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A comparison of the performance of Holstein-Friesian and Jersey crossbred cows across a range of Northern Ireland milk production systems

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SUMMARY

Historical selection programmes within the Holstein breed focused mainly on milk production, while largely ignoring functional traits. The subsequent decline in these functional traits within the Holstein population, especially fertility and health, has now been well documented.

Crossbreeding has been suggested as one option by which some of these problems may be overcome. Benefits which may arise from crossbreeding include the introduction of desirable traits from another breed, the positive effects of hybrid vigour, and a reduction in the negative effects of inbreeding.

To address this issue a research programme was established to compare production, fertility, health and profitability of Holstein-Friesian and Jersey crossbred cows across a range of Northern Ireland milk production systems. This research programme comprised three separate experiments, with Experiments 1 and 2 conducted at AFBI Hillsborough, while Experiment 3 was conducted on 11 Northern Ireland dairy farms. The key findings of these experiments are summarised below.

When calving for the first time the incidence of stillbirths was 8% for Jersey crossbred cows and 12% for Holstein-Friesian cows, although this difference was not statistically significant. When calving for the second time there was no difference between breeds in the proportion of calves born dead.

When calving for the first time Jersey crossbred cows had a marginally poorer temperament at calving than the Holstein-Friesian cows. Milking temperament did not differ between the breeds.

Crossbred cows tended to be between 40 and 60 kg lighter than Holstein cows, although food intake did not differ between breeds.

Jersey crossbred cows produced milk with a substantially higher fat and protein content than Holstein cows.

When managed within low-moderate concentrate input systems (less than 2.0 t concentrate/cow/lactation), crossbred cows produced 5–10% less milk than Holstein cows. However, the yield of fat plus protein was largely unaffected by breed.

When managed within a high concentrate input system (3.2 t concentrate/lactation) Jersey crossbred cows produced 1568 litres less milk than the Holstein cows, while the

fat plus protein yield of the crossbred cows was 66 kg less than for the Holstein cows. This difference was due to the crossbred cows using part of the additional nutrients consumed for body tissue gain, rather than for milk. This suggests that Jersey crossbred cows are not best suited to very high input systems.

Somatic cell counts of the Jersey crossbred cows tended to be similar, or slightly higher than for the Holstein cows. Heterosis for somatic cell count is normally very low. Nevertheless, Jersey crossbred cows had a lower incidence of mastitis than the Holstein cows.

Compared to the Holstein cows, the Jersey crossbred cows had improved fertility in most of the studies, and this is likely due to hybrid vigour.

The Jersey crossbred cows had improved hoof health compared to the Holstein cows.

Within the on-farm study, which was conducted across four lactations, crossbred cows had improved longevity, with 48% of crossbred cows and 38% of Holstein-Friesian cows surviving until the end of the fourth lactation. When extrapolated to give life-time survival, on average Holstein-Friesian cows survived for 3.6 lactations while crossbred cows survived for 4.8 lactations.

An economic analysis of the production data collected from the on-farm project indicated that net profit was £39/cow/year (7%) higher with the Jersey crossbred cows.

BACKGROUND

The problem

The high milk production potential of Holstein cows has resulted in the Holstein breed becoming dominant in many parts of the world. However, historical selection programmes within the Holstein breed focused largely on milk production, and until recently, largely ignored functional traits. The subsequent decline in these traits (especially fertility and health) within the Holstein population is now well documented. As a result, some of the benefits gained with the Holstein breed through increased milk production efficiency have been lost due to poor survivability. While some of these issues 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) 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 results of an AgriSearch funded study which compared the Holstein breed with the Norwegian Red breed has now been published (www.agrisearch.org : AgriSearch Booklet Number 22).

c) Cross-breeding: this is a third option, and the one that is examined within this booklet. The outcomes of three separate studies comparing Holstein cows and Jersey crossbred cows are presented. In each of these experiments Holstein cows were bred using AI to Jersey sires.

Why consider crossbreeding?

There are a number of reasons why dairy farmers may consider the adoption of crossbreeding within their herds. These include:

1) Introduction of desirable traits from another breed:
Examples of this include the use of Jersey sires within crossbreeding programmes to improve milk composition, and Scandinavian sires to improve functional traits such as fertility and health.

2) To reduce levels of inbreeding:
In general, levels of inbreeding within dairy herds within the UK and Ireland remain relatively low. However, inbreeding levels may be high on individual farms, or individual animals may be heavily inbred due to inappropriate breeding decisions in the past. Crossing with a second breed is one option by which levels of inbreeding can be rapidly reduced.

3) Gaining from hybrid vigour:
Hybrid vigour (or heterosis) describes the additional performance benefits that can be obtained with a crossbred animal, over and above the mean of the two parent breeds. For example, if Breed A has a lactation yield potential of 6000 litres, and breed B has a lactation yield potential of 8000 litres, the offspring of the two breeds might be expected to have a lactation yield potential of approximately 7000 litres (Figure 1). However, in the example given the actual production of the crossbred cow is 7350 litres, with the extra 350 litres of milk over and above that expected due to hybrid vigour. The extent of hybrid vigour varies between traits. For example, for traits such as milk yield, hybrid vigour is normally estimated to be between 3 and 6%. However, for traits such as fertility, health and longevity, hybrid vigour may be between 6 and 15%, depending on the degree of genetic differences between the parent breeds. For some other traits, for example somatic cell count and milk composition, hybrid vigour levels can be very low.

