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A comparison of the performance of Holstein-Friesian and Norwegian Red cows on Northern Ireland dairy farms

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Agri-Food and Biosciences Institute, Large Park, Hillsborough,
County Down, Northern Ireland BT26 6DR

Research team: Conrad Ferris, Kyle Molyneaux, Adrian McKeague, Desmond Patterson, Sinclair Mayne, David Kilpatrick and Fred Gordon

Booklet prepared by Conrad Ferris

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SUMMARY

Although dairy farming has made excellent progress with the Holstein-Friesian cow, it is now realised that breeding programmes with a primary focus on milk yield have inadvertently resulted in increased levels of infertility, poorer cow health, and an increased risk of involuntary culling.

In contrast, sire selection programmes within Norway have included traits such as health and fertility for almost 40 years, and evidence from Norway suggests that Norwegian Red cattle are highly fertile, and have a low incidence of mastitis, still-births and calving difficulties.

This study was conducted to examine if the Norwegian Red breed could have a role in overcoming some of the problems associated with the Holstein breed.

The experiment was conducted on 20 Northern Ireland dairy farms and involved 221 Holstein-Friesian dairy cows (locally bred) and 221 Norwegian Red dairy cows (imported from Norway as heifers). Cows completed five lactations on the experiment, unless culled/sold beforehand.

Norwegian Red cows had fewer calving difficulties than Holstein-Friesian cows when calving for their first and second time. This is likely due to the long term inclusion of calving ease within Norway's breeding programme, and the fact that Norwegian Red cows have lighter calves than Holstein-Friesian cows. Calving difficulty score was unaffected by breed when cows calved for the third time.

When calving for the first time the incidence of stillbirths (including deaths within 24 hours of calving) was 4% for Norwegian Red cows and 13% for Holstein-Friesian cows. There was no difference between breeds in the proportion of calves born dead when calving for the second time.

When calving for the first time Norwegian Red cows had a poorer temperament at calving than Holstein-Friesian cows. There was no difference in calving temperament between breeds when calving for the second time.

Norwegian Red cows had a poorer milking temperament during the first three weeks of lactation 1, compared to Holstein-Friesian cows. However, milking temperament score did not differ between breeds during lactation 2.

Although Norwegian Red cows had a higher condition score than Holstein-Friesian cows, both breeds lost and gained condition score at similar rates throughout lactation.

Norwegian Red cows produced milk with a higher protein content than Holstein-Friesian cows, while milk fat content did not differ between breeds.

Holstein-Friesian cows tended to have higher 305-day milk yields than Norwegian Red cows during lactations 1 – 3 (mean: 6476 vs 6219 litres), but not during lactations 4 and 5 (mean: 7206 vs 7178 litres). Fat plus protein yield was unaffected by breed.

Across the range of concentrate feed levels offered within this experiment, the milk yield response to each additional kilogramme of concentrate offered was similar for both breeds.

Somatic cell counts were approximately 40% lower with the Norwegian Red cows. This improved udder health was reflected in the fact that 9.0% of Holstein cows, compared to 4.1% of Norwegian cows, were culled due to mastitis.

Norwegian Red cows had poorer udder conformation than Holstein cows, with 6.8% of Norwegian Red cows eventually culled due to 'poor udder conformation', compared to only 1% of Holstein cows. An increased focus has now been placed on udder type within sire selection programmes within Norway.

There were clear trends for the Norwegian Red cows to have improved fertility (higher conception rates and lower calving intervals) compared to Holstein cows. During the study 28.5% of Holstein-Friesian cows and 11.8% of Norwegian Red cows were culled as infertile. As the condition score results from this study suggest energy balance was similar with both breeds, the improved fertility observed is likely a direct reflection of the long term genetic selection for fertility traits within the Norwegian Red breed.

Norwegian Red cows had improved longevity, with 27.2% of Norwegian Red cows and 16.3% of Holstein-Friesian cows surviving until the end of the fifth lactation. When extrapolated to give life-time survival, on average Holstein-Friesian cows completed 3.5 lactations while Norwegian Red cows completed 4.2 lactations.

When the production data presented within this report were presented on an economic basis, net profit/year was £78/cow (22%) higher with the Norwegian Red cows compared to the Holstein Friesian cows.

