>
<td>407</td>
<td>28</td>
<td>43</td>
<td>177</td>
</tr>
</tbody>
</table>
One of the key drivers of the Mystic Valley performance was the attention to nutrition. Mitch focuses on dry open diets which encouraged high intakes.

An example of a high yielding diet is shown in Appendix 2. Note the expected DMI of 30kg. This is a high yielder’s ration giving M+ 50 litres per cow.
SWEDEN

The Swedish tour was almost all organised by Christer Bergsten. Anybody who knows in any detail about cow’s feet will know of Christer. He lectures worldwide on foot health and related subjects. He is a big advocate of rubber surfaces and has done extensive research to prove the benefits. Telezhenko (2008) concluded that cows had a preference to rubber matting. The three main findings were:

1. Elastic rubber mats improved the gait of lame and non-lame cows. This was particularly noticeable when compared to slippery concrete.

2. Lame cows showed reduced discomfort on rubber floors.

3. When given a choice cows preferred to stand on rubber flooring.

Improving grip and comfort in cow standing/loafing areas should increase bulling behaviour. This in turn should improve conception rates, although this evidence is only anecdotal to date.

There are many rubber mats on the market; some are good and some are poor. Rubber matting can be slippery if there is limited elasticity in the product. Rubber matting used on floors needs to be pliable to give good grip for the cow. Kraiburg rubber matting has the desired properties and is probably the best on the market.

Sweden’s Dairy Health Impact

Average milk yields in Sweden are above 9,000 litres for both black and white as well as red and white breeds. The average herd has 65 cows and many of these are in tie stall barns. The Swedish Dairy Association’s health recording is world renowned, but it was the cow health that was impressive. BVD and IBR have been eradicated and lameness cases are below 5% in herds.

Photograph 15 – Robot and housing

Due to the health problems in the UK and North America, cow cubicle sheds there are being designed with more space and 2 rows of cubicle per feed stance. Ventilation has been improved and more light provided with an emphasis on cow comfort.

It was therefore surprising to see in Sweden 3 and 4 rows of cubicles per feed stance, 2.5 metre passages and no loafing areas (photograph 15). This did not seem to be affecting fertility and did emphasise a good point that healthy animals have less immune challenges and can endure production pressure and stress more readily.
This poses the question as to whether UK cows are immune challenged? The UK is not a closed herd and we need only look at the spread of foot and mouth disease in 2001 to confirm this. The UK herd faces many immune challenges such as BVD, Leptospirosis and neospora. It would be interesting to analyse figures from genuine closed herds in the UK if they exist.

**Olof Janson – Kartorps Sateri**

Nuffield presents a unique opportunity to meet inspirational people and Olaf Janson is one such individual. My experience of organic dairy systems has been limited to more extensive grass grazing systems, but Olaf Janson’s farming system has changed my ideas of what can be achieved in an organic situation.

The milk production and combined fertility figures are shown in table 11. These figures would look good even without a premium organic milk price. The milk price of 3.83 Sw Cr/kg equates to 36p/kg.

**Table 11 – Kartorps KPI’s**

<table>
<thead>
<tr>
<th>Breed</th>
<th>Number</th>
<th>Kg milk</th>
<th>Fat %</th>
<th>Prot %</th>
<th>Calving Interval</th>
<th>1st calving (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holstein</td>
<td>223</td>
<td>9953</td>
<td>4.0</td>
<td>3.2</td>
<td>380</td>
<td>25.6</td>
</tr>
<tr>
<td>SRB</td>
<td>110</td>
<td>8535</td>
<td>4.1</td>
<td>3.3</td>
<td>362</td>
<td>25.7</td>
</tr>
<tr>
<td>Total/Av</td>
<td>333</td>
<td>9428</td>
<td>4.0</td>
<td>3.2</td>
<td>371</td>
<td>25.6</td>
</tr>
</tbody>
</table>

**The farming system at Kartorps**

*Photograph 16 – Raised rubber indexed feed stance*

Kartorps has 800 hectares of arable and grassland. The silage is harvested using forage wagons and therefore has a good chop length. The typical ley mixture is 25% alfalfa, 35% timothy Ragnan, 15% rye fescue Felopa, 10% red clover, 5% white clover, 5% meadow fescue and 5% English ryegrass.

The 7 year crop rotation is integral to the system and is shown in table 12 (next page).

Photograph 16 shows a raised feed stance with indexed feed spaces. This reduces slurry heel and dermatitis.
Improving Fertility in the High Yielding Dairy Cow
A Nuffield Farming Scholarships Trust report by Paul Robinson

Table 12 – Crop Rotation at Kartorps

<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
<th>Normal yield (t dm/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wholecrop beans + wheat/triticale</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Silage ley – 3 cuts</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>Silage ley – 2 cuts</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Winter Oilseed Rape</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>Winter Triticale or Winter Wheat</td>
<td>5.5</td>
</tr>
<tr>
<td>6</td>
<td>Winter Beans or Winter Triticale</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Oats, Wheat or Triticale</td>
<td>5</td>
</tr>
</tbody>
</table>

A self-propelled diet feeder feeds two milking groups which receive 66% and 72% of the dry matter as forage. The TMR is shown in table 13.