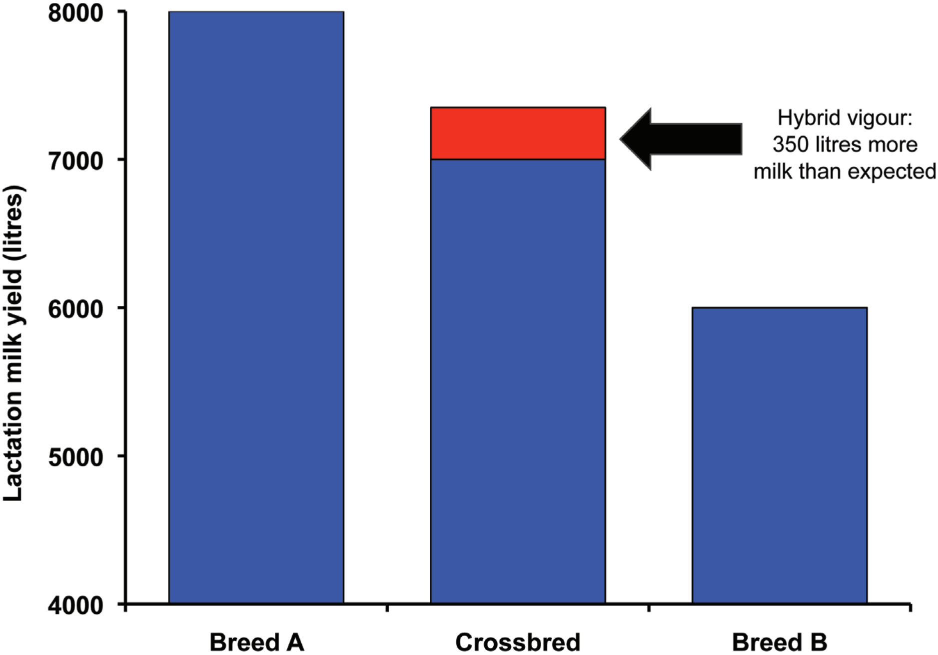

Figure 1: Example of the impact of hybrid vigour on milk production when two breeds are crossed

THE RESEARCH PROGRAMME

This research programme comprised three separate experiments, with the overall objective of the research programme being to compare production, fertility, health and profitability of Holstein-Friesian and Jersey crossbred cows across a range of Northern Ireland milk production systems. Experiments 1 and 2 were conducted at AFBI Hillsborough, while Experiment 3 was conducted on 11 Northern Ireland dairy farms.

EXPERIMENT 1

THE PERFORMANCE OF HOLSTEIN AND JERSEY X HOLSTEIN CROSSBRED DAIRY COWS WITHIN THREE LOW CONCENTRATE INPUT GRAZING SYSTEMS

BACKGROUND

Crossbreeding has been widely and effectively adopted within the New Zealand dairy industry, and because of this it is often assumed that crossbreeding only has a role within very low input systems. However, very low input systems are relatively uncommon within Northern Ireland, while relatively little research has been undertaken to examine the role of crossbreeding within moderate to high input systems. Thus this experiment was undertaken to examine the performance of Jersey crossbred cows within a number of moderate concentrate input spring calving systems, similar to those more commonly adopted within Northern Ireland.

THE STUDY

The performance of Holstein cows and Jersey x Holstein crossbred cows was compared during a three-year study at AFBI Hillsborough. Cows were managed on either a 'Low', 'Medium' or 'High' concentrate input system, with the study involving approximately 100 'lactation records' for each breed. Cows on this study had a mean lactation number of 1.9.

Cows on the 'Low', 'Medium' and 'High' concentrate input systems were offered either 6.0, 8.0 or 10.0 kg concentrate/day from calving until turnout, with this then reduced to either 0, 2.5 or 5.0 kg concentrate/cow/day during the grazing period. Full lactation concentrate inputs were approximately 530, 1100 and 1650 kg for the Low, Medium and High concentrate input systems, respectively.

MAIN FINDINGS

Within this experiment the Holstein and Jersey crossbred cows produced a similar milk yield response to each additional kilogram of concentrate offered, and as such, the results presented here describe the mean performance across the three concentrate feed levels.

Food intakes:
This study involved spring calving cows, and as such, intakes were measured for only a relatively short period prior to turnout. Nevertheless, breed had no effect on pre-turnout dry matter intake (Table 1), even though the crossbred cows were on average 44 kg lighter than the Holstein cows. That the lighter crossbred cows were able to consume a similar amount of food as the heavier Holstein cows highlights the higher intake potential of the crossbred cows per unit of live weight.

Table 1 Food intake, milk production and mean body tissue reserves of Holstein and Jersey crossbred cows (mean performance across the 'Low', 'Medium' and 'High' concentrate input systems)

	Holstein	Jersey crossbred
Average daily dry matter intake (kg/cow)	14.7	14.8
Milk yield (litres/lactation)	6070	5463
Milk fat (%)	4.20	4.78
Milk protein (%)	3.30	3.59
Milk fat + protein yield (kg/lactation)	467	471
Value of milk produced @ 26 ppl (£/lactation)	£1631	£1595
Mean live weight (kg)	513	469
Mean condition score	2.3	2.5

Milk production:

Across the three concentrate feed levels examined the Holstein cows produced 607 litres more milk per lactation than the Jersey crossbred cows, thus highlighting the potential loss in milk volume associated with crossbreeding (Table 1). However, the crossbred cows produced milk with a higher fat and protein content than the Holstein cows, with this reflecting the improved milk composition normally observed with pure bred Jersey cows. The overall effect was that fat + protein yield did not differ between the two breeds. However, at a milk price of 26 pence per litre (adjusted for current compositional bonuses), the value of milk produced by the crossbred cows was approximately £36/cow/lactation lower than for the Holstein cows, representing a 2% reduction.