BACKGROUND

The Problem

Although dairy farming has made excellent progress in recent years with the Holstein-Friesian cow, it is now realised that breeding programmes with a primary focus on yield have inadvertently resulted in increased levels of infertility, poorer cow health, and an increased risk of involuntary culling. The direct and indirect costs associated with each of these problems can be very substantial due to veterinary treatments, reduced milk yields, loss of milk sales, reduced longevity and poor animal welfare. While some of the problems associated with the Holstein-Friesian breed may be overcome through improved feeding and management, the potential of 'breeding strategies' must also be considered.

Potential of breeding strategies to overcome the problem?

a) **Adopt more balanced breeding goals with the Holstein breed:** this approach is now being adopted widely. For example, the Profitable Lifetime Index (£PLI) within the United Kingdom incorporates important economic traits such as fertility, health and lifespan, and there is evidence that some of the declines in fitness traits observed previously are now starting to be reversed.

b) **Cross-breeding:** this approach is being actively examined in a research programme at Hillsborough involving Jersey x Holstein crossbred cows.

c) **Breed substitution:** refers to replacing the Holstein breed with an alternative breed which has been selected and bred for traits which are of economic importance. The study reported in this booklet involved breed substitution.

The Norwegian Red breed - a candidate for breed substitution?

Norway has a dairy cow population of 280,000 cows (similar to Northern Ireland), of which approximately 95% belong to the Norwegian Red breed. However, selection programmes within Norway have included traits such as health and fertility for almost 40 years, with this made possible by the routine recording of calving, health and fertility information by farmers and vets. Having excellent information on these 'functional traits' has meant that bulls which transfer these positive traits can be identified. Within Norway this information is combined into an index called the Total Merit Index (TMI), the current weightings of which are shown on the next page:

Table 1 Current weightings on traits within the Total Merit Index (TMI) within Norway

Trait within bull selection index	Weighting (%)
Milk	28
Mastitis	21
Fertility	18
Udder conformation	15
Growth rate	6
Leg conformation	6
Temperament	2
Diseases other than mastitis	2
Milkability	1
Still birth	0.5
Calving difficulty	0.5

Evidence from Norway suggests that these selection programmes have been highly effective, and that Norwegian Red cattle are highly fertile, and have a lower incidence of mastitis, still-births and calving difficulties, compared to cattle populations in other countries. However, in view of the differences in farming systems between Norway and Northern Ireland (smaller herd sizes, animals often being tied individually, less emphasis on grazed grass in the diet), it was decided that the Norwegian Red breed should be evaluated under Northern Ireland conditions in order to assess its true potential for the local industry.

AIM OF EXPERIMENT

To examine if the Norwegian Red breed has a role to play in improving the efficiency and economic performance of the Northern Ireland dairy sector.

THE EXPERIMENT

Overview

The experiment was conducted on 20 Northern Ireland dairy farms and involved 221 Holstein-Friesian dairy cows and 221 Norwegian Red dairy cows. The experiment started in 2000 and finished in 2008, with cows completing five

lactations on the experiment, unless culled/sold beforehand. The Norwegian Red cows were imported from Norway, while the Holstein-Friesian cows were born on the participating farms.

Selection of Norwegian Red cows

The Norwegian Red animals were sourced from 187 different farms from within three of Norway's main dairying regions, namely Trondheim, Hamar and Stavanger. Animals selected were within the top 10% of the Norwegian Red population in terms of Total Merit Index (TMI). After undergoing a series of health checks, heifers were transported overland to Northern Ireland. Heifers were between 3 and 18 months of age when imported, and were sired by a total of 26 Norwegian Red sires.

Selection of participating farms in Northern Ireland

Twenty Northern Ireland farms were selected, representing a range of geographical locations, calving systems (winter and spring) and concentrate inputs. In addition, a number of the participating farms operated organic systems. Holstein-Friesian 'pair mates' of similar ages to the imported Norwegian Red heifers were selected from the farmers own stock.

Management and breeding of experimental animals

On each farm the Holstein-Friesian and Norwegian Red heifers were subject to the same heifer rearing regimes. A range of breeding policies were adopted, with most farmers using a combination of AI and stock bulls. For farmers using AI, most continued to breed Holstein-Friesian cows to a Holstein-Friesian sire, and Norwegian Red cows to a Norwegian Red sire, although some crossbreeding also took place.

