Fertility Traits in New Zealand versus North American Holsteins

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Take Home Messages

- Selection strategies for the New Zealand Holstein-Friesian cow focus on increasing profitability in a seasonal pasture-based system. North American Holsteins are selected for profitability in a continuous calving confinement-based system with total mixed ration (TMR) feeding.
- New Zealand Holstein-Friesians and North American Holsteins produce about the same amount of milk solids when managed in a pasture-based system. North American Holsteins produce more milk than New Zealand Holstein-Friesians when a TMR is fed.
- During lactation, New Zealand Holstein-Friesians have higher body condition score (BCS) than North American Holsteins. Differences in BCS reflect inherent differences in the capacity for nutrient partitioning in New Zealand compared to North American dairy cows.
- Although lower in postpartum BCS, North American Holsteins cows have a shorter interval from calving to first ovulation than New Zealand Holstein-Friesian cows.
- Low BCS in lactating North American Holstein cows (secondary to nutrient partitioning mechanisms) leads to lower pregnancy rates. New Zealand Holstein-Friesian cows in low BCS have low pregnancy rates as well but fewer New Zealand Holstein-Friesian cows have low BCS during lactation.

Introduction

Most dairy farms in New Zealand are seasonal, grass-based systems. New Zealand dairy cows calve in the late winter/early spring and achieve greatest milk production when the pasture grasses are growing rapidly and produce the greatest amount of energy per hectare. Calving occurs in late winter/early spring to take advantage of maximal springtime pasture growth. To achieve a yearly calving interval dairy cattle are inseminated and pregnancy is

▪ Production and Body Condition Score Differences between New Zealand and North American Dairy Cows.

Genetic selection in North America has been practiced on the typical North American Holstein cow that is fed a high energy TMR in a confinement system. Pasture plays a small role in the nutrition of North American Holstein cows. Genetic selection in New Zealand has been practiced on Holstein-Friesian cows in a seasonal pasture-based system. This review will focus on the North American Holstein and the New Zealand Holstein-Friesian cow. Other dairy breeds are important to dairy industries worldwide. This is particularly true in New Zealand where the Jersey breed and the Holstein-Jersey crossbred (Kiwi cross) make up a large percentage of the national dairy herd. For consistency and simplicity, however, the comments made herein will focus on Holsteins and Holstein-Friesians. The general relationships that are described probably exist in all dairy breeds.

General Characteristics of North American Holsteins and New Zealand Holstein-Friesian cows.

The three most-distinguishing differences between North American Holsteins and New Zealand Holstein-Friesian cows are mature body weight, body condition score (BCS) during lactation, and milk volume/composition (Harris and Kolver, 2001). North American cows are heavier (about 50 to 100 kg greater mature body weight) and have lower BCS during lactation. They also produce greater milk volume than New Zealand cows but have a lower percentage of milk fat and protein.

Milk Production in a Pasture System

When North American Holstein cows are managed in a New Zealand pasture system they produce greater milk volume than New Zealand Holstein-Friesian cows. New Zealand Holstein-Friesian cows produce a higher milk fat and protein percentage. Milk solids production (kg of fat and protein) is approximately equal for North American Holstein and New Zealand Holstein-Friesian cows because the lower milk volume in New Zealand cows is offset by higher milk fat and protein percentages (Harris and Kolver, 2001).

Milk Production in a Total Mixed Ration (TMR) System

Kolver et al. (2002) performed a series of experiments in which New Zealand Holstein-Friesian cows were compared to North American Holstein cows in a pasture-based feeding system and a TMR-based feeding system (2 by 2 factorial arrangement of treatments). New Zealand and North American cows fed pasture produced approximately the same amount of milk solids. These data agreed with data from a variety of previous studies (Harris and Kolver, 2001). Milk production for North American and New Zealand cows increased when a TMR was fed. North American cows fed a TMR, however, produced more milk solids than New Zealand cows fed a TMR. Collectively, these data demonstrate that nutrients limit milk production of pasture-fed dairy cows regardless of genetic strain. Feeding additional nutrients increases milk production but North American cows have a greater capacity to convert feed to milk. Feeding additional nutrients to New Zealand cows increases milk production to a lesser extent. Some of the additional energy is partitioned toward body fat (greater BCS) in New Zealand dairy cows.

