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Comparison of the performance of Holstein-Friesian and Jersey × Holstein-Friesian crossbred dairy cows within three contrasting grassland-based systems of milk production

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ABSTRACT

The performance of spring calving Holstein-Friesian (HF) and Jersey × Holstein-Friesian (J × HF) dairy cows was examined during three successive years (mean of 35 HF cows and 31 J × HF cows per year). Throughout the experiment cows were managed on one of three grassland-based systems of milk production, namely low concentrate (LC), medium concentrate (MC) or high concentrate (HC). Post-calving, cows were housed and offered grass silage, supplemented with 6.0, 8.0 and 10.0 kg concentrate/cow/d in systems LC, MC and HC, respectively (mean period from calving to start of full time grazing, 69 days). During the grazing period target concentrate feed levels were 0, 2.5 and 5.0 kg/cow/d for systems LC, MC and HC, respectively (mean period from start of full time grazing to start full time re-housing, 206 days). Full lactation concentrate inputs were 530, 1092 and 1667 kg/cow, in systems LC, MC and HC, respectively. There were no significant genotype × system interactions for any of the milk production parameters examined. Food intake during the confinement and grazing periods was unaffected by genotype. Milk yield was highest with HF cows while milk fat and milk protein content were highest with the J × HF cows ($P < 0.001$). Genotype had no effect on fat plus protein yield. Milk yield and fat plus protein yield were higher with systems MC and HC than with LC ($P < 0.001$). HF cows were on average 44 kg heavier than J × HF cows, while the mean condition score of the J × HF cows was approximately 0.2 units higher than that of the HF cows ($P < 0.001$). Live weight and condition score changes during the lactation followed similar trends with both genotypes. The J × HF cows had fewer days to first observed heat ($P < 0.05$), a higher conception rate to first service ($P < 0.01$), first plus second service ($P < 0.001$), and a higher pregnancy rate at the end of the breeding season ($P < 0.05$). Although mean somatic cell score was unaffected by genotype, the proportion of cows with one or more cases of mastitis was lower with the J × HF cows ($P < 0.05$). In summary, while the J × HF cows had improved fertility performance compared to the HF cows, both genotypes exhibited similar levels of tissue mobilisation and deposition throughout the lactation, while there was no evidence of a genotype × grassland system interaction for any of the milk production parameters examined.

1. Introduction

During the last few decades the Holstein-Friesian breed has become the dominant dairy cow breed on the

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majority of United Kingdom (UK) dairy farms. However, breeding programmes within the Holstein-Friesian breed have until recently focused largely on a single trait, namely milk production, and this has led to a decline in functional traits, especially fertility (Royal et al., 2000). This, combined with increasing herd sizes and a trend towards reduced labour input per cow, has prompted interest in 'easy care cows', and this has led to a renewed interest in the role of crossbreeding. While many breeds have been used within crossbreeding programmes, there is particular interest in the use of the Jersey breed due to its ability to improve milk composition (Aikman et al., 2008; Rastani et al., 2001; White et al., 2001), and the fact that Jersey crossbred cattle are particularly well suited to grazing systems (Prendiville et al., 2010a).

Evidence highlighting some of the benefits associated with crossbred cows already exists, with Jersey × Holstein-Friesian cows having been shown to produce similar yields of fat plus protein as Holstein-Friesian cows (Auldist et al., 2007; Prendiville et al., 2009). In addition, Heins et al. (2008a) reported higher conception rates to first service in Jersey × Holstein-Friesian cows compared with pure bred Holstein-Friesian cows. While a small number of experiments have examined the performance of Jersey × Holstein crossbred cows within high concentrate input confinement systems (Heins et al., 2008b; Vance et al., 2012), most research has examined the performance of Jersey crossbred cows within low concentrate input grassland-based systems of milk production. No studies have been identified in which the performance of Holstein-Friesian and Jersey × Holstein-Friesian cows have been compared within grassland-based milk production systems involving 'moderate' concentrate inputs.