Yield response to additional concentrate feeding:

Across the range of concentrate feed levels examined within this study (530, 1100 and 1650 kg for the Low, Medium and High concentrate input systems, respectively), cows of both genotypes produced a similar milk yield and fat + protein yield response to each kg of additional concentrates offered. Thus, within this range of concentrate feed levels the Jersey crossbred cows were able to compete well with the Holstein cows. This raises the question as to whether there may be a role for crossbred cows within systems involving concentrate inputs of more than 1650 kg.

Changes in body tissue reserves:

Although the crossbred cows were lighter than the Holstein cows, the mean body condition score of the crossbred cows was 0.2 units higher. Nevertheless, live weight

changes throughout the lactation followed a similar pattern for cows of both breeds (Figure 2). This trend suggests that similar levels of tissue mobilisation (early lactation) and tissue gain (late lactation) occurred with both breeds.

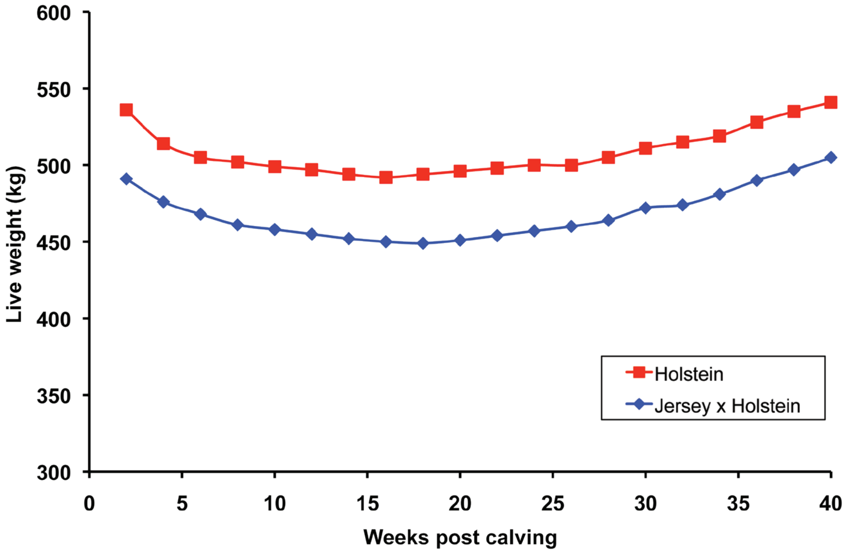

Figure 2 Changes in the live weight of Holstein and Jersey x Holstein crossbred cows throughout the first 40 weeks of lactation (mean data for the Low, Medium and High concentrate input system)

Cow health, calving details and fertility:

Somatic cell counts did not differ between the two breeds within this study, and indeed similar findings have been observed in previous studies involving comparisons of Holstein and Jersey crossbred cows (Table 2). There are two reasons for this. Firstly, in general the Jersey breed does not have a lower SCC than the Holstein breed, and secondly, heterosis for SCC is generally very low. Nevertheless, the crossbred cows had a significantly lower incidence of mastitis compared to the Holstein cows, and this is something that has been observed in a number of other studies.

Breed had no impact on the number of cows treated for lameness. However, the number of cows treated for lameness increased with increasing concentrate feed levels, with the incidence being 5%, 16% and 25% with the Low, Medium and High concentrate feed

levels, respectively.

Jersey crossbred cows had fewer calving difficulties than Holstein-Friesian cows, with the percentage of unassisted calvings presented in Table 2. This reflects the fact that calves born to the crossbred cows were approximately 4 kg lighter than those born to the Holstein cows.

Compared to the Holstein cows, the Jersey crossbred cows had an earlier first observed heat and a higher conception rate to the first service, and to the first plus second service. In addition, the crossbred cows had a higher pregnancy rate than the Holstein cows after 12 weeks of breeding. The improved reproductive performance of the crossbred cows in the current study is in agreement with the findings of a number of other studies undertaken elsewhere with Jersey crossbred cows.

Hybrid vigour is likely to be one of the main factors contributing to the improved fertility performance of the crossbred cows as there appears to have been little difference between genotypes in terms of body condition loss or gain (energy balance). For example, hybrid vigour for fertility traits in dairy cattle can be between 5-10%. Based on the findings of the current study, crossbreeding would appear to provide a clear option by which fertility performance can be improved within a dairy herd.

Table 2 Health parameters, calving details and fertility performance of Holstein and Jersey crossbred cows (mean of 'Low', 'Medium' and 'High' concentrate input systems)

	Holstein	Jersey crossbred
Health parameters		
Somatic cell count (000/ml)	218	173
% of cows with at least one case of mastitis	29	16
% of cows with at least one case of lameness	19	11
Calving details		
% of cows with an unassisted calving	57	65
Calf birth weight (kg)	41.3	37.6
Fertility		
Days to 1st observed heat	50	42
Conception to 1st service (%)	35	58
Conception to 1st and 2nd service (%)	52	81
Pregnancy rate after 12 weeks of breeding (%)	73	89

Economic performance:
The short term nature of this experiment means that a full economic evaluation is not possible. Nevertheless, at similar levels of feed inputs, the value of milk produced with each of the two breeds was similar. In addition, the Jersey crossbred cows had much improved fertility and improved health, and these are likely to result in improved longevity.