Data collection

Data were collected in a number of ways. The participating farmers collected data on calving difficulty, calving temperament, milking behaviour, fertility, concentrate feed levels and reasons for culling. Information on cow condition score and locomotion score was collected by a member of Hillsborough staff during regular visits to the farms. Milk production and milk composition data were obtained through official milk recording schemes.

MAIN FINDINGS

Calving difficulty

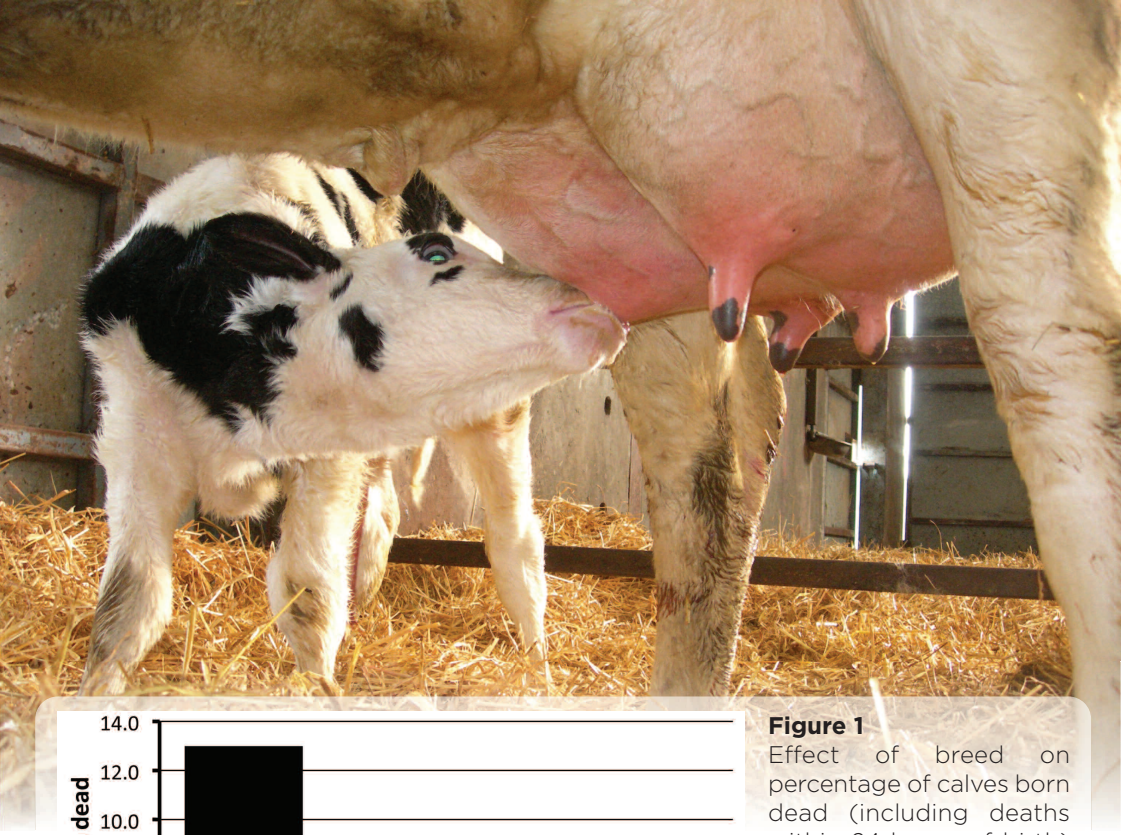
Difficult calvings can lead to a loss of milk production, poor fertility, and an increased risk of health problems for both the cow and calf. Within this study calving difficulty was scored on a 1 - 5 scale, where 1 = unobserved or unassisted, and 5 = calf delivered by caesarean section. Norwegian Red cows had fewer calving difficulties than Holstein-Friesian cows when calving for their first and second time, with the percentage of unassisted calvings presented in Table 2. This is likely due to the long term inclusion of calving ease within Norway's breeding programme, and the fact that Norwegian Red cows have lighter calves than Holstein-Friesian cows. The percentage of unassisted calvings was unaffected by breed when cows calved for the third time.