Table 13 – Total Mixed Ration

<table>
<thead>
<tr>
<th>Feed</th>
<th>Inclusion %</th>
<th>ME (mj/kg dm)</th>
<th>Crude protein (g/kg dm)</th>
<th>NDF (g/kg dm)</th>
<th>Fat (g/kg dm)</th>
<th>Starch (g/kg dm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Cut</td>
<td>24</td>
<td>11.5</td>
<td>128</td>
<td>436</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>2nd Cut</td>
<td>28</td>
<td>10.2</td>
<td>177</td>
<td>418</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Wholecrop</td>
<td>13</td>
<td>10.0</td>
<td>150</td>
<td>455</td>
<td>30</td>
<td>88</td>
</tr>
<tr>
<td>Pre mix</td>
<td>35</td>
<td>15.1</td>
<td>211</td>
<td>175</td>
<td>91</td>
<td>449</td>
</tr>
<tr>
<td>Total/Av</td>
<td>100</td>
<td>12.2</td>
<td>174</td>
<td>342</td>
<td>46</td>
<td>169</td>
</tr>
</tbody>
</table>

Ration includes straw minerals and salt.
The premix is virtually all home grown with the exception of the peas. A summary is shown in table 14. (overleaf)
Kartorps was the only organic dairy I visited during this Nuffield study and it proved to be an inspiration. Olaf Janson is not only a very successful organic dairy farmer, but he helped write a book on the local flora in his district. A system like Kartorps does require a large land base, but provides a very profitable enterprise.
Swedish Breeding Programme

Sweden has long focused breeding on health traits. The Nordic Total Merit (NTM) index is used for bull selection similar to the UK Profitable Life Index (PLI). The NTM is heavily weighted towards health traits as shown below:

<table>
<thead>
<tr>
<th>Traits</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>33</td>
</tr>
<tr>
<td>Health</td>
<td>50</td>
</tr>
<tr>
<td>Conformation</td>
<td>13</td>
</tr>
<tr>
<td>Workability</td>
<td>4</td>
</tr>
</tbody>
</table>

The breakdown of the Nordic Total Merit (NTM) index and a comparison between the selection indices between different countries is shown in appendices 7 and 8. In summary the Nordic countries and Sweden in particular have had a consistently high emphasis on health and welfare traits such as lameness and mastitis. This has produced a cow which is slightly lower yielding, but has an inbred durability.

Swedish summary

The Swedish experience was excellent. The help given by Christer Bergsten and The Swedish Dairy Association (SDA) has been invaluable. The data provided by the SDA has yet to be completely analysed as most of this was in Swedish. The recording process and data collection provides some excellent results and could be used to provide further analysis.

The background details of Swedish milk production are included in Appendix 48. Herd size in Sweden is smaller than in the UK at 65 cows compared to 113 cows in the UK. The average milk yield of 8,324 litres per cow is significantly higher in Sweden than the UK at 7,096 litres per cow.

There are a high number of robot milked herds in Sweden. Approximately 600 herds out of 5,800 are milked in robot parlours. The largest herds tend to be around 300 to 500 cows, but these are a small proportion. It was clear that cow health and durability was integral to the success of Swedish herds. The health status and low disease challenge meant that cows could be housed at a high stocking density with no detrimental effects. This is quite different to the UK where space, loafing areas and lower stocking densities are being used to reduce cow stress. As Swedish herds inevitably get bigger and the Holstein influence takes hold some Swedish units will need to pay more attention to space and stocking density. Fredrick Lindeberg’s new 300 cow unit near Tvaaker has been built with this in mind. Technology is also used for labour saving which could give more dedicated cow time per man (photograph 18).

Swedish dairy diets contain little or no maize silage. Grass silage is the staple forage and much of this is fed as round bale silage. The long fibre has a positive effect on rumen stability and starch is fed in the form of wheat or barley.
The number of hours per cow per year is an important factor which can influence herd health and fertility. Sweden averages 40 man hours per cow compared to Denmark which averages 20 man hours per cow. The UK is likely to be nearer 20-25 man hours per cow.

Lameness and poor fertility go hand in hand. Lame cows will have reduced dry matter intakes and reduced body condition which will lead to poorer fertility. Research into lameness has been comprehensive, but the key to reducing lameness is prevention. Swedish cows are foot trimmed on average 1.5 times per year and this helps produce a national average of lameness of less than 5%. This compares to a UK average of nearer 40%.
Welfare and its relationship to health and reproduction

Dairy cow welfare is firmly in the spotlight in the UK. The mere mention of the Nocton 8,000 cow unit is guaranteed to attract comment, many of which are negative. Welfare on some dairy units is average at best and this is highlighted in a level of lameness above 40%.

