REARING YOUR 2010 HERD

Feeding and managing dairy herd replacements for lifetime performance

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THOMPSONS

REARING YOUR 2010 HERD

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INTRODUCTION TO REARING YOUR 2010 HERD

Rearing dairy herd replacements represents a major investment by dairy producers in the future of the enterprise. In today's fast moving and competitive dairy industry it is crucial that heifers are reared cost effectively to calve at an age and body size which will maximise lifetime performance. This series of on-farm events provides new information across a range of key areas on which to base systems for rearing youngstock which will maximise performance of replacements entering your herd in 2010 and beyond.

In order to make real progress in the industry on the feeding and management of heifers, it was recognised that an integrated approach is essential in terms of research, development and technology transfer. In view of this, the Agri-Food and Biosciences Institute (AFBI) Hillsborough, College of Agriculture Food and Rural Enterprise (CAFRE) and John Thompson and Sons Ltd formed a partnership in 2005, with the objective of transferring research on heifer rearing into new rearing regimes on farms to improve the sustainability of dairying.

The key components of the programme are:-

(1) Research programmes at AFBI Hillsborough designed to underpin improved rearing regimes, funded by DARD and AgriSearch.

(2) A major survey of current heifer rearing practices on farms across Northern Ireland undertaken by the CAFRE Dairying Development Branch and AFBI Hillsborough. This survey, involving over 250 dairy producers, has identified the strengths and weaknesses of current rearing systems enabling technology transfer to be tailored for the local industry. This programme is funded by DARD and AgriSearch.

(3) A blueprint for improved heifer rearing has been developed and is being put into practice on 8 pilot farms by Thompsons, with support from AFBI. This has helped quantify the economic and welfare benefits of adopting improved heifer rearing regimes across a range of milk production systems.

Today's farm tour will present, for the first time, recent findings from all 3 components of the heifer programme which we feel will be important in driving your dairy enterprise forward. Our overall objective is for you to see local research and development in practice with the potential to improve profit on your farm by over £11,000 per 100 cows.

Organising committee

Lynsay Alcorn
AgriSearch

Ian McCluggage
Martin Mulholland
Alan Hopps
CAFRE

Sinclair Mayne
Alistair Carson
Steven Morrison
AFBI

Gordon Donaldson
Fred Gordon
Richard Moore
John Thompson & Sons Ltd.

MANAGING FOR CALF HEALTH

INTRODUCTION

Good husbandry and stockmanship are crucial for successful calf rearing. As herd size increases on dairy farms across Northern Ireland, greater demands are placed on developing successful calf rearing enterprises which can be managed with best use of labour resources. This section reviews the latest research on management systems for optimal calf health and performance. This is of particular importance as calf mortality, and health problems in general, represent a significant economic and welfare cost to the Northern Ireland cattle industry.

Neonatal mortality can be as high as 14% in the progeny from first calving Holstein-Friesian heifers (AFBI on-farm research)

COLOSTRUM

Insufficient intake of colostral antibodies in the first six hours of birth is the main cause of calf health problems in the pre-weaning period. Calves that do not receive adequate antibodies through colostrum are twice as likely to die as those calves receiving adequate colostrum. Recent research has found that calves fed 4 litres of colostrum compared with 2 litres within one hour of birth had reduced veterinary costs and increased milk output during their first and second lactations.

Aside from the valuable nutritive properties of colostrum, reflected in higher levels of fat, protein and vitamins than milk, colostrum also contains antibodies against a range of disease-causing organisms. Particular types of antibodies attach to the lining of the intestine in the calf preventing pathogens from causing disease. Consequently, it is recommended that, wherever possible, colostrum should be fed for the first 3-4 days of the calf's life making full use of this protective function of colostrum as well as its high nutritive value.

Ensuring adequate colostrum intake in all calves can take time and effort. Currently around 24% of producers in Northern Ireland stomach tube every calf in a bid to ensure all calves receive sufficient colostrum and therefore an adequate level of immunity. Calves that are fed colostrum either by stomach tube or by bottle within the first hours of life, compared with calves that are left to suckle the mother, are almost 3 times more likely to have adequate immunity to fight off neonatal diseases. Primarily this is a result of variation in the time taken by calves to suckle successfully.

Calves fed by stomach tube or bottle are 3 times more likely to have adequate immunity

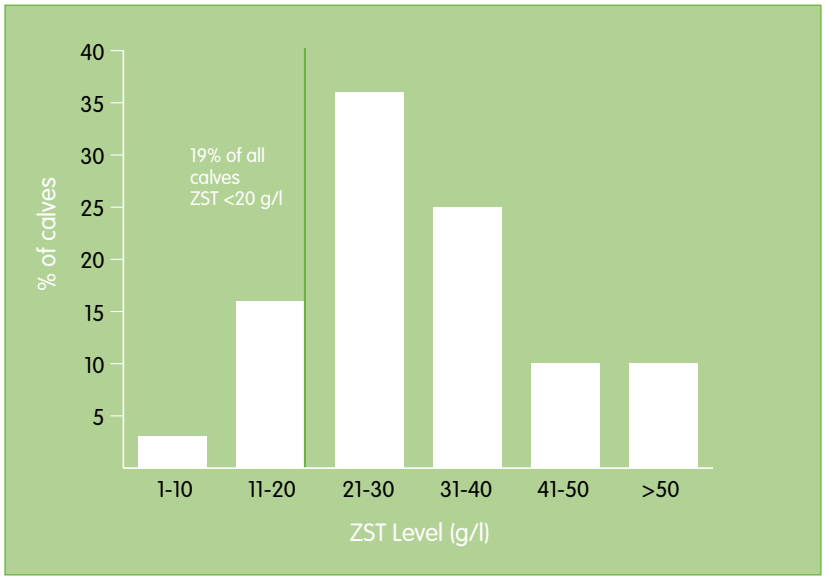
Slowness to suckle successfully can be pronounced in dairy calves, with the average calf from a dairy cow taking over 4 hours to suckle.

There are a number of simple tests that can be carried out to determine the quality of colostrum and the immune status of calves. The immunoglobulin content of colostrum may be assessed by using a colostrometer which measures the specific gravity of the colostrum and estimates total antibodies. Using the Zinc Sulphate Turbidity test (ZST), carried out on a blood sample taken within 1 week of birth, AFBI Hillsborough investigated the immune status of 150 bull calves, sourced from 12 commercial dairy farms. Overall, 19% of calves (Figure 1) had inadequate immune status (ZST levels less than 20 g/l), although there was very significant variation between farms. Over 70% of the calves purchased from one farm had ZST levels less than 20 g/l whereas at the other extreme some farms had no calves with ZST levels less than 20 g/l. The importance of immune status has been highlighted by data produced by AFBI, Veterinary Sciences Division, where 37% of calves submitted for post mortem had no detectable colostrum

immunity and 60% of the dead calves had inadequate cover, with ZST values less than 10 g/l.

The immune status of calves can have long-term effects on growth. Data from AFBI Hillsborough has shown that calves with ZST levels less than 20 g/l had 7% lower liveweight gains from birth to 9 months relative to those with ZST levels greater than 20 g/l. Thus at 9 months of age, cattle which had ZST levels less than 20 g/l were 23 kg lighter than those with adequate ZST levels.

Figure 1. Immune status of spring-born Holstein and beef x Holstein bull calves sourced from dairy farms in Northern Ireland (AFBI Hillsborough)



MAIN DISEASES AFFECTING CALVES

CALF SCOUR

Calf scour remains a major issue on farms, with 38% of producers in Northern Ireland indicating it is a significant problem within their calf rearing system. To minimise the risk of nutritional scour it is important that feeding times each day do not vary and that recommendations regarding the mixing of milk replacers are followed rigidly. Non nutritional calf scours can be caused by a number of pathogens. The results of tests on calf faecal samples sent into AFBI Veterinary Division in the last few months indicate that the main pathogens linked with severe calf scour in calves are cryptosporidia and rotavirus (Table 1). Neither of these are treatable with antibiotics, but the antibodies within colostrum do control their effects.

Pathogens are often picked up from the surrounding environment, thus lack of cleanliness in the calving area and in the calf rearing accommodation are major risk factors. Dry bedding, disinfecting utensils after each use (39% reduction in risk of Cryptosporidium parvum being shed by calves) and minimising the time period the calf is in the calving pen, all reduce the risk of infection.

Table 1. Main pathogens identified in calf faecal samples Oct 07 - March 08 (AFBI, VSD)

Pathogen	Samples tested	Number positive	Percentage (%)
Cryptosporidia	1036	295	28.5
Rotavirus	731	210	28.7
Coronavirus	788	27	3.4
Escherichia coli K99	520	35	9.6

PNEUMONIA

Calf pneumonia is an important cause of mortality and poor performance. AFBI Hillsborough data indicates that calves with a case of pneumonia in early life experienced a significant reduction in growth right through to weaning (-0.57 kg/week compared with calves with no cases). In addition, there was some evidence that a case of pneumonia in early life had significant long-term effects (Table 2). Calves that had suffered from pneumonia in the pre-weaning stage tended to have lower milk fat production in first lactation compared with calves clear of pneumonia. Pneumonia at a later stage in development, from post-weaning to 1 year of age, also had detrimental long-term effects with milk and fat yield tending to be reduced.

Table 2. Milk production of first lactation heifers with or without pneumonia during the rearing stage (AFBI Hillsborough)

First lactation performance (305-days)	Pneumonia in early life (pre-weaning)		Pneumonia in later life (post weaning- 1 yr old)	
	No	Yes	No	Yes
Milk yield (kg)	7027	6773	6972	6539
Fat yield (kg)	276	264	271	263
Protein yield (kg)	231	222	229	213

Pneumonia can occur under any climatic conditions but the risk of an outbreak increases in still, clammy weather. Outbreaks of pneumonia occur more frequently when calves are housed in poorly designed, poorly ventilated houses, with high stocking rates and where young calves are housed in the same airspace as older cattle. The vast majority of ventilation systems used on Northern Ireland dairy farms for calf rearing are based on natural ventilation (93%) which is not a cause for concern, provided air flow is adequate and draughts are not present.