Table 2 Effect of breed on the percentage of unassisted calvings at the first, second and third calving

	Holstein-Friesian	Norwegian Red
First calving (%)	42	70
Second calving (%)	68	82
Third calving (%)	79	82

Still births

When calving for the first time the incidence of stillbirths (including deaths within 24-hours of birth) was 4% for Norwegian Red cows and 13% for Holstein-Friesian cows (Figure 1). While the value recorded for the Holstein-Friesian breed may appear to be high, this is similar to values recorded for Holstein populations in some other countries. The lower incidence of still births with Norwegian Red cows is again likely to reflect the inclusion of this trait within the selection index within Norway. Indeed, the incidence of still births within Norway was recently recorded as 3% at first calving and 1.5% for second and later calvings. There was no difference between breeds in the proportion of calves born dead when calving for the second time.



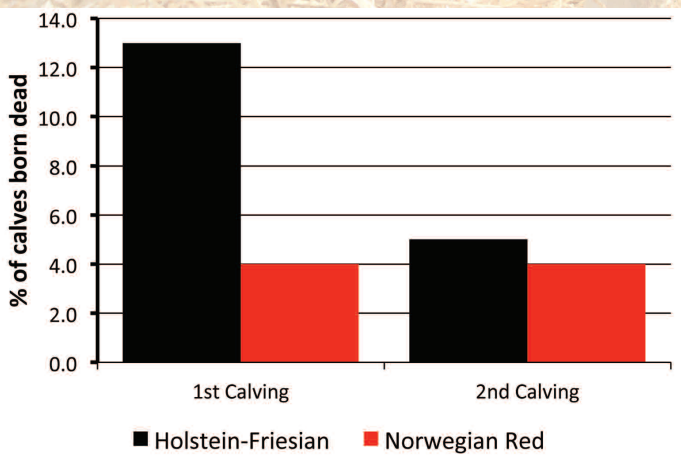


Figure 1
Effect of breed on percentage of calves born dead (including deaths within 24 hours of birth) at the first and second calving

Calving temperament and milking temperament

Calving temperament was scored on 1 - 4 scale during the period when the cow was in the calving pen, where 1 = very quiet and 4 = aggressive. Norwegian Red cows had a poorer temperament than Holstein-Friesian cows when calving for the first time, but not at their second calving. The percentage of cows with a 'very quiet' temperament at calving are presented in Table 3.

Table 3 Effect of breed on the percentage of cows with a 'very quiet' temperament at their first and second calving

	Holstein-Friesian	Norwegian Red
First calving (%)	77	55
Second calving (%)	89	93

Milking temperament was scored on a 1 - 4 scale (within 48 hours of calving and at three weeks post calving), where 1 = stands calmly and 4 = milked with difficulty. Following their first lactation Norwegian Red cows had a poorer milking temperament during the first 48 hours post calving, and at three weeks post calving, compared to Holstein-Friesian cows. Milking temperament score did not differ between breeds during lactation 2. The percentage of cows that 'stood calmly' during the two measurement periods in Lactations 1 and 2 are presented in Table 4

Table 4 Percentage of cows of each breed that 'stood calmly' during milking (within the first 48 hours post calving and at three weeks post calving) during lactations 1 and 2

	Holstein-Friesian	Norwegian Red
Lactation 1:		
- within 48 hours of calving (%)	37	31
- three weeks post calving (%)	91	80
Lactation 2:		
- within 48 hours of calving (%)	82	75
- three weeks post calving (%)	97	94

In summary, while there were some temperament issues with the Norwegian Red cows in the current study, these were primarily observed with first lactation heifers, but not with cows. Within Norway milking temperament is currently included within the Total Merit Index, albeit at a relatively low level (currently 2%). The latter reflects the fact that Norwegian farmers do not perceive the Norwegian Red breed to have a 'poor' temperament, and indeed it is true that the differences observed between breeds within the current study were, on the whole, relatively minor.

Condition score

Norwegian Red cows had a higher condition score than Holstein cows during each of lactations 1 and 2. However, changes in condition score during each lactation were similar for each of the two breeds suggesting that both breeds mobilised and laid down similar amounts of body condition (Figure 2).

