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AFBI research examines the performance of ‘three-way’ crossbred dairy cows in key European Research Programme

by

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Background

Until relatively recently, genetic selection programmes within the Holstein breed focused mainly on milk production, with less emphasis on functional traits. The subsequent decline in these functional traits within the Holstein breed, especially fertility and health, has now been well documented. Crossbreeding has been suggested as one option to overcome some of these problems. Potential benefits of 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.

Previous studies at AFBI Hillsborough compared the performance of Holstein and Jersey x Holstein crossbred dairy cows. Results from these studies demonstrated that Jersey crossbred cows produced less milk than Holstein cows, but a similar fat + protein yield. In addition, Jersey crossbred cows had improved fertility and fewer incidences of mastitis and lameness than Holstein cows. Outcomes of this previous research programme have been summarised within AgriSearch Booklet Number 24.

However, a ‘dilemma’ that is faced by many farmers who adopt crossbreeding is which breed of sire to use on the ‘first generation’ crossbred heifers and cows. A number of

possible breeding strategies exist, including 'back crossing' to one of the original breeds, the use of progeny tested crossbred sires, or the adoption of a 'three-way' crossbreeding programme. The latter strategy (three-way crossbreeding) is often advocated to maximise hybrid vigour in the long term, and this approach has been adopted within the dairy herd at Hillsborough.

The Swedish Red breed was selected as the 'third breed' within the Hillsborough crossbreeding programme, with Jersey x Holstein crossbred cows bred to sires of the Swedish Red breed. The Swedish Red breed was chosen due to the long term focus on health and fertility traits within the Scandinavian countries. Consequently, Scandinavian sires would be expected to introduce positive fertility and health traits. The performance of these three-way crossbred cows has been examined in a study which was co-funded by DARD and the European Union through a Framework 7 Project called SOLIDS (Sustainable Organic and Low Input Dairy Systems).

The study

The study involved 72 spring calving dairy cows comprising 36 Holstein cows and 36 three-way crossbred cows. The three-way crossbred cows were the offspring of a breeding programme in which Jersey x Holstein crossbred cows were bred to sires of the Swedish Red breed. Cows of each genotype were managed on either a low (0.7 t) or moderate (1.7 t) concentrate input system for one full lactation.

Main findings

Overall performance of cows of each of the two breeds (average across the low and moderate concentrate input systems) is presented in Table 1.

Intakes and live weight

Holstein cows had a higher intake (1.5 kg DM per day higher) than the three-way crossbred cows during the winter period prior to turnout. This is in contrast to previous AFBI research in which Jersey crossbred cows had similar intakes to Holstein cows. Thus, part of the high intake potential that was a feature of Jersey crossbred cows appears to have been lost with the three-way crossbred cows. While the three-way crossbred cows had a higher body condition score than the Holstein cows, the crossbred cows were approximately 30 kg lighter.

Milk production, milk composition and somatic cell count

Holstein cows produced approximately 1000 kg more milk/lactation than the crossbred cows, although the crossbred cows produced milk with a significantly higher fat and protein content. The overall effect was that milk solids yield (kg of fat plus protein) was not significantly different between the two breeds, with yields of 546 and 520 kg for the Holstein and crossbred cows, respectively. It is likely that the improved milk composition with the three way crossbred cows is due to hybrid vigour, and the continuing impact of the Jersey sires used during the first cross. At a milk price of 26 pence per litre (adjusted for current compositional bonuses), the value of milk produced was £1967 and £1830 for the Holstein and three-way crossbred cows, respectively, but the three way cross cows had lower feed costs, due to lower intakes.

Fertility and health

While conception rates to first AI did not differ between the two breeds, conception rates after a 14 week breeding period were higher with the three-way crossbred cows. There were no differences between breeds in the number of cows treated for lameness. Significantly fewer crossbred cows than Holstein cows were treated for mastitis during the course of the study, with the lower incidence of mastitis reflecting the focus on mastitis resistance within the Swedish Red population, together with the beneficial effects of hybrid vigour. This lower mastitis incidence occurred despite a significantly higher somatic cell count with the crossbred cows. While these two results would appear to contradict each other, it is known that hybrid vigour does not normally reduce somatic cell count, but can reduce the incidence of mastitis quite considerably. A similar finding (lower incidence of mastitis, but no effect on somatic cell count) has been observed in previous studies with crossbred cows at Hillsborough and elsewhere.

Overall outcomes

The results of this experiment are largely in agreement with findings from studies involving 'first cross' Jersey crossbred cows, namely a reduction in milk yield, but no loss in milk solids yield. In addition, overall fertility performance was improved, while the incidence of mastitis was reduced. However, hoof health was not improved with the three-way crossbred cows, while intakes were lower.

Issues to be considered when thinking about 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.
- 2) Hybrid vigour describes the additional performance benefits that can be obtained with a crossbred animal, over and above the average of the two parent breeds. However hybrid vigour should not be the main reason for adopting crossbreeding as hybrid vigour is not passed on to the next generation.
- 3) The impact of crossbreeding on the value of cull cows, male calves and surplus breeding stock needs to be considered.
- 4) The choice of breed for use within a crossbreeding programme is a critical decision. The breed should be suitable for the milk production system in which its offspring will function (i.e. low input grazing vs high input confinement), and in general, 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.
- 5) The choice of sire within a breed is critical. Sires used within crossbreeding programmes should be top sires for PLI from within the breed selected.

Conclusions

Previous research at Hillsborough has demonstrated that crossbreeding Holstein cows with Jersey sires results in robust cows with similar milk solids yields as

Holstein cows, but with fewer health problems and higher levels of fertility. The current study has demonstrated that many, although not all, of these benefits were maintained when Jersey crossbred cows were bred to Scandinavian Red sires.

Table 1: Performance of Holstein-Friesian and three-way crossbred dairy cows (Swedish Red x Jersey x Holstein) over one full lactation

	Holstein-Friesian	Three-way crossbred
Intakes and body tissue		
Total dry matter intake prior to turnout (kg per day)	17.4	15.9
Average live-weight (kg)	559	530
Average condition score	2.2	2.4
Milk production		
Milk yield (kg/lactation)	7310	6378
Milk fat (%)	4.15	4.63
Milk protein (%)	3.34	3.54
Fat + protein yield (kg/lactation)	546	520
Somatic cell count (000/ml)	107	162
Fertility		
Conception rate to 1st AI (%)	37	37
Conception rate after 14 weeks (%)	72	90
Health		
Cows with at least one case of mastitis (%)	26	6
Cows with at least one case of lameness (%)	10	13