VACCINATION PROGRAMMES

As discussed, effective colostrum management is the key tool in preventing many calf diseases. However, vaccination of cows in order to boost colostrum quality, coupled with early life vaccination of the calf against a number of pathogens, can help when required. Vaccinating cows prior to calving can help protect the calf against a number of common pathogens such as Rotavirus, Coronavirus, E Coli K99 and Salmonella. Unfortunately there is no vaccine currently available for Cryptosporidia. Vaccinations that are given early in the calf's life can help protect the calf against pneumonia related pathogens such as Bovine Respiratory Syncytial Virus (BRSV), Parainfluenza type 3 (PI3), Infectious Bovine Rhinotracheitis (IBR) and Bovine Viral Diarrhoea (BVD). A vaccination programme should be designed in consultation with your veterinary surgeon.

Survey data from farms across Northern Ireland indicates that 15% of producers currently vaccinate their cows to provide better immunity to calves against scours (Table 3 over) (only effective where calves receive adequate colostrum). Twenty-one percent of producers vaccinate their calves against pneumonia agents. The survey also indicated there is some uncertainty amongst producers on the specific details of their current vaccination programmes.

Table 3. Vaccination programmes (Scour and Pneumonia) in practice on dairy farms (AFBI/CAFRE heifer survey)

	Vaccination programme (% of producers)	
	Yes	No
Cow vaccinations	15	85
Calf vaccinations	21	79

Main messages

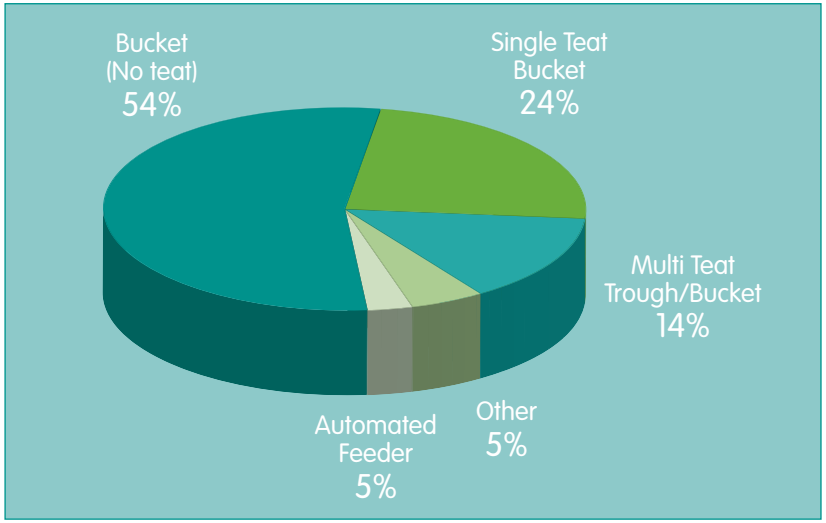
Emphasis on colostrum management during the first 6-hours of life is crucial. Wherever possible, stomach tube or bottle feed calves with colostrum (10% of calf weight) within 6 hours of birth and continue feeding colostrum for 3-4 days.

Vaccinations can be an effective method of boosting a calf's ability to combat many disease causing pathogens. In designing the most appropriate vaccination programme, seek advice from your local veterinary practitioner.

CALF FEEDING SYSTEMS

With increasing herd size, the labour efficiency of milk feeding systems is becoming of even greater importance. Whilst single bucket feeding systems remain the predominant feeding system in practice on Northern Ireland farms, there is now a small, but significant, number of producers using group feeding systems and automatic feeders (Figure 2). This section will review the relative merits of a range of feeding systems.

Figure 2. Milk feeding systems on Northern Ireland farms (AFBI/CAFRE heifer survey)



ONCE A DAY FEEDING SYSTEM

Research over a number of years has shown that calves can be fed successfully on once daily feeding systems. General recommendations for once per day individual bucket feeding systems are summarised as follows:

- Once daily feeding is best suited to either whole milk or milk replacers based on skim milk powder, since the casein component forms a clot in the calf's stomach releasing nutrients slowly over the day.

- There is some evidence to suggest that delaying the start to once daily feeding until 12 days of age maximises performance.
- Feeding calves at the same time every day is important as this keeps calves in a routine and also allows calves to settle onto concentrate feeding.
- The labour saving from once per day feeding can be significant, but it is critical that calves are still checked at least twice per day to detect any potential health problems that may arise.

GROUP FEEDING CAFETERIA

Research with beef calves at AFBI Hillsborough has examined the relative performance of a low labour calf feeding system based on a group feeder designed to feed 30 calves (Table 4). Calves on the cafeteria, fed once daily, had slightly lower liveweight gains relative to those on a standard system (calves individually bucket fed twice per day). At 9 months of age, calves reared on the cafeteria weighed 11 kg less than those on the conventional bucket feeding system. Research is on-going to investigate reasons for poorer growth rates with the cafeteria system.

Table 4. Effect of rearing regime on performance of spring-born Holstein and beef x Holstein steers (AFBI Hillsborough)

	Low labour (cafeteria, X1 daily feed)	Standard (bucket X2 daily feeds)
Live weight (kg)		
3.5 months (at grass)	116	126
9 months (start of first winter)	256	267

AUTOMATIC FEEDERS

There is growing interest in the use of computerised automated milk feeders that control nutrient input on an individual calf basis, with 3% of dairy farmers in Northern Ireland using these feeders. These types of feeders have been used at AFBI Hillsborough for 9 years and have been found to rear calves with similar levels of performance to individually housed bucket fed calves. The high initial capital cost of purchase of automatic feeders and ongoing maintenance costs must be considered carefully before choosing this approach.

LABOUR REQUIREMENTS

From experience of different calf feeding systems practiced at AFBI Hillsborough, the time required to feed 50 calves per week using a range of feeding systems has been estimated (Table 5 over). In this exercise, once per day feeding systems (bucket and cafeteria) started when calves reached 2 weeks of age and calves on all systems were assumed to be weaned at 6 weeks. The time required for veterinary treatment or bedding is not included.

3% of producers operate automatic milk feeding systems (ABFI/CAFRE heifer survey)

Table 5. Estimated time required daily to feed 50 calves with different milk feeding systems (from 2 weeks to weaning at 6 weeks)

Method	Time required per day	Time saving compared with standard
Individual buckets twice daily (standard)	4 h 10 min	-
Individual buckets once daily	2 h 55 min	1 h 15 min
Group feeding cafeteria system (X1 daily feed)	1 h 45 min	2 h 25 min
Automatic feeding system	30 min	3 h 40 min

Main message

Options to reduce labour input in milk feeding calves exist. However, the best system for feeding calves is likely to vary between farms taking into account cost, labour and management issues.

WHOLE MILK VERSUS MILK REPLACER FOR CALVES

The detailed survey carried out across Northern Ireland farms indicates that most dairy producers (77%) reared their calves on predominately whole milk with only 23% using predominately milk replacer. Whilst it is recognised that to minimise waste, discard milk needs to be used for calf rearing, it appears that a significant amount of saleable milk may also be used. There are significant cost implications – £14/calf if all milk fed is saleable.

Opinion on feeding discard milk is mixed. As expected, numerous studies have demonstrated higher levels of bacteria and/or antibiotic residues in waste milk. There are concerns that feeding mastitic milk may increase the risk of scours and some research has shown that calves fed infected milk had mastitis as fresh calvers, caused by the same genotype of bacteria. However, most of the common organisms that cause mastitis are found all over the body, so even a calf suckling from it's mother is likely to ingest potentially mastitis-causing organisms. Feeding whole milk increases the risk of Johnes transmission. For this reason, herds infected with Johnes should not pool colostrum or feed milk from infected cows to calves.

To mitigate against the risk of disease transmission, particularly in situations where whole milk is being fed to a large number of

calves, consideration should be given to on-farm pasteurisation. This will reduce the bacterial loading of waste milk and can kill off the organism causing Johnes. There are two main types of pasteuriser – low temperature/ long time (heating to 62.7°C for 30 minutes) and high temperature/ short time (71.6°C for 15 seconds). Capital costs of the equipment vary between £5,000-12,000 for units capable of pasteurising up to 320 litres of milk.

As for antibiotic milk, it has been highlighted that most cows have had dry cow therapy, and colostrum therefore contains antibiotics. Consequently, it is difficult to argue against the use of whole milk solely on this basis. However, the variation in quality of whole milk should be recognised. Within farms, the whole milk fed to calves can vary from 2.9-5.0% butterfat and 3.0-5.0% protein.

Main message

Feeding saleable whole milk adds a significant cost to calf rearing. In view of (a) possible disease transmission (b) inconsistent quality, discard milk should be fed, wherever possible, to bull calves only. Where large numbers of calves are being fed whole milk, on-farm pasteurisation should be considered.

FEEDING LEVEL AND PROTEIN CONTENT OF MILK REPLACER

Over the last 20 years recommendations for the pre-weaned calf (up to 8 weeks of age) have been to offer 500-600 g per calf per day of a milk replacer (approximately 1.1 lb per day) containing 20-23% crude protein, together with access to ad libitum concentrates and water. The aim has been to achieve growth rates from 450 to 600 g/day. This means that a calf consumes approximately 25-30 kg of milk replacer, in total, over the first 2 months of life.

Recently, research from North America has questioned the approach of restricted milk feeding and proposed that higher feeding levels should be adopted in a bid to accelerate growth (up to 1 kg/ day) in the pre-weaning period. These higher growth rates can theoretically be achieved by feeding 900 to 1200 g of high protein (up to 30%) milk replacer. To evaluate the merits of such feeding systems, which have significant cost implications, a series of collaborative studies have been undertaken at AFBI Hillsborough and Teagasc, Grange to compare the performance of dairy-bred calves offered milk replacer containing 23% or 30% crude protein at two feeding levels (600 g/day or 1200 g/day).