CONCLUSIONS

Across the three systems examined within this experiment the economic value of milk produced by the crossbred cows and Holstein cows was relatively similar, while the crossbred cows had improved fertility and a lower incidence of mastitis. In addition, crossbred cows produced a similar fat + protein yield response as the Holstein cows across the range of concentrate feed levels examined, suggesting that there may be a role for crossbred cows within higher concentrate input systems.

EXPERIMENT 2

PERFORMANCE OF HOLSTEIN AND JERSEY CROSSBRED COWS WITHIN A HIGH AND LOW CONCENTRATE INPUT SYSTEM

BACKGROUND

A key finding within Experiment 1 was that Jersey crossbred cows were able to produce a similar fat + protein yield response as the Holstein cows, as concentrate feed levels increased. While this suggests that there may be a role for crossbreeding within higher input systems, the maximum concentrate feed level within Experiment 1 was approximately 1.65 tonnes per lactation, considerably lower than the Northern Ireland average of approximately 2.0 tonnes per lactation. Thus the current experiment was undertaken to examine the performance of Jersey crossbred cows within a higher concentrate input system than was adopted within Experiment 1.

THE STUDY

Jersey crossbred and Holstein cows were managed on either a low input grazing system or a high input total confinement system for a full lactation. Cows on the low input system were offered approximately 7.0 kg concentrate/day until turnout, and thereafter 1.0 kg concentrate/cow/day throughout the grazing season. Cows on the total confinement system were confined all year and offered a diet containing 60, 50 and 40% concentrate (dry matter basis) during days 1-100, 101-200 and 201-250 of lactation, respectively. Total concentrate inputs with the low input grazing system and total confinement system were approximately 1.2 and 3.3 t per cow per lactation, respectively.

MAIN FINDINGS

Food intakes:
Intakes of the cows on the total confinement system were measured continually throughout the lactation, and in common with the findings of Experiment 1, intakes of the Holstein and Jersey crossbred cows did not differ (Table 3). This again demonstrates the high intake capacity (per unit of live weight) of the smaller Jersey crossbred cows.

Table 3 Food intake and milk production of Holstein and Jersey crossbred cows managed on a low input grazing system and a total confinement system

	Low input grazing		Total confinement	
	Holstein	Jersey crossbred	Holstein	Jersey crossbred
Average daily dry matter intake (kg)	-	-	18.8	18.4
Milk yield (litres/lactation)	6091	5790	8789	7221
Fat %	4.35	4.65	4.34	4.83
Protein %	3.36	3.60	3.40	3.68
Milk fat + protein yield (kg/lactation)	483	493	697	631
Value of milk produced (£/lactation)	£1670	£1680	£2420	£2140

Milk Production:
When managed on the low input grazing system, crossbred cows produced 300 litres less milk than the Holstein cows, although their milk had a higher fat and protein content. Thus, the overall effect was that milk solids yield (fat + protein) was unaffected by breed, while the value of milk produced was almost the same with each of the two breeds. This again supports the findings of Experiment 1, that Jersey crossbred cows can compete well with Holstein cows (in terms of production performance) within lower input systems.

However, when managed on the high input confinement system, the Holstein cows produced 1568 litres more milk than the crossbred cows. In addition, even when the improved milk composition of the crossbred cows was taken into account, the yield of milk solids was still higher (10%) with the Holstein cows, as was the value of milk produced (£280/lactation higher). These findings highlight the potential of Holstein cows to continue to respond to higher concentrate feed levels in comparison to crossbred cows.

Few other studies have examined the performance of crossbred cows within a high concentrate input system. In one exception, pure bred Holstein cows were compared with crosses of the Montbelliard, Scandinavian Red and Normande breeds. The Scandinavian crosses performed especially well, producing 9281 kg milk and 637 kg fat plus protein, while the Holstein cows produced 9757 kg milk and 651 kg fat + protein. Thus while crossbreeding may well have a role in high input systems, careful selection of

breeds, and sires within the breed, is necessary to minimise any loss in the value of milk produced.

