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Performance of Holstein and Swedish-Red × Jersey/Holstein crossbred dairy cows within low- and medium-concentrate grassland-based systems

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ABSTRACT

This 2 × 2 factorial design experiment was conducted to compare the performance of spring-calving Holstein dairy cows (HOL, n = 34) with Swedish Red × Jersey/Holstein crossbred (SR × J/HOL, n = 34) dairy cows within low and medium concentrate input grassland-based dairy systems. The experiment commenced when cows calved and encompassed 1 full lactation. Cows were offered diets containing grass silage and concentrates [70:30 dry matter (DM) ratio, and 40:60 DM ratio, for low and medium, respectively] until turnout, grazed grass plus either 1.0 or 4.0 kg of concentrate/d during the grazing period (low and medium, respectively), and grass silage and concentrates (85:15 DM ratio, and 70:30 DM ratio, for low and medium, respectively) from rehousing and until drying off. No significant genotype × system interactions were present for any of the feed intake or full-lactation milk production data examined. Full-lactation concentrate DM intakes were 769 and 1,902 kg/cow for the low and medium systems, respectively, whereas HOL cows had a higher total DM intake than SR × J/HOL cows in early lactation, but not in late lactation. Although HOL cows had a higher lactation milk yield than SR × J/HOL cows, the latter produced milk with a higher fat and protein content, and thus fat plus protein yield was unaffected by genotype. Milk produced by the SR × J/HOL cows had a higher degree of saturation of fatty acids than milk produced by the HOL cows, and the somatic cell score of milk produced by the former was also higher. Throughout the lactation, HOL cows were on average 30 kg heavier than SR × J/HOL cows, whereas the SR × J/HOL cows had a higher body condition score than the HOL cows. Holstein cows had a higher incidence of mastitis and ovarian dysfunction that SR × J/HOL cows.

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INTRODUCTION

Whereas historic selection programs within the Holstein breed focused primarily on milk production at the expense of health and fertility, selection programs in most countries now include functional traits (Miglior et al., 2005). However, problems within the Holstein breed will take time to reverse, and this is one of several reasons for a renewed interest in crossbreeding.

Benefits of crossbreeding arise through the introduction of desirable traits from a second breed, from hybrid vigor, and through opportunities to minimize the risk of inbreeding. Many breeds have been evaluated within crossbreeding studies, including Normande (Heins et al., 2012), Montbelliard (Heins et al., 2012; Hazel et al., 2014), Brown Swiss (Dechow et al., 2007; Blottner et al., 2011), Norwegian Red (Begley et al., 2009), and Swedish Red (Piccardi et al., 2014; Malchiodi et al., 2014). However, the Jersey is perhaps the breed most commonly used, with research having demonstrated that Jersey × Holstein crossbred cows have similar intakes (Heins et al., 2008a; Prendiville et al., 2009; Vance et al., 2012a) and yields of milk solids as Holstein cows (Vance et al., 2012a, 2013), while also having improved fertility (Heins et al., 2008b).

Although the benefits of crossbreeding are now well established, farmers who adopt crossbreeding are faced with an important question, namely which sire breed to use when breeding the F_1 crossbred cow. Several breeding strategies exist, including crossing back to one of the parent breeds, using progeny-tested crossbred sires, or using a third breed in a 3-breed rotational crossbreeding program. One of the benefits of the latter approach is the potential to maintain heterosis at an average of 86% of that found with the F_1 cross, compared with an average of only 67% if maintaining a 2-breed cross (Sørensen et al., 2008). However, as noted by McAllister (2002), although the theoretical advantages of a 3-breed rotational crossing system are clear, data to recommend the third breed, and the use of this approach in practice, are limited. Only a few studies have examined the performance of 3-breed crossbred cows, with these including studies by Malchiodi et al. (2014) involving Montbelliard × Swedish Red/Holstein cows, and Hazel et al. (2013, 2014) involving Montbelliard × Jersey/Holstein cows.