Studies found no benefits of additional levels of milk replacer thus recommend 600 g/day

Relative to calves offered 600 g milk replacer per day, calves offered 1200 g milk replacer per day grew significantly faster during the milk feeding period (birth to 8 weeks) (Table 6). However, differences in live weight and body size recorded at weaning for calves on the higher level of milk replacer had disappeared by 6 months and there were no beneficial effects on milk production during the first or second lactation. Increasing the protein content of the milk replacer above 23% had no short or long-term effects on performance.

Table 6. Performance of Holstein calves offered 600 or 1200 g milk replacer per day containing 23% or 30% crude protein (AFBI Hillsborough)

	Milk replacer level (g/day)		Milk replacer protein content (%)	
	600	1200	23	30
Live weight (kg)				
8 weeks (weaning)	63	72	68	66
9 months	238	237	241	234
Milk production (1st lactation)				
Milk yield (kg/day)	22.7	22.2	22.4	22.5
Butterfat (%)	3.98	3.79	3.95	3.82
Protein (%)	3.26	3.24	3.26	3.25

WEANING

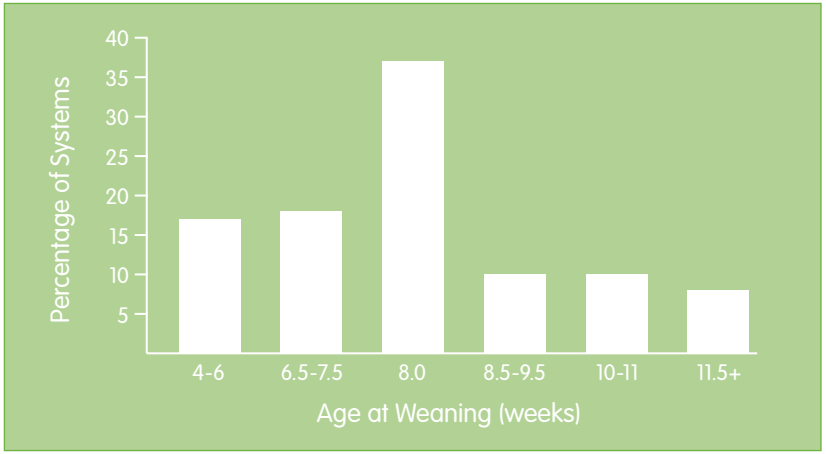
On average, calf rearing systems in Northern Ireland wean calves at 8 weeks of age, although there is considerable variation with over 20% of producers surveyed delaying weaning to between 9 and 12 weeks (Figure 3). Solid food intake, followed by calf size, are the most important criteria on which producers decide to wean.

Previous research has shown that, provided calves are at least 5 weeks of age, concentrate intake is the key factor on which to base when to wean. Concentrate intake is very important in preparing the calf for a solid food diet as the fermentation of the ingredients promotes rumen development.

As a general rule, the calf should be consuming approximately 0.7 kg concentrate/head/day to minimise a post-weaning check on growth. A recent study at AFBI Hillsborough found no difference in the performance of calves weaned on age at 8 weeks, compared with those weaned as soon as concentrate intake went above 0.5 kg/day, with calves totally off milk when concentrate intake was above 1.5 kg/day. Average weaning age for the latter group was 6 weeks.

Provided the rumen has developed sufficiently prior to removal of milk feeding, there is limited evidence to indicate any difference

Figure 3. Estimated age at weaning in calf rearing systems (AFBI/CAFRE heifer survey)



between abrupt weaning and gradual reduction in milk intake. However, if feeding high levels of milk, studies have shown gradual weaning over a 7-10 day period can prevent the associated slump in growth the week after weaning, compared with abrupt weaning.

The recent survey of Northern Ireland heifer rearing enterprises has shown that on farms where concentrate is offered as soon as the calf enters the calf rearing accommodation, rather than later (11 days plus), heifers are served earlier resulting in a lower age at calving. For every day delay in offering calves concentrate, the associated age at first calving increased by 4 days.

Main messages

Increasing milk replacer feeding levels from 600 to 1200 g/day increases growth during the milk feeding period, but these effects disappear over the first year of life and no beneficial effects on milk production were observed in the research programme at AFBI Hillsborough. Increasing the protein content of milk replacer above 23% had no beneficial effects on calf performance. Overall, this work showed no beneficial effects of increasing milk replacer level (additional cost £29/calf) or protein content (additional cost £6.25/calf) of milk replacer above 600 g/day and 23% protein, respectively.

Calves should be offered fresh starter concentrate daily from 2-3 days post birth with concentrate intake being the key criterion used to decide when to wean (aim for 0.7 kg/calf/day at weaning). Weaning from 6-8 weeks of age has been shown to have no long term detrimental effect on heifer development and can help improve the efficiency of calf rearing in terms of both labour and feed costs. If high levels of milk are being fed, gradually wean calves to minimise any potential post weaning slump in performance.

MEASURE TO MANAGE – target body size through the rearing period

INTRODUCTION

The feeding and management of Holstein-Friesian heifers should be geared around achieving a live weight at first calving of 540-580 kg at 23-25 months of age. This section reviews the research and development which underpins these targets and the feeding guidelines developed by Thompsons, in collaboration with AFBI and CAFRE, as part of the heifer rearing blue-print.

EFFECTS OF AGE AT FIRST CALVING ON SUBSEQUENT PERFORMANCE

Research over a number of years has indicated that, economically, the optimum age at first calving is between 23 and 25 months of age. Whilst first lactation milk yields are maximised by increasing age at first calving beyond 25 months of age, this is outweighed by the additional rearing costs and poorer reproductive performance which impacts on overall lifetime yield.

The association between age at first calving and subsequent performance can be seen from recent analyses by AFBI of data from herds of the Irish Holstein Friesian Association (Table 7). Moving from 24 to 36 months of age, first lactation milk yield increased by 791 litres. However, reproductive performance was poorer, and by the 3rd calver stage differences in cumulative milk solids yield from first calving had disappeared. Whilst this analysis could not determine longevity, work in GB has shown fewer problems around calving and increased herd life (+0.2 lactations) with heifers calving at 24 compared with 36 months of age.

Heifers should be managed to calve at 23-35 months of age

Table 7. Association between age at first calving and performance of Holstein Friesian replacements
(data from Irish Holstein Friesian Association herds)

Age at first calving (months)	First lactation milk yield (305 days)	Average calving interval (days) (1-5 calvings)	Average milk solids yield (kg/day) from 1st calving for 3rd calvers
23-25	5,888	394	1.53
26-28	5,960	402	1.53
29-31	6,340	414	1.53
31-34	6,696	408	1.54
35-37	6,679	405	1.55

Age at first calving has a considerable impact on the number of replacements carried on a dairy farm (Table 8). Compared with calving at 24 months, 3-year old calving increases the number of replacement stock on a 100-cow dairy farm by 30 heifers. This will increase farm stocking rate by 0.4 cow equivalents per hectare and by 25 kg of organic manure N per hectare. To maintain the same organic manure loading as a farm calving heifers at 24 months, an additional 10 hectares of land would be required for a 100-cow dairy herd. Calving at older ages also places greater demands on housing facilities, labour inputs and other overhead costs, the implications of which are discussed in a later section.

Table 8. Number of heifer replacements per 100 cows according to age at first calving

	Age at first calving (months)		
Age category	24	30	36
0-12 months	30	30	30
12-24 months	30	30	30
24-36 months	-	15	30
Total replacements	60	75	90

Main message

Manage heifers to calve down at 23-25 months of age.

WHAT IS THE OPTIMUM CALVING SIZE FOR HOLSTEIN FRIESIAN HEIFERS?

Body size targets for Holstein-Friesian dairy herd replacements have been developed from a number of research studies carried out at AFBI Hillsborough over recent years on the feeding and management of dairy heifers. The main findings of this work are summarised as follows:

Live weight at calving on performance

- Milk production. Heifers reared to calve at heavier (620 kg) compared with moderate weights (540 kg) produced 800 litres more milk in their first lactation. However the effects did not extend into subsequent lactations (Table 9).
- The additional milk produced by rearing heavier heifers (620 compared with 540 kg) resulted from increased body tissue mobilisation in early lactation, resulting in poorer reproductive performance. In addition, foot claw condition was poorer with heavier heifers (20% more heifers with heel erosion during rearing period) and was associated with increased lameness (50% higher (poorer) locomotion scores).

Table 9. Summary of research studies on the effect of live weight at first calving on subsequent milk yield

	Moderate heifers	Large heifers	Milk yield (moderate v heavier heifers)	Others
Study 1	570 kg	620 kg	No difference	Larger heifers lost more body condition after calving
Study 2	540 kg	620 kg	1st lactation: 11% lower (800 litres) 2nd lactation +: no difference Overall: No difference	Shorter calving interval (30 days+) and lower incidence of lameness in moderate heifers
Study 3	540 kg	620 kg	1st lactation: Peak yields lower 2 kg/day, but no overall difference 2nd lactation+: no difference Overall: No difference	Larger heifers lost more body reserves after calving
Study 4	550 kg	600 kg	1st lactation: Peak yields lower 3 kg/day, but no overall difference 2nd lactation+: no difference Overall: No difference	Shorter calving interval (40 days+) and lower incidence of lameness with moderate heifers

Growth rates during the rearing period and subsequent performance

- Increasing growth during the first year of life (above 0.7-0.8 kg/day) increased skeletal size. However, very high planes of nutrition can have detrimental effects on udder development, particularly with strains/breeds of lower mature weight.
- Increasing growth during the second year of life (above 0.8 kg/day) has been found to increase body condition score at calving, reducing dry matter intake in early lactation.
- Stair-step growth patterns (restricted followed by ad libitum feeding) exploit compensatory growth and have enabled heavier heifers to be reared with less excessive body condition. However, this type of strategy complicates management and has not resulted in performance benefits.
- Forage type fed during the rearing period has been found to have only small effects on subsequent performance in the milking herd.

Main messages

Steady gains (0.7-0.8 kg/day) during the rearing period are optimum.