Thus the objective of the current experiment was to compare the performance of Holstein-Friesian (HF) and Jersey × Holstein-Friesian (J × HF) dairy cows within grassland-based systems involving a range of concentrate feed levels. Three contrasting grassland-based milk production systems were examined, with the concentrate feed levels examined (approximately 500, 1100 and 1700 kg/cow/lactation) chosen to cover the range of concentrate feed levels that would typically be offered within low–moderate concentrate input spring calving milk production systems within the UK.

2. Materials and methods

This three-year experiment was conducted at the Agri-Food and Biosciences Institute, Hillsborough (latitude 54°27′N; longitude 06°04′W) between January 2006 and December 2008. Cows of two genotypes were managed on one of three grassland-based milk production systems over three successive years.

2.1. Animals

The experiment involved 28 (21 and 7), 35 (12 and 23) and 42 (9 and 33) HF cows and 28 (21 and 7), 32 (8 and 24) and 32 (9 and 23) J × HF cows in each of Years 1, 2 and 3, respectively (numbers of primiparous and multiparous cows in brackets). During each of Years 1, 2 and 3, cows on the study were in lactations 1 and 2, 1–3 and 1–4, respectively. The HF cows (which were sired by 19 Holstein-Friesian sires) had a mean Predicted Transmitting Ability (PTA_{2010}) for fat plus protein yield of +9.5 kg and a mean Profitable Lifetime Index (£PLI_{2010}) of +£26, with these cows within the top 20% of HF cows within the UK for these two parameters. The J × HF cows were the offspring of a breeding programme involving randomly selected Holstein-Friesian cows from the AFBI Hillsborough herd and Jersey sires of both Danish ($n=5$) and New Zealand ($n=4$) origin, with the Jersey sires used having a weighted PTA_{2010} for fat + protein yield of +16.5 kg, and a weighted PLI_{2010} of +£75. The dams of the HF and J × HF cows used in this experiment had similar genetic potentials, having mean PTA_{2010} for fat + protein yield of 5.7 and 2.7 kg, respectively, and a mean PLI of +£11.7 and +£16.0, respectively. All genetic parameters presented above were determined within the April 2011 proof run. Mean calving dates were 28 January (s.d. 21.4 days), 9 February (s.d. 23.7 days) and 4 February (s.d. 24.0 days) in each of Years 1–3, respectively.

2.2. Overview of feed systems

In Year 1 (2006) cows from each genotype were allocated to one of the three grassland-based systems of milk production within 36 h of calving, namely 'low concentrate' (LC), 'medium concentrate' (MC) and 'high concentrate' (HC). Genotype groups were balanced across the systems according to calving date, parity, pre-calving live weight and body condition score, sire, and in the case of the HF cows, PTA for fat plus protein yield. Cows remained on the same management system for the duration of the experiment, or until removed from the experiment. Cows that were removed during or at the end of Years 1 and 2 were replaced at the start of Years 2 and 3, respectively. Replacement animals were largely primiparous (with these also balanced across systems according to the traits described above), although on occasions multiparous cows were used as replacements.

2.2.1. Indoor periods

Cows were transferred to cubicle accommodation within 36 h of calving, and housed as a single group until the start of turnout. During the 'winter period', from calving until the start of turnout, all cows were offered diets comprising grass silage and concentrates. Throughout the experiment a common concentrate was offered to cows on all three systems, with the ingredient composition of this concentrate presented in Table 1. Changes in the availability and cost of some ingredients meant that the ingredient composition of the winter concentrate varied from year to year. Target concentrate intakes during the winter periods were 6.0, 8.0 and 10.0 kg/cow/d (fresh basis) with systems LC, MC and HC, respectively. With system LC, the daily concentrate allowance was divided into two equal feeds each day, and offered via in-parlour feeders at each milking. With system MC, 1.0 kg of the daily concentrate allowance was offered during milking (0.5 kg at each milking), with the remaining 7.0 kg being offered through two out-of-parlour feed