The European Food Safety Authority (EFSA) has recently produced a report on the impacts of poor welfare on dairy cows in relation to metabolic and reproduction problems. This was based on a risk assessment with special reference to the impact of housing, feeding management and genetic selection.

This paper concluded that the most important hazards in relation to housing were poor space allocation although this had a lower risk with straw yards. Ventilation, humidity and temperature were the most important in straw yards.

Inadequate transition feeding had the most important influence on metabolic and reproduction disorders in housed herds. Over feeding in late lactation was shown to have the 2nd highest risk.

The level of inbreeding was also implicated in reduced herd health. Inbreeding is increasing by 0.17 to 0.20% per year. This can lead to poor reproduction and reduced lifetime milk.

The highest ranked management hazard was biosecurity. This could be inter farm or between individual livestock. The apparent level of poor biosecurity in the UK was highlighted with devastating effect with the 2001 Foot and Mouth epidemic.

Water quality was also highlighted as a key risk. Poor quality water will often have an odour, foul taste and may contain infectious agents.

Dystocia was also implicated in a number of future problems such as retained cleansings, and other genital infections.

The EFSA report suggested that hormone treatment should not be a substitute for poor nutrition, housing, handling and management.

**EFSA Report Summary**

The EFSA report scientifically pulls together what many farmers and advisors already know. One key area which could be improved quickly and cost effectively is biosecurity. As dairy farmers we can learn a lot from the pig industry. Sweden also has strict biosecurity and this helps keep an exemplary level of herd health.

Increasing cow space is important to reduce stress. Many dairy units in the UK are in the process of renewing small cubicles and allowing greater loafing areas in winter housing. This is bound to have a positive impact on cow welfare. We can learn much from Sweden on cow health, but Sweden should also take note from the UK and when expanding dairy units allow more space for the larger cow.
Fertility as an identifier of poor welfare

Dairy cow welfare is clearly in the spotlight both within the European continent and closer to home in the UK.

It is clear to anyone who has worked with extremely high yielding cows that good welfare equals efficient milk production. Anything less and cow health will deteriorate along with profitability.

The research paper ‘Using a national database to identify herds with poor welfare’ has developed a methodology for identifying poor welfare in dairy herds by using database records. This work was carried out with the help of the Swedish Dairy Association (SDA) using its comprehensive database. Cow fertility is an indicator of other herd management issues such as environment, nutrition and health. The main fertility KPIs used were calving interval and number of cows not served by 120 days. The Swedish Dairy Association are already formulating tools for improved animal welfare which include recognition systems and training courses.

It will not be as easy to implement this type of system in the UK due to the lack of recording on many farms. This does not stop the commitment to improved welfare as seen by the Dairy Cow Welfare Strategy 2010 which has been developed by the National Farmers Union. It would not be surprising to see fertility performance coming higher up the agenda during a farm assurance visit in the future.
Conclusions

1. The focus of this Nuffield study tour has specifically been dairy cow fertility but inevitably the spot light has been on the Holstein cow. I do not hold the view that the Holstein is a frail ‘hat rack’. I feel lucky to have worked with some very good, profitable Holsteins, or maybe that was not luck but passion and a relentless attention to detail.

2. This Nuffield Scholarship Report does not provide a silver bullet for fertility improvement across all herds. It is clear that all herds are different in many aspects including housing, genetics and nutrition management. When pushing for higher yields, attention to detail in all areas is critical. The payback for higher yield is good provided other health costs and significantly poorer fertility don’t increase disproportionately.

3. The study suggests that having a healthy cow is the starting point for good fertility. Closed herds and disease elimination provides for healthy cows. These animals would appear to have better immune systems and are therefore able to cope with more production pressure. Even post Foot and Mouth 2001, biosecurity on UK farms is average at best. Biosecurity is not just about farm to farm, it is about internal biosecurity. For example keeping calf housing separate, avoiding through traffic and having a disinfection routine between young stock and older animals. Much can be learned from the pig industry in regard to biosecurity and protocols.

4. Poor fertility is caused by a number of often complex factors. It is easy to highlight the negative correlation of yield per cow and fertility because this can be clearly measured, but this is not the whole picture. Many high yielding cows across the world have acceptable fertility and it is unrealistic to expect more yield at no extra cost. Some American herds were producing over 14,000 litres with a conception rate over 44% and a calving interval of 410 Days. This shows the capability of the Holstein with the correct management.

5. Although health traits are multi-factorial, lameness management is crucial to fertility improvement. Herds with rigid hoof care regimes have increased heat detection rates, increased conception rates, and therefore increased the number of pregnant cows. Many farms do not have good hoof care programs and this shows in the level of lameness in UK herds (approximately 40%). A universal locomotion scoring system is now available and this have should be used comprehensively as a management tool to reduce lameness. Lameness is one health issue that can only be tackled at farm level. Every cow’s foot should be lifted at least once a year and treated appropriately.