Feed inputs to achieve moderate (540-580 kg), but not heavy (600 kg+), live weights at first calving are significantly less. In studies at AFBI Hillsborough, this has amounted to 500-800 kg less concentrates over the 2-year period. Also, in-calf heifers reared to moderate weights required less grazing area (12% less).

Milk production in heifers reared to calve at moderate live weights caught up with heifers reared to large weights by the end of the 2nd lactation.

Reproductive performance and the incidence of lameness, both key determinants of longevity, were better with heifers reared to calve at 540-560 kg compared with 600 kg+.

MANAGEMENT AT MATING

To achieve an average first calving age of 24 months, insemination needs to start from 13.5 months of age (Table 10). Once the decision is made to start mating, on average it will be 11 days before the average heifer is on heat. Allowance must also be made for missed heats and returns to service. The starting age of 13.5 months to achieve 24-month calving age is based on a submission rate for insemination of 70% and a conception rate to service of 50%. Good fertility records and observation are essential and submission rates can be improved through using heat detection aids such as tail paint, kamars, teaser bulls, and pedometers.

Breeding should commence at 13.5 months of age to calve at 23-25 months of age

Currently, 29% of producers surveyed across Northern Ireland estimate that they commence breeding at 13-14 months of age. A further 31% of producers commence breeding at 15-months of age with 40% of producers delaying the start of breeding to 16 months or above. So overall, only one third of producers are aiming to start breeding at the optimum age for economic heifer rearing, with a significant number delaying their breeding programme.

In terms of deciding when to commence breeding, body size and live weight as well as age are considered important by the majority of producers. On dairy farms, visual assessments only are made of heifer growth with little weighing or measuring being undertaken (less than 10% of producers). Whilst producers are confident of their ability to identify the optimum size for breeding, the AFBI/CAFRE survey shows (1) there can be a large difference between actual live weight and that predicted by producers using visual assessment, (2) body sizes targeted by producers to commence breeding tend to be larger than optimum.

Table 10. Commencement of breeding and associated calving ages

Breeding start age (months)	Average age at calving (months)
13.5	24
14	24.5
15	25.5

MONITORING GROWTH

Monitoring heifer growth by measuring heifers is key to making informed management decisions. AFBI Hillsborough over the last 10 years has collected a comprehensive dataset on body size measurements during each stage of the rearing period (Table 11). This has enabled the development of simple and easy assessment of live weight through the measurement of heart girth diameter. Measuring tapes scaled with the live weight of Holstein Friesian heifers have been produced. These are now available for producers to monitor progress of heifers against targets at key times, facilitating a cost effective rearing regime. The optimum body size targets developed from the Hillsborough research programme are presented in Table 11.

Table 11. Target live weights for Holstein Friesian heifers

Age (months)	Live weight (kg)
2	76
9	243
13	336
24	570

More information on heat detection and dairy herd fertility management is available through the CAFRE Dairy Herd Fertility Challenge or at:
http://www.ruralni.gov.uk/index/learning/challenges.htm

FEEDING AND MANAGEMENT FROM 12 WEEKS TO CALVING

There are significant economic and lifetime production benefits from calving replacement heifers at 24 months of age and at 540-580 kg live weight. Central to achieving 24 month old calving at this weight is a controlled feeding and management approach throughout the rearing period from 12 weeks old to the point of calving. In essence, a simple but robust method is required which will ensure the consistent production of well framed heifers calving down at 24 months of age.

With this objective in mind, John Thompson and Sons Ltd. in collaboration with AFBI and CAFRE, have developed a series of rearing blueprints. These blueprints, 4 in total, detail feeding and management regimes which will ensure the heifer meets growth targets during the entire rearing period. These growth targets are a liveweight gain of 0.7-0.8 kg/day from 12 weeks old to calving.

The blueprints take into account the need for different management and feeding policies, depending on the nature of the individual dairy enterprise, land availability/ accessibility and labour available. Each blueprint is also dictated by the season of birth of the calf, as this has a significant impact on the ease with which targets will be met on farm. This is particularly important with March-July born calves.

Blueprints have been developed to meet target growth rates from 3-months to calving

Three of the blueprints are based on winter diets using grass silage with an ME content of approximately 10.7 MJ/kg DM and summer grazing. The fourth is based around a housed system using straw as the forage. In each case a concentrate allowance of an appropriately balanced Heifer Rearing concentrate is recommended to allow growth targets to be met.

REARING THE AUGUST-NOVEMBER BORN CALF – KEY POINTS

12 Weeks old – mid April

- Achieve steady growth rate over the period - balanced nutrition required throughout
- Good ventilation and no draughts in the rearing house
- Good calf health requires good nutritional and housing management.

From Mid April – Autumn

- Maintain a level pattern of concentrate supplementation at grass to ensure adequate calf growth
- Adopt management and veterinary routines to control parasites
- House sufficiently early in Autumn to ensure performance is maintained.

Breeding Management

- Minimise stress around mating and maintain a steady nutritional regime before and throughout the breeding period.

Post-Breeding and Pre-calving

- Maintain steady growth rate throughout pregnancy and calve down at Condition Score 3
- Acclimatise heifers to the post-calving diet for 3 weeks pre-calving.

FEED PLAN TO ACHIEVE TARGETS WITH AUGUST – NOVEMBER BORN CALVES

Age (months)								
0	3	6	9	12	15	18	21	24
	Silage + 2 Kg HGM Heifer Nuts		Grass + 1 Kg HGM Heifer Nuts		Silage + 2 Kg HGM Heifer Nuts		Grass only	

REARING THE DECEMBER-FEBRUARY BORN CALF – KEY POINTS

12 Weeks old – 9 months of age

- These calves should be kept inside until at least 12 weeks of age
- Pasture quality must then be very good, and good parasite control adopted
- Concentrate must be offered throughout the summer to ensure controlled growth rates
- House in early Autumn to ensure a steady growth rate through this difficult period.

Second winter

- Settle animals quickly onto full winter rations and adopt an appropriate parasite control programme.

Second summer

- These animals must be kept growing at pasture through supplementation with concentrates
- House in early Autumn to ensure animals maintain steady growth during pregnancy.

Pre-calving management

- Maintain a steady growth rate throughout pregnancy and calve down at Condition Score 3
- Acclimatise heifers to the post-calving diet for 3 weeks pre-calving.

FEED PLAN TO ACHIEVE TARGETS WITH DECEMBER – FEBRUARY BORN CALVES

Age (months)								
0	3	6	9	12	15	18	21	24
	Silage + 2 Kg HGM Heifer Nuts	Grass + 1.5 Kg HGM Heifer Nuts	Silage + 2.5 Kg HGM Heifer Nuts		Grass + 1.5 Kg HGM Heifer Nuts		Silage + 2 Kg HGM Heifer Nuts	

REARING THE MARCH-JULY BORN CALVES – KEY POINTS

12 Weeks old – 11 months of age

- These calves should be kept inside until 11 months of age and preferably offered straw as the basal forage
- While this method adds costs it is essential if these calves are to calve down at 24 months of age
- This method also allows for pulling these calves towards 22-23 month old calving which may be beneficial in terms of herd calving pattern.

Second Summer period

- These animals must be kept growing at pasture through the supplementation with concentrates
- At grass a good parasite control policy is vital
- House in early Autumn to ensure animals maintain steady growth during pregnancy.

Pre-calving management

- Maintain a steady growth rate throughout pregnancy and calve down at Condition Score 3
- Acclimatise heifers to the post-calving diet for 3 weeks pre-calving.

FEED PLAN TO ACHIEVE TARGETS WITH MARCH – JULY BORN CALVES

Age (months)								
0	3	6	9	12	15	18	21	24
	Ad-lib Straw + 3 Kg HGM Heifer Nuts	Ad-lib Straw + 4 Kg HGM Heifer Nuts		Grass + 1.5 Kg HGM Heifer Nuts		Silage + 2 Kg HGM Heifer Nuts		

STRAW SYSTEM – KEY POINTS

- Conventional grass silage and grazing systems have their advantages e.g. reduced variable costs. However in some farm situations e.g. shortage of land/labour or requirement to reduce bio-security risk with off-farm grazing, straw-based systems may offer an advantage
- This method will add to variable costs. However depending on farm circumstances it may still offer financial advantages on certain units
- Straw must be of good quality
- Allow animals access to grazing during some stage of the rearing programme to enable them to develop grazing skills
- Remember animals put to grazing after being housed for most of the rearing period are still susceptible to intestinal parasites despite their age.

FEED PLAN TO ACHIEVE TARGETS WITH A STRAW-BASED SYSTEM

Age (months)								
0	3	6	9	12	15	18	21	24
	Ad-lib Straw + 3 Kg HGM Heifer Nuts		Ad-lib Straw + 4 Kg HGM Heifer Nuts		Ad-lib Straw + 5 Kg HGM Heifer Nuts		Grass + 2 Kg HGM Heifer Nuts	

THOMPSONS/AFBI/CAFRE HEIFER REARING PROJECT

INTRODUCTION

John Thompson & Sons Ltd. have been mindful of the increasing financial pressures in Northern Ireland dairy farming. However they recognised that there was a considerable volume of new research evidence on heifer rearing, particularly from Hillsborough, which if implemented at farm level had the potential to reduce milk production costs by over 1 p/litre on all milk produced on the farm. As a result in 2005 they developed a series of Heifer Rearing Blueprints for managing and feeding heifers born during different seasons of the year. These blueprints, detailed in the previous section, were based on the most up-to-date research and practical information available.

In order to validate these blueprints and ensure that they could be easily implemented at farm level in September 2005 Thompsons, in conjunction with AFBI Hillsborough and CAFRE, Greenmount entered into a province-wide heifer rearing project on 8 commercial dairy units. These units ranged in size from 90 to 400 cows. The objective of the project was to demonstrate that the rearing blueprints, in conjunction with a simple system of measuring heifer size quarterly, could economically produce well grown heifers to calve at 24 months of age. Heifers on each farm born after 1st September 2005 were therefore entered unto the blueprint rearing systems.