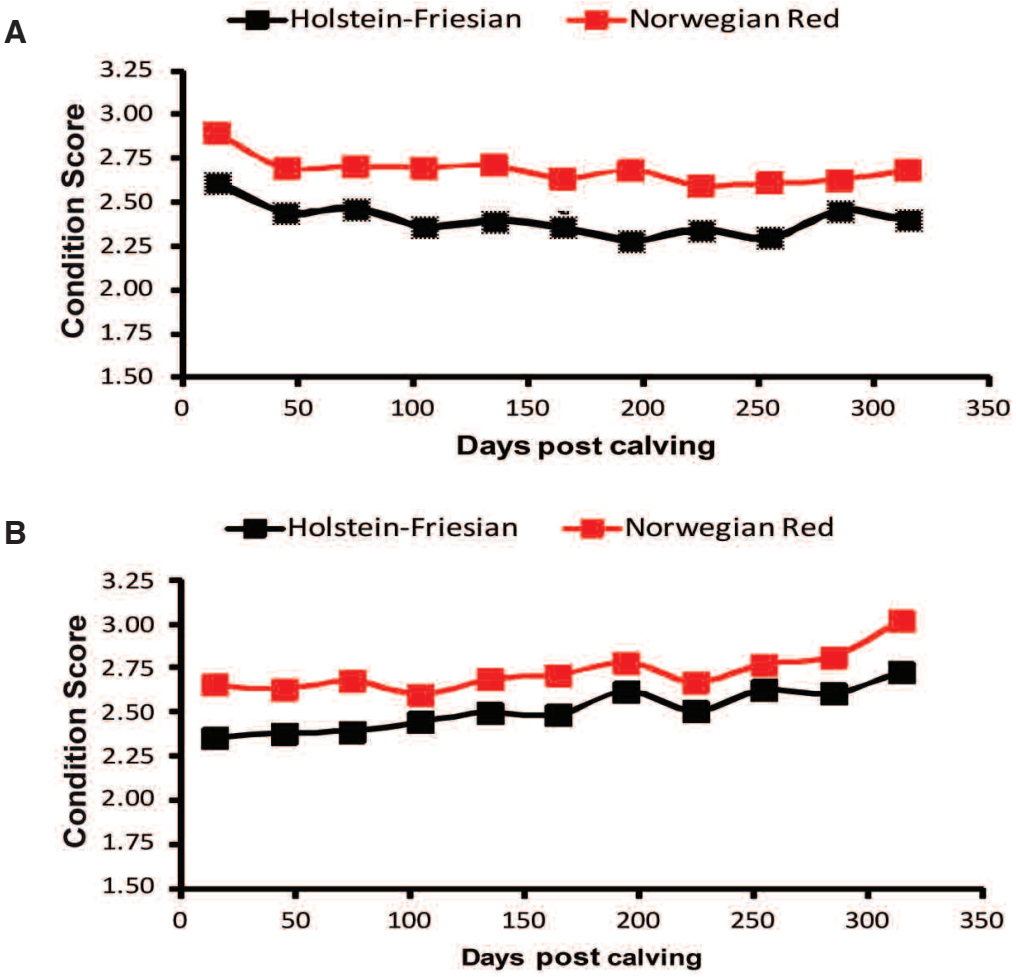


Figure 2
Effect of breed on cow condition score during lactations 1 (a) and 2 (b)

Hoof health

Cows of the two breeds had similar locomotion scores. However, in a separate study at Hillsborough Norwegian Red cows were found to have lower sole lesion scores and lower white line scores than Holstein-Friesian cows, suggesting improved hoof health with the Norwegian Red cows. Nevertheless, the number of cows culled due to 'feet and leg' problems within this study was similar for both breeds.

Milk production and composition

Milk production and milk composition during each of lactations 1 - 5 is summarised in Table 5. There was a general trend for Holstein-Friesian cows to have higher 305-day milk yields and full lactation milk yields than the Norwegian Red cows in lactations 1 - 3, but not during lactations 4 and 5. However, Norwegian Red cows produced milk with a higher milk protein content than the Holstein-Friesian cows, the overall effect being that the two breeds did not differ in terms of fat plus protein yield in any lactation. These similar milk yields are likely due to the fact that the two breeds have similar intakes, and similar metabolic efficiencies. In addition, condition score data in Figure 2 provide no evidence of differences in condition score change between breed.

The results of this study also demonstrated that the two breeds showed a similar milk yield and fat + protein yield response to each additional kilogram of concentrate fed across the range of concentrate levels offered. This suggests that up to medium concentrate feed levels, Norwegian Red cows and Holstein-Friesian cows have a similar genetic potential to respond to additional concentrate feeding. Nevertheless, when very high concentrate feed levels were offered in a separate study at Hillsborough, Holstein-Friesian cows out performed Norwegian Red cows.