6. The multifactorial complexity of dairy cow fertility makes it difficult to improve with a single magic ingredient. Each farm will have different fertility issues and it is important to isolate these. The starting point has to be recording. Many computerised systems are available, but are often underutilised. One of the most notable aspects of the USA and Swedish dairy farms I visited was the universal recording systems. In Sweden the Swedish Dairy Association handles most of the
Improving A
Nuffield

11.

10.

8.

Manipulation.

It

production

with

bred

cases

either

The

The

space,

generation

give

The

Al

analyzed

management
to

recorded

Medicine

cows.

Veterinary

management
to

record

Veterinary

account

This

Al

Al

suited

The

milk.

Dairy

farms

are

all

and

that

which

many

high

herds

are

not

health

record

and

this

needs

to

improve.

The

data

needs

to

be

clear

and

concise.

Packages

such

as

Kingshay’s

Health

Manager

give

clear

and

concise

printouts

that

can

be

analysed

quickly.

7.

The

impact

of

proactive

veterinary

advice

cannot

be

overstated.

Veterinary

and

medicine

costs

are

often

targeted

when

the

financial

pressure

is

on,

but

good

veterinary

intervention

will

drive

output

through

improved

fertility.

In

UK

situations

proactive

veterinary

advice

will

often

be

less

than

4% of

total

costs.

8.

Improving

fertility

starts

with

heat
detection.

With

a

UK

average

heat
detection

rate

of

only

45% most

herds

will

be

challenged

to

achieve

an

acceptable

calving

interval.

Al

Safi

dairy

improved

heat
detection

by

having

staff

rotas

solely
to

detect

heat

and

serve

cows.

The

high

yielding

USA

dairy

units

took

heat
detection

in

hand

by

using

synchronisation

programs.

The

message

is

clear:

heat
detection

needs

taking

in

hand

either

by

manual

observation,

technology

such

as

pedometers,

or

by

hormonal

manipulation.

9.

It

is

clear

that

the

Holstein

cow

is

the

target

of

a

great

deal

of

criticism

and

in

some

cases

this

is

justified.

This

animal

should

be

marvelled

at

for

its

ability

to

convert

a

range

of

feeds

and

forages

into

milk.

Given

the

right

management

this

animal

will

give

a

long

lasting

return.

If

there

is

any

question

about

longevity,

a

Holstein

cow

bred

by

Larry

Jerome

of

Jerland

Holsteins

in

North

Wisconsin

could

be

the

10th

generation

excellent

cow

that

has

given

at

least

18,000

litres

in

one

lactation.

This

means

that

all

maternal

grandparents

have

had

a

minimum

of

3

lactations.

What

makes

this

more

remarkable

was

that

all

these

animals

had

been

housed

in

a

tie

stall

barn.

10.

The

starting

point

for

good

fertility

is

having

the

right

environment,

cow

comfort,

space,

ventilation,

light,

hygiene

and

diet.

You

would

not

expect

an

Olympic

athlete

to

perform

with

poor

training

facilities

and

diet.

Many

dairy

units

have

not

moved

with

modern

day

genetics

and

in

a

way

the

breeding

program

has

been

a

victim

of

its

own

success.

If

farms

are

not

prepared

to

change

the

dimensions,

facilities

and

management

then

alternative

genetics

should

be

sourced.

There

are

dairy

cow

genetics

across

the

world,

which

are

suited

to

different

systems.

11. The modern herdsperson

The

role

of

the

herdsperson

needs

to

evolve,

to

cater

for

increased

cow

numbers

and

production

pressure,

swapping

the

muck

fork

for

the

laptop.

The

main

focus

should

be

‘cow

time’

which

centres

around

health

and

production.

A

significant

amount

of

the

herdsman’s

time

should

be

dedicated

to

the

following:
- Recording – milk, fertility, cow health and key KPIs
- Record analysis
- Fertility analysis
- Heat detection and AI
- Liaison with vet/nutritionist/advisors
- Herd health monitoring
- Hoofcare
- Transition cow management and fresh cow checks
- Staff management, development and training
- Embracing and developing protocols
- Ground level nutrition e.g. diet presentation and monitoring

12. The management approach needs to be preventative rather than take a fire fighting attitude. Good herdspersons are invaluable and should be treated as such. The herdsperson needs to be given time to do the important tasks listed above and lower-skilled labour should be employed to do the basic manual tasks. UK herdspersons are often over stretched, doing too many jobs at once. A normal day could comprise of milking, feeding, bedding and tractor tasks when the most important work is herd management tasks. Some herdspersons are not good at routines, but can drive larger more progressive units along with strict protocols.
Future Focus

I have presented to at least 10 farmer groups during 2009 and 2010 and there will be more to come in 2011. The focus of the presentation has been the ability of the Holstein to produce oceans of milk and be reasonably fertile in a range of farming systems. As I have stressed during this report, fertility is multifactorial and to keep the Holstein on track there are no shortcuts.