PROJECT SET-UP

A selection of heifers within each age group (normally 5 heifers per group) were measured for size on a quarterly basis on each of the 8 farms. Progress in weight gains during the rearing period were monitored and nutritional regime adjusted where necessary. In total, over 1,500 animals have been reared according to their appropriate blueprint with some now coming near the end of their first lactation.

RESULTS

As can be seen from Table 12 overleaf the average age at first calving has been reduced from 27-29 months prior to commencement of the project to 25 months of age.

Table 12. Average age at calving in autumn-born heifers across the farms

	Autumn 2003 heifers	Autumn 2004 heifers	Autumn 2005 heifers
Average age at calving (months)[1]	28	28	25
Milk yield (litres)[2]	7672	7629	7506*
Calving interval (days)[2]	421	417	402*

[1] Data from all 8 farms; [2] Data from 5 milk recorded farms;
* Data includes completed and projected records

As expected, first lactation milk yields in the recorded farms have been reduced (by approximately 150 litres) (Table 12), however projected calving interval records show an improvement in fertility performance, key in meeting the target lifetime yield of 30,000 litres, a figure which is well above the national average of approximately 25,000 litres.

MONITORING PROGRESS

Tracking heifer growth performance through quarterly measurement highlighted a number of issues.

- Winter forage fed to heifers varied in quality across the eight farms, from silages with ME contents below 10.0 MJ/kg DM to others above 11.5 MJ/kg DM. This had a significant effect on the ability of heifers to meet targets when fed according to the blueprint recommendations.
- Equally periods of difficult grazing conditions either in grass quality or quantity significantly impacted on performance.
- If not recognised early, these periods of poor growth resulted in heifers not achieving targets and subsequently incurred increased feeding costs.
- It is also important to recognise periods of over nutrition where excess fat will be laid down. This is common on high quality silages where concentrates continue to be fed and is detrimental to long term heifer performance as well as adding unnecessary cost to the system.
- The key is to monitor progress and alter nutrition accordingly.

THE IMPORTANCE OF MAKING BEST USE OF HOME GROWN FORAGES

The rearing blueprints and feeding recommendations presented earlier are appropriate for the majority of dairy farms. However it is vital to recognise that the availability and quality of the silage, or grass, offered to the calves/heifers will have a major impact on the quantity of concentrate required to achieve the necessary growth rate of 0.8 kg/day. For example, a yearling heifer given a very good quality silage (high ME content and good intake potential) can achieve 0.8 kg/day when supplemented with only 0.5 kg concentrate/day. In contrast with a lower quality silage, 3.5 kg concentrate will be required to achieve the same target growth rate. There are therefore massive opportunities for making savings in heifer rearing costs through ensuring that they receive good quality silage where at all possible. This was clearly demonstrated on some of the 8 project farms where very good silages were available and it was possible to reduce concentrate feeding levels and hence rearing costs. Unfortunately on many farms the heifers are allocated the poorer quality silages and hence will require considerable concentrate supplementation.

To provide farmers with guidance on the necessary levels of concentrate required with differing silages Thompsons are now providing concentrate feeding guidelines for heifers of different ages on all their silage analysis reports.

Similar opportunities arise when calves/heifers are at grass. This is particularly true when animals are in their first year at grass. In the majority of grazing systems, young calves at grass will require concentrate supplementation. However if calves can be grazed as a leader group, in which they can select the higher quality grass leaf and leave the lower quality material to be grazed by older stock, then concentrate levels can be reduced - or even eliminated. In most other grazing systems, where calves are

required to eat pastures out before moving, then concentrate will be necessary to achieve the target growth of 0.8 kg/day.

An additional, and vital, factor in management at grass is the need for a a robust approach to the control of parasites. A good grazing season can be quickly ruined through a relatively short lapse in parasite control. While this particularly applies to young calves it can be equally important with older animals.

Less than 5% of producers operate leader-follower grazing systems (ABI/CAFRE heifer survey)

KEY MESSAGES

Blueprint rearing systems ease management decisions.

The systems presented here have been validated on 8 farms with 1500 heifers.

During winter, silage quality dictates the amount of concentrate required to acheive 0.7-0.8 kg liveweight gain/day.

Thompsons have now introduced a "Heifer Concentrate Feeding Recommendation" on all their silage reports.

Grazing systems can be extremely variable and often cause many problems.

Monitoring growth rates and adjusting feed accordingly is the key to success.

SELECTING SIRES FOR YOUR FUTURE DAIRY HERD

Sire selection represents the key breeding decision, with long-term effects on animal performance, health and welfare and overall farm profitability. Today's breeding decision will result in replacements entering the dairy herd in 2011, with a direct impact on herd performance lasting to 2015 and beyond. Given the long time nature of genetic improvement, it is crucial to make the best decisions possible now. This section briefly reviews the main factors to consider in selecting sires to produce cows for your future herd.

SIRE PROOFS WORK IN PRACTICE

The breeding values of sires for an increasing range of traits are now available. These values are expressed as Predicted Transmitting Abilities (PTAs) which measure the average value of traits transmitted from a sire (or cow) to its progeny and are derived from the performance of the animal and all known relatives.

The good association between PTAs and actual performance has been again demonstrated in a recent study undertaken by AFBI Hillsborough for the Irish Holstein Friesian Association. For first lactation heifers, over 70% of the variation in milk yield between individuals could be attributed to differences in their genetic merit for milk yield, as expressed by milk PTA.

Over 70% of variation in milk yield between heifers could be attributed to milk PTAs

Increasingly, genetic information on fertility, health and longevity traits is becoming available for sires. Whilst such traits are very much affected by herd health, feeding and management, genetics has also a significant effect. In regard to reproductive performance, the genetic variation in daughter fertility produced from different sires has been found to be relatively large, meaning that significant genetic progress can be made. Thus in sire selection it's important that appropriate consideration is given to health and fertility traits, (published for example, at www.holstein-uki.org.uk and www.dairyco.org.uk).

SELECTION INDEXES ARE USEFUL TOOLS

With genetic information becoming available for a greater range of production and non-production traits, breeding programmes in all of the main dairy producing countries are now broadening out their breeding goals. Selection indexes are the best way to combine information on a number of traits, weighting each by its appropriate economic value.
An index of total economic merit is a combination of an animal's predicted transmitting ability (PTA) for all economically important traits, with each trait weighted by its relative economic value.

In the UK, the index of total economic merit, Profitable Lifetime Index (PLI), has recently been amended, based on research carried out by Scottish Agricultural College (SAC) on behalf of DairyCo. In general terms, the new PLI has a reduced emphasis on production traits and an increased weight on the 'fitness' traits in line with their future expected economic values to farmers. Consequently, the predicted genetic response to selection on the new PLI indicates that alongside increased production, lifespan will increase, somatic cell count will decrease, feet and legs and udder traits will improve and the decline in fertility traits will have nearly been brought to a standstill. In addition to the relative weight changes, the new PLI is presented as a 'true' Profitable Lifetime Index and so reflects the profitability differences of the progeny over its lifetime, rather than per lactation as undertaken previously.

PLI now places increased emphasis on non production traits

The relative economic values for traits within selection indices are determined from national farm economic models. These models continually develop to take into consideration changing market outlooks, new environmental considerations and developments in production systems. AFBI is currently carrying out work in this area, with SAC, examining the relative economic values for production and non-production traits in 7,000-8,000 litre systems. Modelling work has shown these moderate output systems are optimum over a range of milk pricing, input price scenarios and are likely to be the "norm" for the majority of the industry in Northern Ireland.

SIRE SELECTION FOR USE ON MAIDEN HEIFERS

Ease of calving is an important consideration in selecting sires, particularly for use on maiden heifers. This reflects the significant impact a difficult calving has on subsequent performance. Calves are more likely to die if they have experienced calving difficulty. Calves born from a difficult calving are also more likely to be weak or have low vigour, and these grow more slowly to weaning and are more susceptible to other diseases. On the cow side, there is evidence that dystocia reduces milk yield, increases the risk of mastitis and increases the chances that a cow will be prematurely culled.

In terms of sire selection, it is important to note the negative genetic relationship between genetic merit for ease of calving and subsequent maternal calving ability. Within a breed, female calves born more easily are expected to show greater difficulties when giving birth as dams, because of reduced pelvic dimensions. Hence selection for both direct and maternal genetic components of calving ease is the best way forward.

Currently some genetic information is available on direct calving ease for sires. Work by SAC is currently being undertaken with input from AFBI Hillsborough better quantify the relative economic value of calving ease to enable the incorporation of direct and maternal calving ease traits into selection indexes. Currently, no UK data are available for maternal calving ease, hence type predictors such as rump width are the only available option.

CURRENT SIRE SELECTION

For the first time, we have information regarding the basis for sire selection by dairy producers in Northern Ireland based on AFBI/CAFRE heifer survey. The key messages from this AFBI/CAFRE work undertaken over the last 12 months are summarised below.

- In Northern Ireland the use of AI is extensive, albeit lower than some of the other main dairy producing countries. 62% of producers use AI for the majority (50% plus) of their heifer matings (Table 13). With mature cows, the use of AI is slightly greater, with 69% of producers using mainly AI for breeding.
- A high proportion of farmers consider ease of calving and PTAs for milk composition as very important criteria in sire selection (Table 14). In addition, milk yield and type traits are considered very important by a significant proportion of producers. There were no indications of any significant use of the fertility index in sire selection.
- Surprisingly, the PLI is considered very important by a relatively small proportion of farmers with significantly more assessing it either as unimportant or had no opinion on it.

Table 13. Percentage of farmers using bulls compared with AI

	% of producers	
Method of mating	**Heifers**	**Cows**
Bull only	27	20
Mostly bull	11	12
50 bull:50 AI	11	17
Mostly AI	24	32
AI only	28	20

Table 14. Sire selection criteria for use on maiden heifers

Criteria	% of producers assessing as very important	% of producers with no opinion or consider unimportant
Ease of calving	56	5
Milk composition	44	12
Type traits	26	21
Milk yield	22	16
Selection index (PLI)	7	43.5
Cost of straw	6	34

GENOMIC SELECTION

In the future genomic (DNA) data will be incorporated into dairy cattle selection programmes. This will enable more accurate selection index evaluations and direct increased genetic gains. Inclusion of genomic data in national evaluations is expected to increase genetic progress by around 50% over the next 10-15 years.