Table 5 Effect of breed on milk production and milk composition during each lactation.

	Holstein-Friesian	Norwegian Red
Lactation 1		
305-day milk yield (litres)	5818	5601
Milk fat (%)	3.82	3.88
Milk protein (%)	3.21	3.28
305 day fat + protein yield (kg)	408	399
Lactation 2		
305-day milk yield (litres)	6479	6269
Milk fat (%)	3.69	3.77
Milk protein (%)	3.25	3.31
305-day fat + protein yield (kg)	447	442
Lactation 3		
305-day milk yield (litres)	7131	6787
Milk fat (%)	3.69	3.80
Milk protein (%)	3.26	3.33
305-day fat + protein yield (kg)	493	482
Lactation 4		
305-day milk yield (litres)	7323	7108
Milk fat (%)	3.84	3.90
Milk protein (%)	3.23	3.34
305-day fat + protein yield (kg)	515	512
Lactation 5		
305-day milk yield (litres)	7089	7248
Milk fat (%)	3.72	3.88
Milk protein (%)	3.24	3.35
305-day fat + protein yield (kg)	491	523

Somatic cell count and mastitis

While there was a trend for SCC to increase with increasing lactation number, SCC's were approximately 40% lower for the Norwegian Red cows during each of lactations 1 - 5 (Figure 3). While detailed information on mastitis incidence was not recorded by farmers within the current study, it is known that there is a strong relationship between SCC and incidence of mastitis. Indeed, the percentage of Norwegian Red cows culled due to mastitis (Table 7) was approximately half of that for the Holstein-Friesian cows. This agrees with the findings of studies undertaken at Hillsborough in which Holstein-Friesian cows had a higher mastitis incidence than Norwegian Red cows.

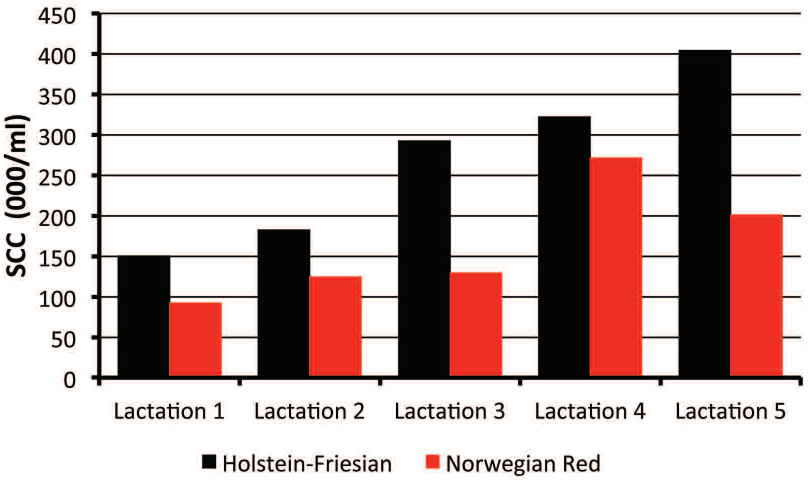


Figure 3 Effect of breed on mean somatic cell count (000/ml) during lactations 1 - 5

Fertility

The results of the current study provided clear evidence of improved fertility with Norwegian Red cows, compared to Holstein-Friesian cows. For example, there was a clear trend toward a higher conception rate at first artificial insemination with the Norwegian Red cows. In addition, there was a trend for Norwegian Red cows to have a lower calving interval than the Holstein-Friesian cows in each of lactations 2 -4, although it must be remembered that the calving interval data hides the increased infertility rates with the Holstein-Friesian cows. The overall culling data from the experiment highlighted that 28.5% of Holstein-Friesian cows and 11.8% of Norwegian Red cows were culled as infertile prior to lactation 6.

While poorer fertility levels are normally associated with increased levels of negative energy balance, the condition score data from this experiment suggested no

difference between breeds in the extent of tissue mobilisation. Thus the improved fertility within the current study is likely a direct reflection of the long term genetic selection for improved fertility within Norway.

Table 6 Effect of breed on conception to 1st AI, calving interval (days) and the percentage of cows culled as infertile.