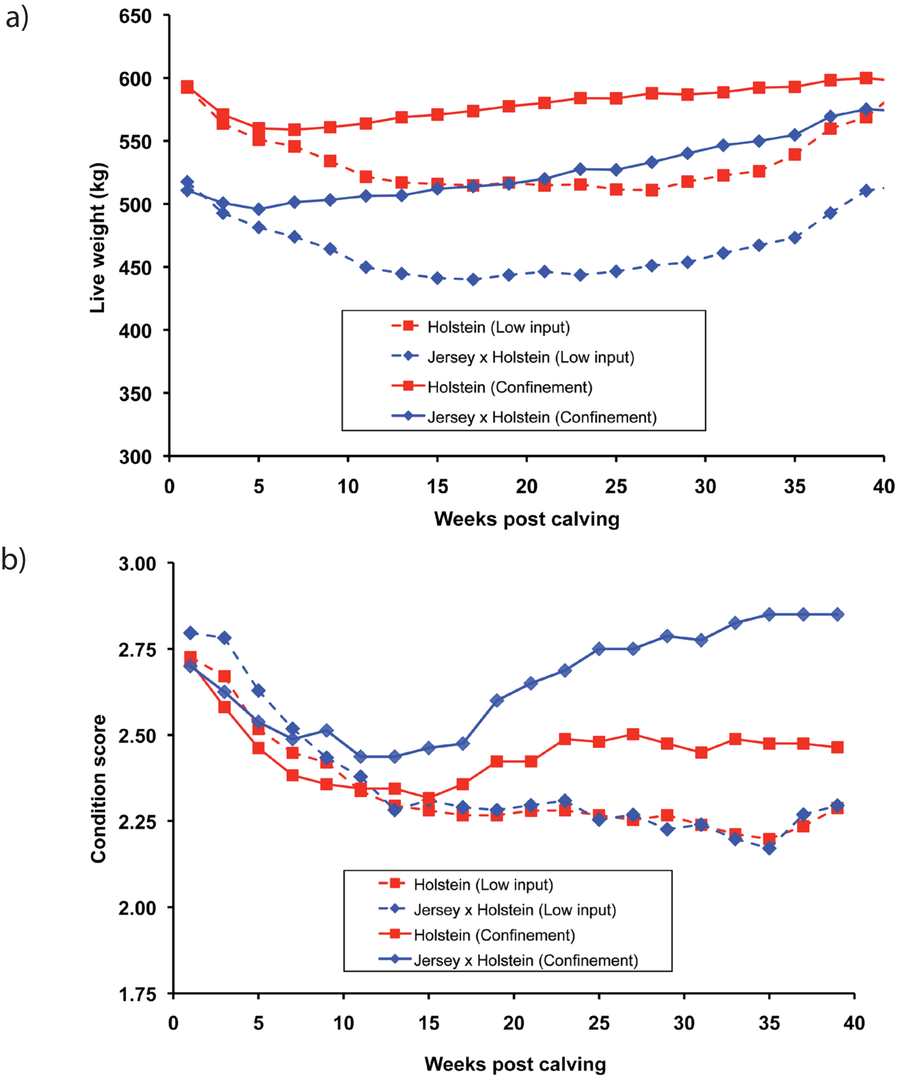

Figure 3 Changes in live weight (a) and condition score (b) of Holstein cows and Jersey x Holstein crossbred cows during the first 40 weeks of lactation within the low input grazing system and the total confinement system

Changes in body tissue reserves:

While the crossbred cows in this study were approximately 90 kg lighter than the Holstein cows at calving, cows of both breeds had similar condition scores at calving (Figure 3). Within the low input grazing system the live weight and condition scores of both breeds followed a similar pattern, with the delay in condition score gain until approximately week 35 of lactation reflecting the difficult grazing conditions encountered during the study. However, when the Jersey crossbred cows were managed on the total confinement system they began to gain condition from approximately week 20 of lactation onwards, so that by week 35 of lactation the mean condition score of this group was almost 3.0, compared to a score of approximately 2.5 with the Holstein cows. This difference reflects differences in 'nutrient partitioning' between the breeds, and provides an explanation as to why the crossbred cows did not produce as large a milk yield response to the additional concentrate as the Holstein cows. The crossbred cows used part of the extra nutrients offered from the concentrates to lay down body tissue reserves.

Fertility performance and hoof health:

While there were trends towards improved fertility performance with the crossbred cows within this study (Table 4), the study involved insufficient animals to measure fertility robustly. However, there was no evidence of any difference in fertility performance between the low input grazing system and the high input confinement system, even though very different diets were offered and milk yields were very different.

The hind feet of all cows were examined for sole lesions, heel erosion and white line disease at approximately 250 days post calving. In general, crossbred cows had a lower incidence of hoof health problems than Holstein cows. Indeed, previous research has demonstrated that Jersey cows have harder hooves than Holstein cows.

CONCLUSIONS

While Jersey crossbred cows performed well within the low input grazing system, they were unable to compete with the Holstein cows in terms of milk and fat + protein yield within the high input confinement system.

Table 4 Effect of dairy cow breed and management system on fertility performance

	Low input grazing		Total confinement	
	Holstein	Jersey crossbred	Holstein	Jersey crossbred
Conception to 1st and 2nd service (%)	67	70	58	75
Pregnancy rate after 12 weeks of breeding (%)	72	75	74	85

EXPERIMENT 3

COMPARISON OF THE PERFORMANCE OF HOLSTEIN-FRIESIAN AND JERSEY CROSSBRED COWS ON NORTHERN IRELAND DAIRY FARMS

BACKGROUND

Experiments 1 and 2 were conducted at AFBI Hillsborough, and were designed to provide detailed information on issues such as oestrus behaviour and food intakes. However, these experiments involved relatively low numbers of cows, and as such were not designed to provide information on cow longevity, a key factor influencing profitability. To address this issue, Experiment 3 was established on local dairy farms and involved a much larger number of animals. This experiment was designed to provide robust information on cow performance, fertility and survival across a range of on-farm management systems.

OVERVIEW

This experiment was established on 11 Northern Ireland dairy farms in 2002, with these farms including both spring and autumn calving herds. Concentrate inputs ranged from approximately 0.7–2.2 tonnes/cow/year. On each farm pairs of Holstein-Friesian cows were matched for genetic merit, with one cow within each pair bred using AI to a Holstein-Friesian sire and the other bred using AI to a Jersey sire. The offspring of this breeding programme were used within this experiment. The experiment involved 192 Holstein-Friesian dairy cows and 189 Jersey crossbred dairy cows, with the Holstein-Friesian cows sired by a total of 64 Holstein-Friesian sires, while Jersey crossbred cows were sired by a total of 8 Jersey sires. Cows completed a minimum of four lactations on the experiment, unless culled/sold beforehand.

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 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:
Within this study calving difficulty was scored on a 1-5 scale, where 1 = unobserved or unassisted, and 5 = calf delivered by caesarean section. The percentage of unassisted calvings was unaffected by breed when cows calved for the first and second time (Table 5).