The use of genomic information in the livestock industry is not a new phenomenon. Many farmers and AI companies routinely send hair samples for parentage identification, as well as the detection of genetic defects such as BLAD and CVM. However, its use in national selection indexes is very new, and requires the identification of known sequences within DNA (termed SNPs) and the subsequent association of these sequences with actual performance for production and non-production traits.

AFBI have developed a resource in this area enabling parentage verification in support of animal identification (contact Dr Adrian Allen, VSD, Stormont: Adrian.Allen@afbini.gov.uk). Current research, in partnership with The Roslin Institute (University of Edinburgh), funded by the BBSRC, is investigating whether host genetics influences TB susceptibility in cattle. This potentially involves identification of DNA markers linked to TB resistance, which could be used to breed for reduced TB susceptibility.

Main messages

Sire proofs are a reliable indicator of progeny performance.

Only high PLI bulls are made available by breeding companies.

Genetic evaluations for fertility, health and welfare traits are becoming increasingly available.

Selection indexes are the best way to combine information on the large number of traits now available for sires. Currently, the PLI is only considered important by a minority of producers. It will be important to address this. AFBI work looking at selection indexes specific to Northern Ireland circumstances will play a role here.

The accuracy of selection indexes will increase further with the introduction of genomic information. In addition, new possibilities for breeding for disease resistance are likely to develop.

SMOOTHING THE TRANSITION INTO LACTATION

During the period around first calving, dairy herd replacements are exposed to many changes which, if not managed, can result in nutritional, physiological and social stress. These types of stressors can have long-term effects on subsequent milk production, fertility, health and welfare. This section reviews management options to reduce stress during the transition period with the aim of smoothing the transition into lactation.

TRAINING HEIFERS TO THE PARLOUR

Training heifers prior to calving to the milking routine has been suggested as a way to reduce stress in early lactation. Indeed, this is a common management practice with 58% of producers adopting this practice. Research at AFBI Hillsborough has identified the main effects of training heifers to the parlour – these are summarised below and detailed in Table 15.

- Increased milk yield in early lactation – 1.3 kg/day over the first 100 days of lactation.
- A significant reduction in somatic cell count (95,000 versus 156,000).
- Slightly more kicks and flinches over first few days of milking as heifers are more confident. Untrained heifers show the same number of kicks and flinches after a week or so in the parlour.
- No benefits on reproductive performance. Indeed, trained heifers with higher milk yield in early lactation showed poorer levels of fertility.

Benefits of training heifers to the parlour pre-calving were generally shortlived

Overall, training heifers had a significant impact on milk production, and somatic cell count, but the effects were relatively short-lived with no longer term effects evident. The behaviour of heifers in the milking parlour is altered by training, but again these effects were short-lived with untrained heifers following the same behavioural patterns over time as they became accustomed to the parlour. In terms of fertility there were no beneficial effects, in fact the opposite was observed where the additional early lactation milk yield was not supported by additional feed intake.

Table 15. The effects of training heifers to the parlour for 3-weeks pre-calving on subsequent milk production over the 1st 100 days of lactation

	Control	Pre-conditioned
Milk Yield (kg/d)	25.4	26.7
Fat (%)	3.99	3.87
Protein (%)	3.30	3.31
Somatic cell count ('000)	156	95
Interval calving-conception (days)	83	102

INTRODUCING HEIFERS INTO THE HERD

The majority of producers introduce dairy heifers straight into the dairy herd after first calving (Table 16). However, some producers form small groups of calved heifers (or heifers/mature cows) and introduce these groups into the milking herd together. This approach is likely to be beneficial, based on the findings of recent research at AFBI Hillsborough. This work found that heifers introduced to the milking herd as pairs rather than individually had higher milk yields in early lactation (2 kg/day during the first month of lactation) without detrimental effects on fertility. Behavioural observations indicated the paired heifers were less fearful than those introduced

into the milking herd as individuals. Delaying the introduction of heifers (as singles) into the herd from day 1 to day 7 post-calving had no benefits on performance or behaviour.

A small study in GB has indicated that heifers find it easier to integrate if they are introduced into the milking herd after the evening, rather than the morning, milking. Cows are less socially active in the evening thus heifers may have time to settle into the pecking order more easily. Work funded by DARD and AgriSearch will examine this, and other management options, to enable improved transition management to be developed for dairy herd replacements.

Table 16. Methods of integrating heifers into milking herds (AFBI/CAFRE heifer survey)

Method of integration	% of NI dairy herds
Straight into milking herd as individuals	74
Group of heifers formed and then introduced	11
Grouped with small batch of cows and then introduced	7
Separate heifer group maintained post-calving	0.5
Other	7

MANAGING HEIFERS AS A SEPARATE GROUP

The pecking order which exists in a herd of cows means that the youngest and newest members of the group normally rank lowest. The individual animal's rank in the herd is thought to play an important role in determining her feed intake. Thus it has been suggested that regrouping cows more uniformly with less extremes in social strength will improve the conditions for the weaker individuals of the herd.

Work carried out 20 to 30 years ago reported significant benefits from housing heifers separately from mature cows. On self-feed silage systems, a GB study found that heifers housed separately from mature cows produced 3.5 kg/day (+18%) more milk. With easy-feed systems, a Danish study indicated smaller but still significant effects (5 to 10%) of housing first lactation heifers separately from mature cows (+0.8 to 1.6 litres per day). These responses were the result of heifers grouped separately spending 10 to 30 minutes longer per day eating compared with heifers grouped with older cows.

It was suggested that this difference in intake was due to the fact that first lactation heifers mixed with mature cows follow the same eating pattern as the cows (social facilitation). Since mature cows eat faster than first lactation heifers, the eating time for heifers mixed with cows is reduced compared to the situation when heifers are housed as a single group. With complete diets, the effects of housing heifers separately have been found to be less, or totally absent, perhaps as a result of total time feeding being less of a limitation on total dry matter intake.

Heifers follow the same eating pattern as older cows

Housing first lactation animals separate from mature cows undoubtedly complicates feeding and management and is only practiced by a very small number of dairy producers in Northern Ireland (less than 1%). Research information in this area is limited, particularly in relation to effects on reproductive performance, incidence of mastitis and lameness. Nonetheless, in some housing systems the separation of heifers from mature cows during the first lactation may be a practical and cost-effective practice.

HOUSING SYSTEMS

There is clear evidence that feet lesions in first lactation heifers are greater when animals are housed in cubicle accommodation compared with straw yards. Housing heifers for 4 to 8 weeks after calving on straw before moving to cubicle accommodation has been found to significantly reduce the severity of feet lesions. However, even this limited period of housing heifers on straw would have a significant impact on the costs of production and it is also important to consider that there is an increased risk of environmental mastitis with animals on straw bedded courts. With cubicle accommodation, emphasis must be placed on making cubicles as comfortable as possible to maximise lying time and hence reduce the incidence of lameness.

Main messages

Training heifers to the milking parlour has short-term benefits on milk yield and somatic cell counts, but this has not been accompanied by improved fertility (in fact the opposite has been the case in the AFBI study). Evidence to date indicates that this management option is probably not worth considering if it does not fit in easily with current practices.

Form small groups of heifers (2+) before introducing into the main milking herd.

Housing heifers separately from mature cows during the first lactation may have benefits but complicates management and has been adopted by a very low percentage of producers.

Housing heifers on straw for 4-8 weeks post-calving reduced lameness but again is not a practical option on most systems. With cubicle accommodation emphasis must be placed on comfortable lying time.

WHAT IS THE TRUE COST OF REARING A DAIRY HEIFER?

Since late 2007, costs on dairy farms have increased substantially with high oil prices forcing up feed, fertiliser and fuel prices.

This pushes up milk production costs and has the knock-on effect of increasing heifer rearing costs as well. The detailed survey of heifer rearing on Northern Ireland farms gave producers an opportunity to estimate the cost of rearing a dairy heifer on their farm. The results in Table 17 show that all farmers thought that they could rear their heifers for less than £1,000 with 23% of farmers considering that £500 or less was their rearing cost.

Table 17. Estimates by farmers of their heifer rearing costs (AFBI/CAFRE heifer survey)

Rearing cost (£)	% of responses
500 or less	23
500-700	42
700-1000	35

A number of dairy farmers have benchmarked their dairy heifer rearing enterprises over the past few years to find out the full cost of rearing their heifers. This has given an insight into the typical physical performance achieved by such enterprises. Typically, dairy heifers calve at 28 months of age on average having consumed 860 kg of concentrate to rear them to this stage. Table 18 shows how current input costs will impact on rearing costs. The average cost of £1,220 is well beyond the estimates given by farmers in Table 18. It is evident that farmers often do not take into account the full rearing cost (including overheads) of their heifers.

Table 18. Typical costs of rearing a Holstein dairy heifer to point of calving

	£/head
Concentrate 0.86 t @ £250/t	215
Forage	143
Other variables	112
Total variable	470
Overheads (less conacre paid)	390
Land opportunity cost of renting @ £300/ha	150
Total costs	**1010**
Calf	210
Cost of heifer	1220

A number of points should be noted from the above table:

- No account is taken of the farmer's own labour.
- There is a large variation around the average. The top 25% most efficient farmers can rear their dairy heifers using over 620 kg less meal per heifer than the bottom 25% of farmers (580 kg compared with 1200 kg). For a 100 cow dairy farm rearing 30 heifers per year, this difference in concentrate feeding at current costs is equivalent to £4,500 per year.

The top farms:-

- serve heifers earlier
- maximise grazing days for heifers
- make quality silage
- have more heifers born in the autumn than in the spring

- Overheads are allocated per hectare on a dairy farm. This method of allocation is the same for all farmers using benchmarking and thus guarantees consistency. It may slightly disadvantage the heifer enterprise as the dairy herd

will be responsible for a larger proportion of overheads than the heifers. On a farm rearing dairy heifers only, overheads per animal are likely to be less than the figure stated in Table 18.