In the future it will be a back to basics approach; encouraging farmers to employ good herdsman/herdswomen and giving them the responsibility they require as it is dedicated man hours per cow that counts. Herdsman need more high level training in data analysis, basic practical nutrition and herd health. I don't like to see herdsmen on large units bedding calves and driving tractors. Strict routines and protocols sound mundane but need to be instigated and adhered to daily.

For my consultancy role, there will a greater emphasis on training and educating rather than just telling the client, with more emphasis on explaining the background behind the decisions made, backed up by sound research and data. My company, Kingshay, is in a unique position to provide this and already leads the field in many aspects of knowledge transfer.

Technology will play a greater role in future herd management. I have experienced some cutting edge technology on my travels including the ‘Smart Bolus’ which checks cow health and movement from within the rumen. A cow tracking system is also available for monitoring cow movements in very large herds. This system has wi-fi connectivity and will enable monitoring of individual cows within massive herds.
Acknowledgements

It would not have been possible to undertake this project without the help, support and guidance of a number of individuals and organisations. I would like to thank the following:

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- The Newcastle University Mac Cooper Award
- Kingshay Farming and Conservation for allowing me the extra time to tour during 2009
- Matthew Currie, my referee and source of inspiration to do this
- My wife Rachel for being supportive in every way, whilst looking after our 5 wonderful children, Emily, Jessica, Chloe, Owen and Lauren
- Malcolm Graham for converting the dairy rations into UK format

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- John Lawton, my sponsor, who arranged the fantastic opportunity to visit Al Safi
- Russell Wards the Herds Manager who organised day to day visits and joined me for dinner most evenings
- All the Al Safi staff, too numerous to mention, who were extremely helpful

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- David and Joan Wieckhart for accommodation in Madison and introducing myself and Andrew Mycock to Rosendale Dairy
- Mary Beth De Ondarza, a renowned dairy nutritionist, for my visits in Vermont
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- Mitch Breunig of Mystic Valley for a great visit and recommending other Wisconsin herds
- Nigel Cook of University of Wisconsin Veterinary School. An English vet who is helping to improve fertility in the USA.
- Larry Gerome, Jerland Holsteins a breeding enthusiast from dogs and horses to Holsteins
- University of Wisconsin Madison – All staff who supported my visit

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- The Swedish University of Agricultural Sciences (SLU)
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- Hans Magnussen of HBGentics for arranging visits in Southern Sweden
Bibliography

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- Green Mountain Dairy, Sheldon, Vermont
- Chaput Family Farms, North Troy, Vermont
- Green Dreams Dairy, 149 Bliss Road, Enosburg Falls, Vermont
- Dr Mary Beth De Ondarza, Paradox Nutrition, LLC, 413 Lake Shore Road, West Chazy, NY 12992. paradoxnut@westelcom.com
Improving Fertility in the High Yielding Dairy Cow
A Nuffield Farming Scholarships Trust report by Paul Robinson

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- David Fisher, Mapleview Dairy, 307 Jones Road, Madrid, NY
- Debora Wickhart, Hooters Holsteins, 730 Bliss Hill Rd, Morrisville, VT 05661. hootersholsteins@aol.com
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- Hanna Lomander, Swedish University of Agricultural Sciences (SLU), Skara, Sweden
- Christer Bergsten, Swedish University of Agricultural Sciences (SLU), Skara, Sweden
- Lena Lidfors, Swedish University of Agricultural Sciences (SLU), Skara, Sweden
References

- Dairy Cattle Fertility and Sterility (2007). *Hoard’s Dairyman*

- Dairy Cow Welfare Strategy (2010). *NFU*


- The William H. Miner Agricultural Research Institute. Farm Reports. [www.whminer.org](http://www.whminer.org)
## Appendix 1 – Al Safi diet

### Formulation report

**CLIENT DIETS**

Nutritionist: Malcolm R Graham - CMD Agribusiness   Tel: 07989 985937 or 01938 590615

**Diet name:** 100916 Al Safi Milker (White)

<table>
<thead>
<tr>
<th>Animal breed:</th>
<th>Holstein - High</th>
<th>Milk Yield (kg/d):</th>
<th>45.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg):</td>
<td>680</td>
<td>Milk fat (%):</td>
<td>3.6</td>
</tr>
<tr>
<td>Fat mobilisation change (kg/d):</td>
<td>-0.20</td>
<td>Milk protein (%):</td>
<td>3.1</td>
</tr>
<tr>
<td>Growth rate (kg/d):</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days calved:</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactation:</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition score:</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Feeds