Table 5 Effect of breed on the percentage of unassisted calvings at the first and second calving

	Holstein - Friesian	Jersey crossbred
First calving (%)	87	91
Second calving (%)	97	98

Still births:
When calving for the first time the incidence of stillbirths was 12% for the Holstein-Friesian cows and 8% for the Jersey crossbred cows (Figure 4). This difference was not statistically significant. While the value recorded for the Holstein-Friesian breed may appear to be high, this is almost identical to the value of 13% recorded for Holstein cows in the AgriSearch funded on-farm Norwegian cow project. The incidence of still births was much lower at the second calving, and was again unaffected by cow breed.

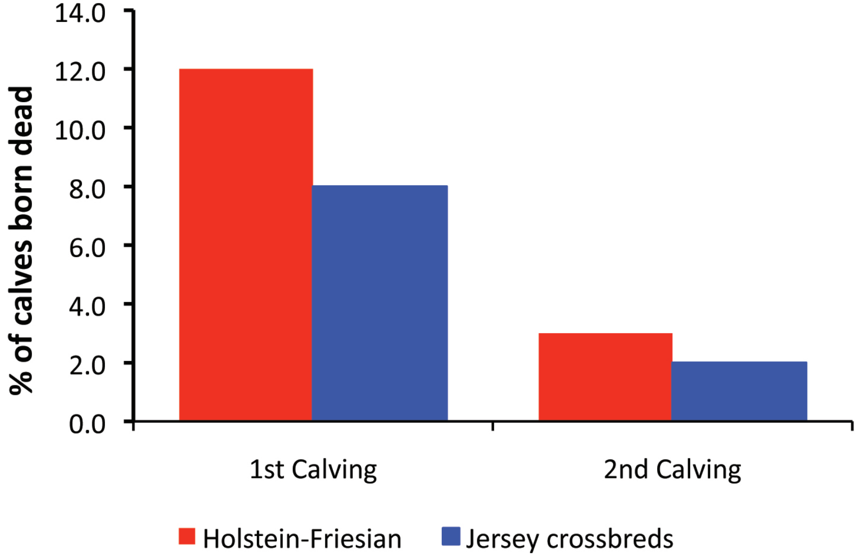

Figure 4 Effect of breed on percentage of calves born dead at the first and second calving

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. Jersey crossbred cows tended to have a poorer temperament at first calving than the Holstein-Friesian cows, while there was no difference between breed at their second calving. The percentage of cows with a 'very quiet' temperament at calving is presented in Table 6.

Table 6 Effect of breed on the percentage of cows with a 'very quiet' temperament at their first and second calving

	Holstein - Friesian	Jersey crossbred
First calving (%)	78	71
Second calving (%)	96	96

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. The Holstein-Friesian and Jersey crossbred cows did not differ in milking temperament during any of the measurement occasions. The percentage of cows that 'stood calmly' during the two measurement periods during Lactations 1 and 2 are presented in Table 7

Table 7 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	Jersey crossbred
Lactation 1:		
- within 48 hours of calving (%)	40	39
- three weeks post calving (%)	88	84
Lactation 2:		
- within 48 hours of calving (%)	87	89
- three weeks post calving (%)	95	96

Condition score:
The crossbred cows had a higher condition score than the Holstein cows during lactation 1, and during the first 100 days of lactation 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 5).

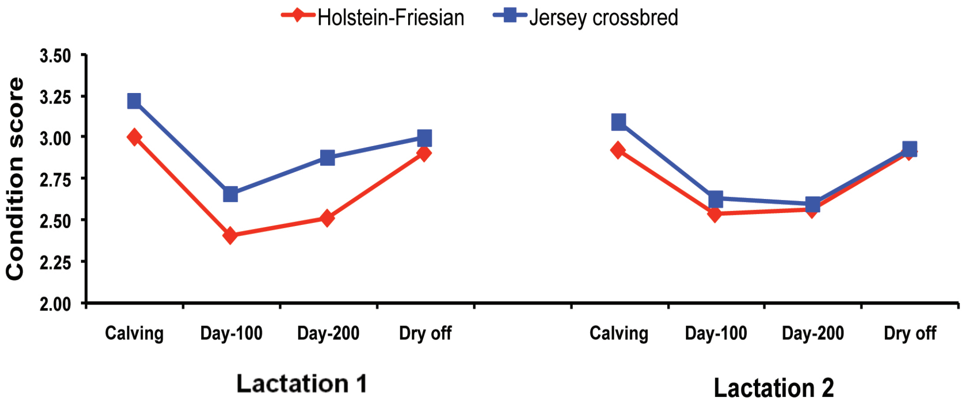

Figure 5 Effect of breed on cow condition score during lactations 1 and 2

Milk production and composition:
Holstein cows had greater full lactation milk yields than the Jersey crossbred cows during each of lactations 1-4 (Table 8), producing on average 770 litres more milk per lactation, although their average lactation length was approximately nine days longer. However, Jersey crossbred cows produced milk with a much higher fat and protein content than the Holstein-Friesian cows. The overall effect was that fat plus protein yield did not differ between breeds in lactations 1, 2 and 4, while being lower with the crossbred cows during lactation 3.