– Figures in Table 18 are a guide only – these figures should be changed to get the true figure for your farm.

Average cost of rearing a heifer is £1220

The high cost of heifers requires high lifetime yields to spread this cost over a greater number of litres. If an animal lasts for only 1 lactation of 7,000 litres and is then culled for £400, the replacement cost per litre for that milk will be almost 12 pence. This shows just how important an investment heifers are to the modern dairy herd.

CALVING AGE

There is a wide range of average age at calving on dairy farms in Northern Ireland. Calving heifers older should produce larger and heavier heifers at calving which are likely to yield more in their first lactation. Is this a false economy? This question is best answered by looking at an example farm with 100 cows currently calving heifers at 36 months of age. If this farm moved to calving at 24 months or to the typical 28 month calving, what would be the financial result? Table 19 shows the situation on the farm with either 24, 28 or 36 month calving.

Table 19. Stock numbers on a farm calving heifers at either 24, 28 (typical calving age) or 36 months

	Age at calving (months)		
	36	28	24
Cows	100	109	114
Heifers over 2 yrs	30	11	0
Heifers 1-2 yrs	30	33	34
Heifers under 1 yr	30	33	34
Area farmed (hectares)	75	75	75

This example assumes that additional cows can now be accommodated in the housing that the heifers over 2 years of age occupied. It also assumes that sufficient slurry capacity exists to milk additional cows instead of keeping 30 heifers on average over 2 years of age.

For the purposes of this calculation, it is assumed that 24 month heifers yield 780 litres less per lactation than 36 month heifers while 28 month old heifers yield 580 litres less than 36 month heifers. The lower yield of 24 month heifers may well be made up during the productive life of the animal but this has been ignored in this calculation. It has also been assumed that any additional cows can be milked without additional labour.

The "base" position is 100 cows and 36 month calving.

MOVING FROM 36-28 MONTH CALVING

Farm profit would be £6,500 higher if the farm moves to 28 month calving and keeps additional cows (up to the 170 kg livestock manure nitrogen per hectare limit). This assumes an average milk price of 23 pence per litre.

If the farm stays at 100 cows and moves to 28 month calving, there is land released that does not have to be taken in conacre or land that can be let out. If a price of £300 per hectare (£120/acre) is used for conacre, the farm would be better off by £4,600.

MOVING FROM 36-24 MONTH CALVING

Farm profit would be £10,600 higher if the farm moves to 24 month calving and keeps additional cows (up to the 170 kg livestock manure nitrogen per hectare limit). This assumes an average milk price of 23 pence per litre. Every 1 pence difference in milk price from 23p would change this calculation by almost £1,000.

If the farm stays at 100 cows and moves to 24 month calving, there is land released that does not have to be taken in conacre or land that can be let out. If a price of £300 per hectare (£120/acre) is used for conacre, the farm would be better off by £6,900 (Table 20).

Table 20. Increases in profit by moving from 36 month calving to either 28 month or 24 month calving through renting out land or increasing cow numbers

	28 month calving (typical calving age)	24 month calving (target calving age)
Moving from 36 month calving and land freed up let out in conacre	£4,600	£6,900
Moving from 36 month calving and additional cows milked	£6,500	£10,600

HEIFER REARING SYSTEMS

Table 21 shows various options for producing well grown heifers that calve at 24 months on average. It can be seen that autumn born calves can be reared more cost effectively than late winter/early spring calves (based on a straw system). This is because they have a higher proportion of grazed grass in the diet. Not only is grass cheaper to produce, it requires less concentrate feed to balance the ration.

Straw systems require substantially more concentrates to ensure adequate growth. If concentrate and straw prices were to reduce and fertiliser prices continued to rise, the difference between this system and the others would narrow. The fact that feeding large quantities of bought-in straw is "land saving" is now less of an advantage given the Nitrates Action Programme Regulations in Northern Ireland. Sufficient land will still have to be controlled, or slurry exported, to stay within the appropriate limit of Livestock Manure Nitrogen per hectare.

It is also important to note that in poorly managed grazing systems where grass quality and utilisation are below average, grass may be much more expensive than assumed in Table 21.

Table 21. Comparison of the costs of heifer rearing systems

	HGM Heifer Nuts (kg)	Silage (t fresh)	Grass (t Dry Matter)	Straw (t fresh) +	Lifetime DMI (t)	Cash cost (£)*
Autumn born	795	4.6	2.0	0.0	3.8	408
Mid winter born	1215	6.3	1.2	0.0	3.9	506
Spring/ summer born	1510	5.2	1.0	0.4	4.0	567
Straw system	2225	0.0	1.2	1.0	4.0	680

Rearing costs of £65 per heifer have not been included in the above figure. This covers milk substitute, concentrate, hay, straw bedding and veterinary up to the age of 3 months.

* Cash cost is based on a concentrate price of £250 per tonne as paid and on the cash costs for forages produced by CAFRE/ AFBI in 2008. This is the lifetime cost per heifer reared of feed and forage on a cash basis.

Summary points

Dairy farmers in Northern Ireland underestimate the cost of rearing their heifers. At current prices, a heifer will cost £1,220 to rear.

Efficient use of forage will reduce rearing costs. The top 25% of farms use 620 kilos less meal to rear a heifer than the bottom 25%.

Moving to 24 month calving will increase farm profit if the additional land released is used to milk additional cows or let out in conacre. Savings in rearing costs and additional fertility performance and lifetime yield will be additional benefits.

Autumn born calves are cheaper to rear to 24 months of age than spring born calves.

REARING YOUR 2010 HERD – KEY FACTS

CALF VIABILITY AND HEALTH

- Overall, pre-weaning mortality rates estimated at 7%
- Mortality rates of progeny from first calving Holstein Friesian heifers recorded at 14%
- Estimated that 33% of heifers require intervention at calving
- Colostrum management is the key to calf health (10% of calf weight within 6-hours) along with hygiene and housing
- 19% of calves sourced from NI farms found to have low immune status
- Evidence of inadequate colostral immunity in 60% of calves given post-mortem at VSD
- Pneumonia and calf scour are considered significant problems by over 32 and 38% of producers, respectively.

MILK FEEDING

- Only 23% of producers use predominately milk replacer to feed calves
  - Additional cost of £14/calf if all milk is saleable
- Recommended to feed 500-600 g/day of milk replacer (23% protein content adequate)
- No long-term benefits observed of feeding higher levels of milk replacer (1200 g/day) of high protein content (27-30%). Such a system adds cost – £35.25 per calf
- Wean on concentrate intake (0.7 kg concentrate/day) from 5 weeks of age
  - Cost saving of £5/calf over weaning on age at 8-weeks.

MEASURE TO MANAGE

- Target first calving at 23-25 months of age with live weight of 540-580 kg
- Essential to monitor growth by girth tape to make informed decisions
- Less than 10% of producers currently record live weight or any other measures of body size
- Current systems: heifers 24-36 months of age (average 28 months), live weight of 600 kg+

– For calving at 23-25 months of age: start to breed at 13.5 months at average weights of 350-370 kg
  - Currently only 30% of producers start breeding at 13-14 months of age.

BLUEPRINT FOR FEEDING AND MANAGEMENT

– Blueprints developed detailing feeding and management regimes to meet target growth rates

– Blueprints tested across 8 farms with 1,500 heifers and average calving age reduced from 28 to 25 months

– Aim to reduce rearing costs by 1 p/l.

SIRE SELECTION

– 62% of producers use AI for majority (50% plus) of heifer matings

– PLI only considered very important selection criterion by 7% of producers.

SMOOTHING THE TRANSITION INTO LACTATION

– Benefits accrue with forming small groups of heifers and introducing these into the main milking herd
  - Additional 1-2 kg milk yield per day in early lactation.

WHAT IS THE TRUE COST OF REARING A DAIRY HEIFER?

– Typical cost of rearing dairy heifer to point of calving is £1,220 for benchmarked farms- excluding any change for farmers own labour

– Applying this rearing cost to average milk yield of NI producers means that rearing costs equate to 3.3 p/l.

PUTTING INTO PRACTICE THE DIFFERENT ASPECTS OF RESEARCH AND DEVELOPMENT

Typical performing herd with 100 cows with 30 replacements

– Calf feeding and management
  - Reducing calf mortality to 3% equates to £400 per annum
  - Increasing reliance on milk replacer and optimum weaning age: estimated at £12 per calf i.e. £360 per annum

– Smoothing the transition into lactation
  - Introducing heifers in groups to main milking herd: estimated at 1-2 litres additional milk in early lactation. Longer-term effects currently being determined

– Managing heifers to calve at 24 months
  - Additional cows milked: moving from 28 months to 24 months of age increases profit by £4,100 per annum

– Targeting live weight of 540-580 kg
  - Compared with 600 kg+ heifers, feed costs reduced by £130/heifer equating to cost saving of £3,900 per annum
  - Reproductive performance improved (30 days shorter calving interval) associated. Reduced lameness also observed. Overall, assumed 4 months additional herd life in milking herd increasing output, net of feed costs, by £2,450 per annum

– Overall financial impact of over £11,000 or over 1 p/l on all milk produced.