	Holstein-Friesian	Norwegian Red
Conception to 1st AI (%)		
Heifers	58	66
1st lactation	41	55
2nd lactation	39	60
3rd lactation	35	65
4th lactation	52	59
Calving interval (days)		
1st lactation	389	399
2nd lactation	390	379
3rd lactation	397	376
4th lactation	387	384
Cows culled as infertile during study (%)	28.5	11.8

Reasons for culling and cow longevity

The results of this experiment demonstrate that a much broader selection index, such as the Total Merit Index in Norway, can improve cow longevity. For example, 27.2% of Norwegian Red cows, compared to 16.3% of Holstein-Friesian cows, survived until the end of the fifth lactation. Although cow survival was not monitored after this point, an extrapolation of the data indicates that on average Holstein cows completed 3.5 lactations while Norwegian Red cows completed 4.2 lactations.

While cows were culled for many reasons, the main 'cow' reasons were infertility, mastitis, feet and legs and udder structure. Infertility, udder health and hoof health have already been discussed. The higher culling rate of Norwegian Red cows due to poor udder structure can be related to an apparent weakness in the medial suspensory ligament of the udder, and this tended to be more common in later lactations, especially on farms where feed inputs and milk outputs were high. In recognition of the importance placed on udder characteristics internationally, the weighting on udder type within the Norwegian breeding programme has increased during the last decade to its current level of 15%.

Table 7 Main reasons for cows being removed from the study

	Holstein-Friesian	Norwegian Red
% of cows completing 5 lactations	16.3	27.2
Main reasons for culling cows during lactations 1 – 5		
Infertile (%)	28.5	11.8
Mastitis (%)	9.0	4.1
Poor Udder (%)	0.9	6.8
Feet and leg problems (%)	5.0	4.5
Low milk yield (%)	0.5	1.8
Farmers retiring/notifiable disease (%)	18.9	21.7

Financial performance of the two breeds

The financial performance of the two breeds has been compared based on the performance data contained within this report (Table 8). Milk yield and milk composition were adjusted to take account of the different herd structures arising due to differences in survival between breeds, with milk price adjusted for compositional bonuses. The analysis has been undertaken at a milk price of 26 pence per litre. Differences between breeds in replacement rates, stillbirth rates, calves sold, and cull cows sold have been included within the calculations. The values of calves sold, cull cows and replacement heifers were assumed to be the same for both breeds, based on findings from previous Hillsborough studies. Feed costs were based on annual food intakes obtained from previous Hillsborough studies (involving similar levels of performance), with feed costs assumed to be the same for both breeds. Vet/medicine and semen costs were assumed to be 20% lower with the Norwegian Red cows due to their improved health and fertility.

Table 8 Comparison of the economic performance of Holstein-Friesian and Norwegian Red cows (cow/year basis)

	Holstein-Friesian	Norwegian Red
Milk sold (litres/cow/year)	6582	6508
Fat (%)	3.78	3.87
Protein (%)	3.25	3.33
Outputs (£/cow/year)		
Milk sold	1700	1708
Calves sold	89	104
Cull cows sold	198	164
Less replacement charge	374	309
Total outputs	1613	1668
Variable costs (£/cow/year)	763	739
Gross margin (£/cow/year)	851	929
Overhead costs (£/cow/year)	490	490
Net profit (£/cow/year)	361	439

Milk price, 26 ppl: Value of bull calf, £100: Value of heifer calf, £160: Value of cull cow, £690: Value of replacement heifer, £1300: Annual feed costs, £618/cow; Sundries, £145/cow/year for Holstein cows and £121 for Norwegian cows; Total overhead costs £490/cow/year.

When expressed on an annual basis, the value of milk sold with each of the two breeds was almost identical. However, when account is taken of differences in culling rate, calf survival and replacement rate, total outputs were £55/cow/year higher with the Norwegian cows compared to the Holstein-Friesian cows. The lower variable costs with the Norwegian Red cows reflects the lower vet/medicine and AI costs assumed, while equal overhead costs were adopted with each breed. The overall outcome was that Norwegian Red cows had a gross margin and net profit which was £78/cow/year higher than for the Holstein Friesian cows.

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Northern Ireland Agricultural Research and Development Council
97 Moy Road
Dungannon
County Tyrone
BT71 7DX

T: 028 8778 9770
F: 028 8778 8200

www.agrisearch.org

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