Table 1. Total lactation milk production, milk fat percentage, milk protein percentage, and total lactation milk solids production for New Zealand Holstein-Friesian (NZ) and North American Holstein (NA) dairy cows fed grass pasture or total mixed ration (TMR) (Kolver et al., 2002).

	Pasture		TMR	
	NZ	**NA**	**NZ**	**NA**
Lactation milk production[1], kg/cow	5300	5883	7304	10097
Milk fat[2], %	5.03	4.28	4.60	3.62
Milk protein[3], %	3.74	3.50	3.65	3.54
Lactation milk solids production[4], kg/cow	465	459	602	720

[1]Standard error = 301; Genotype by diet, P<.01.
[2]Standard error = .23; Genotype, P<.001.
[3]Standard error = .08; Genotype, P<.05.
[4] kg fat + kg protein; standard error = 22; Genotype by diet, P<.05.

Body Condition Score during Lactation

North American cows have lower BCS during lactation than New Zealand Holstein-Friesian cows. The lower BCS in North American cows reflects different prioritization for nutrients. In early lactation, North American cows rapidly lose BCS. This early lactation BCS loss is greater than that which occurs in New Zealand cows.

The period of predominant BCS loss is the first eight weeks after calving. Afterwards, North American cows still lose BCS but the rate of loss is less. New Zealand cows gain BCS after eight weeks. The larger size (and therefore greater maintenance requirements) of North American compared to New Zealand cows may be the primary cause for the greater BCS loss on pasture. Although often portrayed as quite large, the difference in BCS during lactation for North American cows relative to New Zealand cows is equal to 0.3 units on the North American 1 to 5 BCS scale (Lucy and Verkerk, unpublished).

Body condition loss in early lactation is a characteristic of North American cows under pasture management systems (Harris and Kolver, 2001). It is also a characteristic of North American cows in traditional North American systems where negative energy balance during early lactation is considered necessary to support a high level of milk production (Drackley, 1999). The changes in BCS for North American cows in New Zealand are approximately equal to those that occur in North American cows in North America (TMR feeding system). Regardless of system, North American cows control their BCS loss.

Supplementing Concentrate as a Method to Increase Body Condition

Supplementation is practiced in grazing systems in an attempt to increase BCS of postpartum cows. This strategy is only partially effective for North American cows in a pasture system. The additional energy found in supplements is partitioned toward milk production and is not deposited as body fat. North American cows require extremely high levels of supplementation before they will gain BCS during lactation (Table 2; Roche and Lucy, 2004). New Zealand Holstein-Friesian cows will gain BCS during lactation at lower rates of supplementation.

Table 2. Body Condition Score (New Zealand 1 to 9 Scale) at 16 weeks postpartum for New Zealand Holstein-Friesian cows and North American Holstein cows fed different daily amounts of concentrate (55% corn, 45% barley, and 5% molasses) during lactation (adapted from Roche and Lucy 2004).

	Type of cow	
Concentrate (DM/cow/day)	**New Zealand Holstein-Friesian**	**North American Holstein**
0 kg	3.9	3.4
3 kg	4.3	3.4
6 kg	4.6	4.0

▪ Reproductive Characteristics of North American Holstein and New Zealand Holstein-Friesian Cows

There are two primary differences between North American and New Zealand cows in a pasture system. First, the interval from calving to first ovulation is shorter for North American cows. Thus, more North American cows are cycling at the beginning of the breeding season. Second, herd pregnancy rate at the end of the breeding season is lower for North American cows.

Interval from Calving to First Ovulation

North American cows have a shorter interval from calving to first ovulation than New Zealand cows. Meyer et al. (2004) reported that the difference in interval to first ovulation was approximately one week (Table 3). They also reported that increasing the amount of pasture offered to New Zealand cows decreased the interval to first ovulation. Increasing the amount of pasture offered to North American cows had no effect on interval to first ovulation.