<table>
<thead>
<tr>
<th>Feeds</th>
<th>Amount fed (kg as fed/head/d)</th>
<th>kg DM/head/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Cracked</td>
<td>0.260</td>
<td>0.224</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>1.800</td>
<td>1.663</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>1.360</td>
<td>1.333</td>
</tr>
<tr>
<td>Flaked Corn (Al Safi)</td>
<td>3.400</td>
<td>2.992</td>
</tr>
<tr>
<td>Flaked Corn (ARASCO)</td>
<td>3.500</td>
<td>3.080</td>
</tr>
<tr>
<td>Corn Wet Fibre</td>
<td>5.200</td>
<td>2.288</td>
</tr>
<tr>
<td>Water</td>
<td>7.200</td>
<td>0.018</td>
</tr>
<tr>
<td>Yeast Pack</td>
<td>0.020</td>
<td>0.020</td>
</tr>
<tr>
<td>Buffer</td>
<td>0.200</td>
<td>0.192</td>
</tr>
<tr>
<td>Al Safi 21</td>
<td>2.000</td>
<td>1.740</td>
</tr>
<tr>
<td>Veg ByPass Protein</td>
<td>1.400</td>
<td>1.232</td>
</tr>
<tr>
<td>Alfalfa Hay Al Safi</td>
<td>8.000</td>
<td>6.800</td>
</tr>
<tr>
<td>Barley Silage Al Safi</td>
<td>4.400</td>
<td>1.430</td>
</tr>
<tr>
<td>Soya Meal</td>
<td>0.120</td>
<td>0.106</td>
</tr>
<tr>
<td>Energizer</td>
<td>0.500</td>
<td>0.495</td>
</tr>
</tbody>
</table>

*Continued overleaf*
**Improving Fertility in the High Yielding Dairy Cow**

A Nuffield Farming Scholarships Trust report by Paul Robinson

**TMR diet**

<table>
<thead>
<tr>
<th>As Fed intake (kg/d): 39.4</th>
<th>Diet DM (%): 60.0</th>
<th>Cost (£/head/d):</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nutrient (Units/d)</th>
<th>Intake</th>
<th>%DM</th>
<th>Requirement</th>
<th>Shortfall/Excess</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM (kg)</td>
<td>23.6</td>
<td>21</td>
<td></td>
<td>2.6</td>
</tr>
<tr>
<td>Forage DM (kg)</td>
<td>8.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forage as fed (kg)</td>
<td>12.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ME (MJ)</td>
<td>292.8</td>
<td>12.4</td>
<td>300.0</td>
<td>-7.2</td>
</tr>
<tr>
<td>ME (%req)</td>
<td>97.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk from ME (kg)</td>
<td>43.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein (%DM)</td>
<td>17.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP (g)</td>
<td>2849.6</td>
<td>12.07</td>
<td>2670.7</td>
<td>178.8</td>
</tr>
<tr>
<td>MP (%req)</td>
<td>106.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERDP (g)</td>
<td>2116.5</td>
<td>8.96</td>
<td>1708.4</td>
<td>408.2</td>
</tr>
<tr>
<td>ERDP (%req)</td>
<td>123.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DUP (g)</td>
<td>1760.5</td>
<td>7.46</td>
<td>1581.6</td>
<td>178.8</td>
</tr>
<tr>
<td>Rumen Starch (g)</td>
<td>4732.3</td>
<td>20.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undeg Starch (g)</td>
<td>961.2</td>
<td>4.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starch plus Sugar (g)</td>
<td>6626.0</td>
<td>28.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDF from Forage (g)</td>
<td>3872.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSV</td>
<td>114.6</td>
<td>114.0</td>
<td></td>
<td>0.6</td>
</tr>
<tr>
<td>Calcium (g)</td>
<td>322.3</td>
<td>1.37</td>
<td>136.0</td>
<td>186.3</td>
</tr>
<tr>
<td>Phosphorus (g)</td>
<td>127.2</td>
<td>0.54</td>
<td>88.9</td>
<td>38.3</td>
</tr>
</tbody>
</table>
Formulation report

CLIENT DIETS
Nutritionist: Malcolm R Graham - CMD Agribusiness  Tel: 07989 985937 or 01938 590615