To help address this issue, the performance of Holstein (**HOL**) and 3-breed crossbred cows (Swedish Red × Jersey/Holstein; **SR × J/HOL**) cows were compared over a single lactation. The use of the Swedish Red as the third breed within this crossbreeding program was based on several factors, including sire selection programs in Sweden having incorporated fertility and health traits for several decades (Heringstad et al., 2000; Philipsson and Lindhe, 2003). In addition, when used as a first-cross within crossbreeding programs, Scandinavian Red crossbred cows had fewer calving difficulties and still births (Heins et al., 2006a), improved fertility (Heins and Hansen, 2012; Malchiodi et al., 2014; Piccardi et al., 2014), similar lactation fat plus protein yields (Heins et al., 2006b), but higher lifetime yields and greater survival (Heins et al., 2012) compared with purebred Holstein cows. Although crossbred cows, and especially Jersey crossbred cows, are often perceived to be primarily suited to lower concentrate input systems, a recent study (Vance et al., 2013) compared the performance of Holstein and Jersey × Holstein cows within 3 grassland-based systems of milk production (concentrate inputs of approximately 0.5, 1.1 and 1.7 t/cow per lactation). This study provided no evidence of a genotype × nutrition interaction for any of the parameters examined. As crossbred cows are increasingly being used within medium concentrate input systems, the current study was conducted to compare the performance of HOL and SR × J/HOL cows within both a low and medium concentrate system.

MATERIALS AND METHODS

This study was conducted at the Agri-Food and Biosciences Institute (**AFBI**), Hillsborough, between January 2013 and February 2014. Four treatments were examined in a continuous 2 (cow genotype) × 2 (system) factorial design experiment. The experiment commenced when the cows calved and was conducted over one full lactation. All experimental procedures in this study were conducted under experimental license granted by the Department of Health, Social Services and Public Safety for Northern Ireland in accordance with the United Kingdom (**UK**) Animals (Scientific Procedures) Act 1986.

Animals

The experiment involved 68 spring calving dairy cows, 34 HOL cows and 34 three-breed crossbred cows (SR × J/HOL). The HOL cows had a mean predicted transmitting ability for fat + protein yield of +12 (±10.6; ±SD) kg and a mean profitable lifetime index (**PLI**) of +£141 (±123.6; ±SD), with these cows being within the top 5% of Holstein cows in the UK for these 2 parameters. The genetic parameters presented above were determined within the April 2015 proof run. The HOL cows used in the experiment were sired by a total of 11 Holstein-Friesian sires, with these sires selected from within the 20 highest ranking sires for PLI available within the UK during the years that the dams of the HOL cows were bred. The SR × J/HOL cows were the offspring of a breeding program in which randomly selected Holstein cows from the AFBI Hillsborough herd were bred to Jersey sires of Danish and New Zealand origin (described previously by Vance et al., 2012a, 2013), with the offspring of this breeding program subsequently bred to sires (n = 6) of the Swedish Red breed. These sires were within the 5 highest ranking Swedish Red sires for total merit index available within the UK during the years that the dams of the SR × J/HOL cows were bred. All cows on the study were multiparous, with the HOL and SR × J/HOL cows having a mean lactation numbers of 2.8 and 2.9, respectively.

Systems

Cows from each genotype were allocated to 1 of 2 grassland-based milk production systems (low and medium) within 36 h of calving, with systems differing in concentrate inputs. Within each genotype cows were balanced across the low and medium systems according to calving date, parity, precalving BW and BCS, sire, and in the case of HOL cows, predicted transmitting ability for fat + protein yield and PLI. Full details of each of the 2 systems are described below. Cows had a mean calving date of February 15 (±26.8 d; ±SD).

Winter Period. During the dry period before the start of the experiment all cows were offered grass silage plus 100 g/cow per d (target intake) of a dry cow mineral/vitamin mix. Following calving (within 36 h) cows were moved from a maternity pen to freestall cubicle accommodation. Cubicles were fitted with rubber mats that were cleaned daily, bedded with sawdust thrice weekly, and treated with lime weekly. Concrete passageways within the house were cleaned every 2 to 3 h throughout the day using an automatic slurry scraper system.