Table 8 Effect of breed on full lactation milk yield, milk composition and fat + protein yield during each of lactations 1-4

	Holstein - Friesian	Jersey crossbred
Lactation 1		
Milk yield (litres)	6084	5486
Milk fat (%)	4.14	4.59
Milk protein (%)	3.35	3.50
Fat + protein yield (kg)	453	444
Lactation 2		
Milk yield (litres)	6783	6152
Milk fat (%)	4.22	4.67
Milk protein (%)	3.43	3.61
Fat + protein yield (kg)	518	508
Lactation 3		
Milk yield (litres)	7320	6226
Milk fat (%)	4.21	4.76
Milk protein (%)	3.41	3.62
Fat + protein yield (kg)	556	520
Lactation 4		
Milk yield (litres)	7417	6647
Milk fat (%)	4.17	4.81
Milk protein (%)	3.38	3.60
Fat + protein yield (kg)	559	558

Somatic cell count and mastitis:
While there was a trend for SCC to increase with increasing lactation number (Figure 6), SCC's did not differ between the two breeds in any of lactations 1-4. This was similar to the outcomes of Experiments 1 and 2. While detailed information on mastitis incidence was not recorded by farmers within the current study, the number of cows culled due to mastitis did not differ between breeds (Table 10).

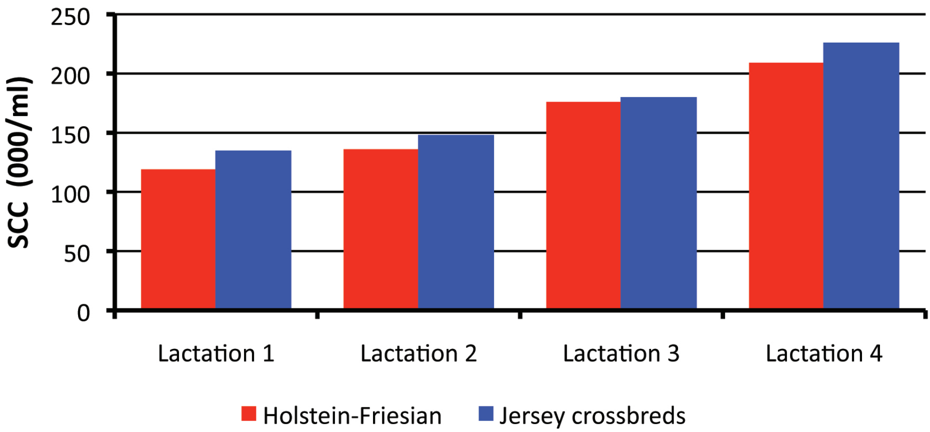

Figure 6 Effect of breed on mean somatic cell count (000/ml) during each of lactations 1-5

Fertility:
Jersey crossbred cows tended to have higher conception rates to first AI as heifers and during lactations 1 and 2, but not during lactations 3 and 4 (Table 9). Similarly, the crossbred cows tended to have a shorter calving interval than the Holstein-Friesian cows, although differences were not significant. The overall culling data from the experiment highlighted that 30% of Holstein-Friesian cows and 25% of Jersey crossbred cows were culled as infertile prior to lactation 5.

While the results of the current study suggest an overall higher level of fertility with the Jersey crossbred cows, compared to the Holstein cows, these differences were not as great as those recorded within Experiment 1. This difference may reflect the fact that the Holstein cows in Experiment 1 had a much higher genetic merit for milk yield than those within the current experiment, and this is likely to have reduced their fertility performance.

Table 9 Effect of breed on conception to 1st AI, calving interval and the percentage of cows culled as infertile.

	Holstein - Friesian	Jersey crossbred
Conception to 1st AI (%)		
Heifers	61	72
1st lactation	46	54
2nd lactation	44	54
3rd lactation	51	55
4th lactation	45	52
Calving interval (days)		
1st lactation	397	392
2nd lactation	394	384
3rd lactation	389	380
4th lactation	398	370
Cows culled as infertile during study (%)	30.2	25.0

Reasons for culling and cow longevity:
Crossbred cows had a higher survivability than Holstein cows, with 48% of Jersey crossbred cows surviving until the end of the fourth lactation, compared to 39% of Holstein cows (Table 10). In addition, an extrapolation of the data indicates that on average Holstein cows completed 3.6 lactations while crossbred cows completed 4.8 lactations.

While cows were culled for many reasons, infertility was the primary reason for culling. With regards to other culling reasons, there were few differences between breeds. However, considerably more Holstein cows than crossbred cows were culled due to 'feet and leg' problems, with this supporting the improved hoof health characteristics observed with Jersey crossbred cows in Experiment 2.

Table 10 Main reasons for cows being removed from the study

	Holstein - Friesian	Jersey crossbred
% of cows completing 4 lactations on the study	39	48
Main reasons for culling cows during lactations 1-4		
Infertile (%)	30.2	25.0
Slipped calving pattern (%)	5.5	4.1
Mastitis (%)	2.7	2.7
High SCC (%)	3.0	2.8
Feet and leg problems (%)	4.1	0.5
Low milk yield (%)	2.3	1.1

Financial performance of the two breeds in Experiment 3:
The financial performance of the two breeds has been compared based on the performance data contained within this report (Table 11). 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, still birth rates, calves sold, and cull cows sold have been included within the calculations. The values of Holstein calves sold were assumed as £100 (bull) and £150 (heifer), while the value of Jersey crossbred calves sold were assumed as £50 (bull) and £150 (heifer). Holstein cull cows were assumed to have a value of £600, while crossbred cull cows were assumed to have a value of £470. The value of replacement heifers was assumed to be the same for both breeds. 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 crossbred cows due to their improved health and fertility.

The overall outcome of the economic analysis was that Jersey crossbred cows had a gross margin and net profit which was £39/cow/year higher than for the Holstein Friesian cows.