Rearing your 2010 herd

Profit from research and development on heifer rearing

Objective of the event

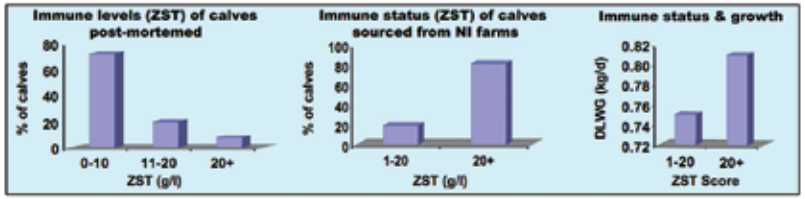
To see local research and development in practice to improve your profit by over £11,000 per 100 cows

Format of the event

- Stop 1: Calf Clinic
- Stop 2: Measure to manage
- Stop 3: Blue print for feeding and management
- Stop 4: Selecting the best genetics
  Smoothing transition to the milking herd
- Stop 5: Economics of heifer rearing

Calf health

- Calf health and mortality remains an economic and welfare cost
- AFBI on-farm research: 14% mortality in progeny from first lactation HF heifers
  - 32% of farms indicate pneumonia problem
  - 38% of farms indicate scour problems



- Intake of high quality colostrum (within 6 h of birth) is key

Message

2-4 litres of good quality colostrum within 6 hours, feed for 4 days when possible

Options for calf feeding

Current feeding practices

Frequency

Once per day feeding - 6%
Twice per day feeding - 94%

Main methods

Automated feeder - 3%
Multi-teat bucket - 14%
Single bucket - 78%

System	Time saved per day/50 calves	Performance
Once a day feeding	1h 15 min	Equal weight at 8 weeks
Group feeding cafeteria	2h 25 min	Cafeteria calves weighed 10kg less at 3½ months
Computerised automated	3h 40 min	Equal weight at 8 weeks

Whole milk versus milk replacer?

Current feeding

- 77% of producers predominantly feed whole milk

Feeding whole milk

- One 25kg bag of milk replacer = 192 litre of whole milk
- Saleable whole milk: cost of £14/calf above milk replacer
- Waste milk
  - Can represent an increased disease risk (e.g. Johnes)
  - Variable composition
  - Wherever possible feed to bull calves only
  - On-farm pasteurisation reduces pathogens

How much milk replacer to feed

Heifer Rearing Survey

- Average 8 week weaning age
- Range 4-12 weeks
- 27% weaning >9 weeks

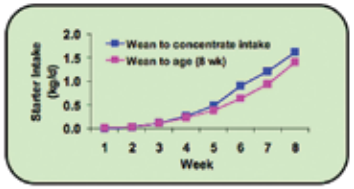
- 85% of NI farmers: size and solid food intake most important weaning criteria

	Milk replacer (l/day) 5	10
Lwt 8 weeks (kg)	63	72
Lwt 9 months (kg)	238	237
Milk Yield (kg/d)	22.5	22.2

Message

Feed: 5-6 l per day of a 23% protein milk replacer

Weaning Age: 5 weeks onwards but meal intake is the key weaning guide - 0.7 kg/day for 2 consecutive days



Replacements required

100-cow herd with 30 replacements each year

Age category on farm	Age at first calving (months) 24	30	36
0 – 12 months	30	30	30
12 – 24 months	30	30	30
24 – 36 months	-	15	30
Total replacements	60	75	90

Breeding age & calving age

Breeding Start Age	Average Calving Age	Survey Results
13.5	24	30%
14	24.5	
15	25.5	30%
16+	27+	40%

Submission rate 70% & conception rate 50%

1/3 of survey farms mainly use bulls. To improve heat detection aids:

- Teaser bulls
- Tailpaint
- Synchronisation
- Pedometers

Optimum body size at first calving

Target: live weight of 540 -580 kg (condition score 2.5-3.0)

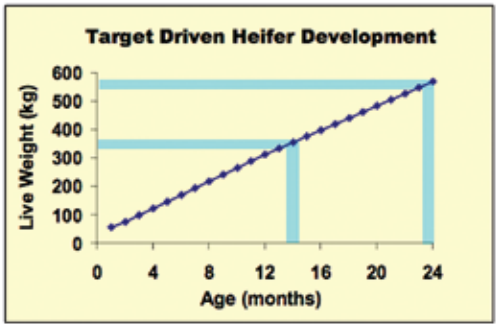
- **Represents adequate size without over conditioning**
- **Targets based on AFBI Hillsborough research which shows rearing moderate heifers (540-580 kg) compared with large heifers (600 kg plus):**
  - **Lower milk yield in early part of first lactation (2-3 litres/day) but lighter heifers catch-up**
  - **Better fertility (30 days + shorter calving interval)**
  - **Better feet condition and lower lameness**

Optimum size for mating

Which heifers are ready for service?

Target live weight

Average 350-370 kg
Cut off 330 kg



THOMPSONS HEIFER REARING PROJECT IN ASSOCIATION WITH AFBI HILLSBOROUGH AND CAFRE

- **Objectives**
  - To produce a heifer at approx. 580 kg that has calved at 24 months of age
  - Improve lifetime performance to 30,000 litres and reduce costs by over 1 p/l
- **Methodology**
  - 8 farms across N.Ireland commenced project in Autumn 2005
  - Measurements taken from a sample of heifers quarterly
  - Approx. 1,500 heifers reared on project to date
- **Feeding**
  - Feeding Blueprint developed by Thompsons
- **On Farm Monitoring**
  - Heifer heights and girths measured at each visit
- **Growth Management**
  - Feed-rates adjusted according to growth rates

What has been achieved

- Age at Calving – 28-25 months
- lactation yields – 7506 litres

Example Blueprint – Rearing the Aug./Nov. Born calf
There is only one chance to get it right

From 12 weeks – mid April:

- Straw or silage as forage
- Good silage + 2kg Conc.
- Clean Straw + 3kg Conc.
- Well ventilated housing

From mid April – Autumn:

- Conc. feed rate adjusted to quantity/quality of grass
- Good parasite control regime
- House early to ensure mating at 13-14 months (350-370 kg)
- If indoors - clean straw or silage + conc.

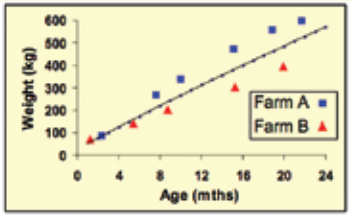
Second Winter:

- Silage + 1-4kg conc.
- Straw + 4-5kg conc.
- Possibly reduce conc. when in calf

Second summer at grass

- Parasite control may still be important
- Acclimatise heifers to post calving diet
- Importance of management around calving

Blueprint yes!---but must monitor progress



- **Winter forage quality has a major impact**
- **Grazing managment - critical !**
- **Performance can easily be lost through a period of under nutrition**

Key Point – monitor progress and alter management accordingly

Late winter/spring calves need more control in management

- **For many farmers housing over the first summer is easier to control**
- **If at grass, grazing system and worm control are critical aspects**
- **Concentrate feeding at grass normally required - but not a substitute for good grassland management**
- **House early and feed well during the second winter**

Selecting sires for your future dairy herd

- Sire selection represents the key breeding decision
- Sire proofs work in practice
- Genetic information on fertility, health & longevity:
  - now available
  - should attract more attention
- Selection indexes – best way to combine information on traits
- Profitable lifetime index
  - Used by breeding companies to select bulls
  - Surprisingly, considered by minority of producers
  - AFBI looking at selection indexes specific to NI systems
  - DNA information will improve selection indexes further

Smooth transition into the dairy herd

Training heifers to the parlour

- 58% of producers train heifers to the parlour

What's research shown?

- Training results in increased milk yield, but poorer fertility

	Control	Trained
Milk yield (kg/day)	25.4	26.7
Fat +Protein (kg/day)	1.83	1.89
SCC (X'000/ml)	156	95
Calving-conception (days)	83	102

Introducing heifers to the milking herd

- 74% of producers send heifers straight into the dairy herd

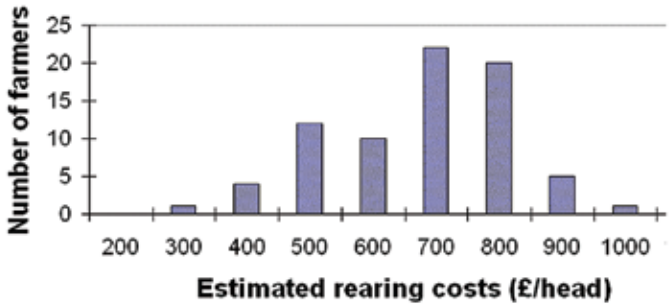
What's research shown?

- Pairing heifers together increased milk production by 2 kg/day
- Delaying introduction of single heifers for 7 days post calving of no benefit
- Behaviour of paired heifers indicated less stress

Message - Form small groups of heifers (2+) before introducing into main herd

What do farmers think their heifer rearing costs are?

Source: Northern Ireland heifer survey



What is the true cost of rearing a heifer?

Source: Greenmount heifer benchmarking

	£/head
Concentrate 0.86t	215
Forage	143
Other variables	112
TOTAL VARIABLES	**470**
Overheads	390
Land (£300/ha)	150
TOTAL COSTS	**1010**
Calf	210
COST OF HEIFER	**1220**

Family labour costs not included

Effect of reducing age at 1st calving from 36 months

100 cow farm, keeping 30 heifers per year – 75 hectares farmed

Currently calving at 36 months .....

(£/year)	28 mths	24 mths
Let land saved	4,570	6,900
Milk more cows	8,000	9,600

(keeping below 170kg LMN/ha)

Efficiency pays when rearing dairy heifers

- **Top 25% farms calve 24 month heifers at 580kgs using 600kgs concentrate**
- **Low 25% farms calve 28 month heifers at 600kgs using 1200kgs concentrate**
- **Concentrate difference alone = £4,500 for 100 cow herd**
- **The top farms:**
  - **Serve heifers early**
  - **Have good grazing systems**
  - **Maximise grazing days for heifers**
  - **Make quality silage**
  - **Have more heifers born in autumn**

Financial impact of implementing research & development work

Typical 100 cow herd rearing 30 replacements

	£ per annum
Reducing calf mortality (to 3%)	400
Optimum milk replacer levels	360
Smoothing transition to dairy	Work still in progress
24 month old calving + 540-580 kg	
Releasing land	4,100
Feed costs (cp with 600 kg+)	3,900
Assume herd life +4 months (fertility, lameness, age)	2,450
Total	**11,200**

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THOMPSONS

For further information
contact The Secretary at AgriSearch:

97 Moy Road
Dungannon
Co Tyrone
BT71 7DX

T: 028 8778 9770
F: 028 8778 8200
E: info@agrisearch.org
www.agrisearch.org