<table>
<thead>
<tr>
<th>Diet name: 100916 Al Safi Milker (White)</th>
<th>Nutrient (Units/d)</th>
<th>Intake</th>
<th>%DM</th>
<th>Requirement</th>
<th>Shortfall/Excess</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium (g)</td>
<td>109.3</td>
<td>0.46</td>
<td>44.8</td>
<td>64.5</td>
<td></td>
</tr>
<tr>
<td>Vitamin E (iu)</td>
<td>1589.4</td>
<td></td>
<td>528.6</td>
<td>1060.8</td>
<td></td>
</tr>
<tr>
<td>Vitamin E (supp) (iu)</td>
<td>1149.6</td>
<td></td>
<td>544.0</td>
<td>605.6</td>
<td></td>
</tr>
<tr>
<td>Ash (g)</td>
<td>2223.0</td>
<td>9.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lys (g/100g MP)</td>
<td>6.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Met (g/100g MP)</td>
<td>1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium (g)</td>
<td>314.3</td>
<td>1.33</td>
<td>259.3</td>
<td>55.1</td>
<td></td>
</tr>
<tr>
<td>DCAB (mEq/kgDM)</td>
<td>142.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper (mg)</td>
<td>966.6</td>
<td></td>
<td>304.0</td>
<td>662.6</td>
<td></td>
</tr>
<tr>
<td>Cu availability (%Cu)</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>2497.2</td>
<td>0.36</td>
<td>868.5</td>
<td>1628.7</td>
<td></td>
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<tr>
<td>Sodium (g)</td>
<td>84.4</td>
<td></td>
<td>47.0</td>
<td>37.5</td>
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<tr>
<td>Chlorine (g)</td>
<td>126.3</td>
<td>0.53</td>
<td>71.1</td>
<td>55.3</td>
<td></td>
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<td>Oil (AH) (%DM)</td>
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<td>Calcium (%DM)</td>
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<td>Phosphorus (%DM)</td>
<td>0.5</td>
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<td>Magnesium (%DM)</td>
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<td>Forage NDF deg (%ForNDF)</td>
<td>69.5</td>
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</table>
## Appendix 2 – Mystic Valley diet

### Formulation report

**CLIENT DIETS**

Nutritionist: Malcolm R Graham - CMD Agribusiness  Tel: 07989 985937 or 01938 590615

Diet name: 100916 Mystic Valley Milker

<table>
<thead>
<tr>
<th>Animal breed:</th>
<th>Holstein - High</th>
<th>Milk Yield (kg/d):</th>
<th>50.0</th>
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</thead>
<tbody>
<tr>
<td>Weight (kg):</td>
<td>680</td>
<td>Milk fat (%):</td>
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<tr>
<td>Fat mobilisation change (kg/d):</td>
<td>0.00</td>
<td>Milk protein (%):</td>
<td>3.3</td>
</tr>
<tr>
<td>Growth rate (kg/d):</td>
<td>0.00</td>
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</table>

Days calved: 50  
Lactation: 2  
Condition score: 2.5

### Feeds

<table>
<thead>
<tr>
<th>Feeds</th>
<th>Amount fed (kg as fed/head/d)</th>
<th>kg DM/head/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Silage</td>
<td>21.400</td>
<td>7.297</td>
</tr>
<tr>
<td>Haylage 3rd</td>
<td>17.800</td>
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<tr>
<td>Shell Corn Ground</td>
<td>4.900</td>
<td>4.214</td>
</tr>
<tr>
<td>Hominy</td>
<td>2.500</td>
<td>2.200</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>2.300</td>
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<tr>
<td>Megalac</td>
<td>0.160</td>
<td>0.152</td>
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<tr>
<td>Straw -Wheat</td>
<td>0.230</td>
<td>0.198</td>
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<tr>
<td>Mineral Supplement</td>
<td>1.360</td>
<td>1.333</td>
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<tr>
<td>TMR Protein Mix</td>
<td>4.200</td>
<td>3.751</td>
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### TMR diet

- **As Fed intake (kg/d):** 54.8  
- **Diet DM (%):** 54.6  
- **Cost (£/head/d):** 0.00
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<thead>
<tr>
<th>Nutrient (Units/d)</th>
<th>Intake</th>
<th>%DM</th>
<th>Requirement</th>
<th>Shortfall/Excess</th>
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</thead>
<tbody>
<tr>
<td>DM (kg)</td>
<td>30.0</td>
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<td>24.7</td>
<td>5.3</td>
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<tr>
<td>Forage DM (kg)</td>
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<tr>
<td>Forage as fed (kg)</td>
<td>39.4</td>
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<tr>
<td>ME (MJ)</td>
<td>363.2</td>
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<td>338.2</td>
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<td>ME (%req)</td>
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<tr>
<td>Milk from ME (kg)</td>
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<td>Protein (%DM)</td>
<td>18.4</td>
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<td>MP (g)</td>
<td>3395.4</td>
<td>11.33</td>
<td>3161.0</td>
<td>234.4</td>
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<tr>
<td>MP (%req)</td>
<td>107.4</td>
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<tr>
<td>ERDP (g)</td>
<td>3252.1</td>
<td>10.85</td>
<td>2516.5</td>
<td>735.7</td>
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<td>ERDP (%req)</td>
<td>129.2</td>
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<tr>
<td>DUP (g)</td>
<td>1791.2</td>
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<td>1556.7</td>
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<td>Rumen Starch (g)</td>
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<td>Undeg Starch (g)</td>
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<td>Starch plus Sugar (g)</td>
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<td>NDF from Forage (g)</td>
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<td>RSV</td>
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<td>Phosphorus (g)</td>
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<td>Magnesium (g)</td>
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<tr>
<td>Vitamin E (iu)</td>
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<td>Ash (g)</td>
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<td>Lys (g/100g MP)</td>
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<tr>
<td>Met (g/100g MP)</td>
<td>1.8</td>
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</table>
**Formulation report**