Table 11 Comparison of the economic performance of Holstein-Friesian and Jersey crossbred cows (£/cow/year basis)

	Holstein - Friesian	Jersey crossbred
Milk sold (litres/cow/year)	6372	5973
Fat (%)	4.17	4.74
Protein (%)	3.39	35.9
Outputs (£/cow/year)		
Milk sold	1728	1739
Calves sold	90	71
Cull cows sold	165	96
Less replacement charge	358	266
Total outputs	1626	1640
Variable costs (£/cow/year)	763	739
Gross margin (£/cow/year)	863	902
Overhead costs (£/cow/year)	490	490
Net profit (£/cow/year)	373	412

Milk price, 26 ppl: Value of Holstein bull calf, £100: Value of Holstein heifer calf, £150: Value of crossbred bull calf, £50: Value of crossbred heifer calf, £150: Value of Holstein cull cow, £600: Value of crossbred cull cow, £470: Value of replacement heifer, £1300: Annual feed costs, £618/cow; Sundries, £145/cow/year for Holstein cows and £121 for crossbred cows; Total overhead costs £490/cow/year.

Issues to be considered before adopting crossbreeding

The adoption of crossbreeding is not a decision that should be taken lightly, and its impact on a herd, both in the short-term and long-term needs to be considered. The following are some of the key issues to consider before embarking on a crossbreeding programme:

1) Crossbreeding will not solve problems associated with poor management or poor nutrition. Many dairy farmers have adopted crossbreeding in an attempt to solve problems that are largely management related, such as high cell counts and lameness. Many of these problems may remain unresolved with crossbred cows. Farmers must clearly identify why they are considering crossbreeding (i.e. what is the problem that they are attempting to solve), and then identify if crossbreeding is likely to provide part of the solution, or if management changes will be equally effective.

2) Crossbreeding does not represent true genetic improvement. True genetic improvement takes place when the top AI sires (for the most economically important traits) are used within that breed. For some genetic 'problems', the solution may well be found within the parent breed. Selection indexes which have a major emphasis on functional traits now exist for the Holstein breed (e.g. PLI). Through careful sire selection, bulls which can help to overcome existing herd weaknesses can be chosen. Nevertheless, on some herds it will take many generations to reverse some longstanding problems.

3) Hybrid vigour should not be the main reason for adopting crossbreeding. While hybrid vigour can be particularly beneficial for traits such as health and fertility, for other traits such as milk yield, levels of hybrid vigour can be relatively low (average of 4.7%), or in the case of somatic cell count, normally non-existent. Adopting crossbreeding solely to gain the benefits of hybrid vigour is unlikely to be justified. It must be remembered that hybrid vigour is not passed on to the next generation.

4) Crossbreeding is a long term commitment. For cows bred to a sire of a different breed today, it will be three years before the potential benefits of these animals becomes apparent within the herd, and at that stage these crossbred cows are unlikely to comprise more that 25% of the herd. Similarly, while 'crossbreeding' can be introduced into the herd during a single breeding season, it can take many generations to 'erase' the impact of a crossbreeding decision if its effects are found to be undesirable.

5) Crossbreeding can complicate management issues, especially in relation to housing and milking facilities. Depending on the breeds used, crossbreeding will often result in smaller cows, and cows with a more diverse range of sizes. While the former may

be advantageous within a grazing system, smaller and mixed sized cows can result in problems in the milking parlour and in cubicle houses.

6) In general, Holstein cows have better quality udders (in terms of attachment, teat placement and length) compared to many other breeds. As a result, crossbred cows frequently have 'poorer' udders than purebred Holstein cows. While this was not a major issue during the course of the studies presented within this booklet, udder structure problems have become more apparent in some of these cows in later lactations (4 - 5th lactation onwards). It is important to choose sires which transmit good udder attachment traits, especially when breeding crossbred cows for higher milk output systems.

7) The impact of crossbreeding on the value of cull cows, male calves and surplus breeding stock needs to be considered. The impact may vary depending on the breed chosen. For example, the use of the Montbeliarde breed within a crossbreeding programme may increase the value of cull cows and male calves, while the reverse may be true when the Jersey is used. In addition, the impact of crossbreeding on the long term value of the herd needs to be considered.

8) The choice of the second (and possibly third) breed for use within a crossbreeding programme is a critical decision. A number of issues need to be considered. Firstly, the breed should be suitable for the milk production system in which its offspring will be managed (i.e. low input grazing vs high input confinement). In most cases, a breed should be chosen to minimise any loss in milk production, while at the same time maximising the gain to be made in other traits. In addition, any breed being considered for use within a crossbreeding programme should have an associated breed improvement progeny testing programme, with a significant focus on traits of greatest economic importance. To facilitate this, breeds being considered should have a sufficiently large population size to allow ongoing genetic improvements to be made. When choosing a breed the first step is to identify the key goals of the crossbreeding programme, and to identify a breed which will allow these goals to be achieved.

9) The choice of sire within a breed is perhaps even more critical than the choice of breed itself. The perception is still widespread that a bull of a different breed purchased from a 'neighbour down the road' will be suitable for crossbreeding, just because it is of a 'different breed'. This will only do a great disservice to the concept of crossbreeding. Sires used within crossbreeding programmes should be top sires for PLI from within the breed selected.

CONCLUSIONS

Crossbreeding is not for everyone, and on many farms crossbreeding will not overcome problems of poor management. Nevertheless, a well planned and well managed crossbreeding programme can result in robust cows with fewer calving difficulties, fewer health problems, higher levels of fertility, and ultimately improved longevity. While crossbreeding may have a detrimental impact on some economic aspects such as the value of male calves and cull cows, the positive financial impact associated with improvements in functional traits has the potential to improve overall economic performance of the dairy business.

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