**CLIENT DIETS**

Nutritionist: Malcolm R Graham - CMD Agribusiness  Tel: 07989 985937 or 01938 590615

**Diet name:** 100916 Mystic Valley Milker

<table>
<thead>
<tr>
<th>Nutrient (Units/d)</th>
<th>Intake</th>
<th>%DM</th>
<th>Requirement</th>
<th>Shortfall/Excess</th>
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<tbody>
<tr>
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<td>Chlorine (g)</td>
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<td>Iodine (mg)</td>
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<td>Selenium (mg)</td>
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<td>NDF (g)</td>
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<td>Oil (AH) (g)</td>
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<td>Marg Milk Yield (kg)</td>
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<td>Magnesium (%DM)</td>
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<td>Forage NDF deg (%ForNDF)</td>
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### Appendix 4 – DairyCOMP 305 printout 1

#### Herd Summary

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<th>Name</th>
<th>Total Milk</th>
<th>Peak Milk</th>
<th>Lactation</th>
<th>Feed Day Average Production</th>
<th>Rolling Heat A ME 205 Avg Max</th>
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#### Average Test Day Milk Production

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<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
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#### Peak Milk by Day

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<th>Milk</th>
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#### Rolling Heat A ME 205 Avg Max

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<th>Heat A ME 205 Avg Max</th>
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### Dairy Farming Scholarships Trust report by Paul Robinson
Improving Fertility in the High Yielding Dairy Cow

Appendix 5 – DairyCOMP 305 printout

A Nuffield Farming Scholarships Trust report by Paul Robinson
Appendix 7 – Nordic Total Merit (NTM)
Appendix 8 – Comparison of Index for production, conformation and health

### Selection Index 1996-2009
production, conformation, health

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<td>30/18/52</td>
<td>30/13/57</td>
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<tr>
<td>Denmark</td>
<td>26/31/43</td>
<td>29/34/37</td>
<td>32/15/53</td>
<td>30/13/57</td>
</tr>
<tr>
<td>Canada</td>
<td>60/40/0</td>
<td>60/28/12</td>
<td>54/29/17</td>
<td>51/27/22</td>
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<td>50/15/35</td>
<td>45/15/40</td>
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<td>51/0/49</td>
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<td>57/29/14</td>
<td>50/30/20</td>
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<td>62/15/23</td>
<td>46/13/41</td>
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<td>&quot;World&quot;</td>
<td>79/15/06</td>
<td>60/18/22</td>
<td>53/17/30</td>
<td>52/18/30</td>
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Source: Holstein International
Appendix 9 – List of Tables, Figures and Photographs

Table 1 – UK Fertility Trends
Table 2 – Typical fertility performance indicators
Table 3 – Al Safi Dairy
Table 4 – G and B Brown herd results (dairy com 305)
Table 5 – Ovsynch/Intercept programme
Table 6 – Presynch + Ovsynch programme
Table 7 – Double Ovsynch programme
Table 8 – The onset of common dairy diseases
Table 9 – Comparison 2006 to 2009
Table 10 – Mystic Valley fertility KPIs
Table 11 – Kartorps KPIs
Table 12 – Crop Rotation
Table 13 – Total Mixed Ration
Table 14 – Pre mix
Photograph 1 – Al Safi dairy
Photograph 2 – Double 60 parlour
Photograph 3 – TMR feeders
Photograph 4 – TMR feeders
Photograph 5 – Cow health
Photograph 6 – Cow type
Photograph 7 – Indianhead Holsteins
Photograph 8 – Sand bed cubicles
Photograph 9 – The Miner Institute
Photograph 10 – Heifer housing
Photograph 11 – Heifer housing
Photograph 12 – Jersey, Norwegian Red and Holstein
Photograph 13 – Neck callus, broken feed fence, electric wire
Photograph 14 – Mystic valley
Photograph 15 – Robot and housing
Photograph 16 – Raised rubber indexed feed stance
Photograph 17 – Modern Swedish dairy
Photograph 18 – Robot bedding machine
Postscript

This Nuffield study tour has been a life changing experience. For someone who has worked with cows all his life the chance to visit so many units in different countries and meet so many like minded and inspirational people has been unique.

There was an element of payback on some of the visits. Al Safi asked me to make a presentation on what I had seen during my stay and comment on any improvements that could be made. This was an honour in that I came originally from a 32 cow farm and had managed up to 600 cows but now I was making recommendations to the world’s largest integrated dairy unit!

The SLU (Swedish Agricultural University, Skara) in Sweden were very good to me and on the very first day there I was asked to stand in for a speaker at a welfare seminar. Having just returned from Al Safi and North America my topic was Welfare on Large Dairy Units.

For all young people it is a competitive world out there and you need every advantage. The main attributes that set us apart as individuals are our inherent personality and our life experiences.

Nuffield’s addition to this experience is immeasurable; the key to our future is using it.

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