Table 3. Number of days from calving to ovulation for cows from different genetic strains given different feed allowances within a pasture-based dairy system. Data are as mean ± SEM (Meyer et al., 2004).

	Type of cow[1]	
Pasture allowance (ton DM/cow/year)	**New Zealand Holstein-Friesian**	**North American Holstein**
5.0	44 ± 5	-
5.5	40 ± 4	28 ± 3
6.0	27 ± 4	21 ± 2
6.5	30 ± 4	31 ± 4
7.0	-	28 ± 4

[1]Feed by strain, P<.01.

Pregnancy Rate

There is general agreement that North American cows have lower pregnancy (in-calf) rates than New Zealand cows (Harris and Kolver, 2001). The in-calf rates are approximately 5 to 10% lower for North American cows on pasture. Many of the cows that are not pregnant are “phantom cows” (non-pregnant cows that do not return to estrus; Cavalieri et al., 2003). The presence of phantom cows creates a serious reproductive challenge in pasture systems. Under traditional reproductive management, a phantom cow is not detected until pregnancy exam; 40 to 60 days after initial insemination. This diagnosis may be too late for rebreeding in a pasture system. Low BCS is a risk factor for phantom cow syndrome (Cavalieri et al., 2003). Low BCS in North American cows probably leads to a high incidence of phantom cows.

Phantom cow syndrome is not restricted to North American Holstein cows. We found evidence for phantom cow syndrome in New Zealand Holstein-Friesian cows that had low BCS (Lucy and Verkerk, unpublished). There is a lower proportion of low BCS cows in New Zealand Holstein-Friesian cows. Thus, the incidence of phantom cow syndrome is lower in New Zealand cows.

▪ General Comments Concerning Body Condition and Reproduction in North American and New Zealand Cows

Nutrient partitioning is a key event that determines level of milk production in early lactation dairy cattle. Reproductive success of dairy cows is closely tied to nutrient partitioning (Lucy, 2003). Most of the available literature suggests that dairy cattle have a genetically-determined set point for BCS during lactation (Stockdale, 2001). Once dairy cows begin lactation, they will migrate toward their BCS set point through the coordinated depletion of adipose tissue. The magnitude of adipose tissue loss does not depend on nutrient demands per se but instead depends on the available adipose tissue mass and the genetically-determined set point for the individual cow.

There is wide-spread consensus that the genetically-determined set point for BCS during lactation affects the reproductive performance of dairy cows. Cows with a high BCS during lactation have high fertility whereas cows with a low BCS during lactation have low fertility (Pryce et al., 2002; Berry et al., 2003). Genetic selection for milk production has changed the phenotype of dairy cattle. Modern dairy cows are thinner (lower BCS) during lactation when compared to traditional dairy cows (Hansen, 2000). The lower BCS of modern dairy cows reflects the genetic predisposition to direct nutrients away from body fat during lactation (homeorhetic mechanism that supports milk production). A variety of hormones are involved in homeorhesis but growth hormone (GH) may be the most important because GH promotes lipolysis while antagonizing lipogenesis and blocking insulin-dependent glucose uptake in peripheral (non-mammary) tissues (Etherton and Bauman, 1998).

The average Holstein-Friesian cow in New Zealand has about 40% North American Holstein (Harris and Kolver, 2001). A common perception is that lower reproductive rates in modern New Zealand dairy cows are caused by the influx of North American genetics into the New Zealand herd. Although the argument has some merit, the fact that cows with low BCS during lactation have lower fertility applies to both North American Holstein cows and New Zealand Holstein-Friesian cows. New Zealand Holstein-Friesian cows have better fertility because they have greater BCS during lactation. Continued selection of New Zealand Holstein-Friesian cows for milk production will lead to lower BCS and lower fertility. An appropriately developed selection index with an appropriate weighting for fertility and (or) BCS will counteract this trend.

■ Summary

New Zealand Holstein-Friesians and North American Holsteins produce about the same amount of milk solids when managed in a pasture-based system. During lactation, New Zealand Holstein-Friesians have higher BCS than North American Holsteins. Differences in BCS reflect inherent differences in the capacity for nutrient partitioning in New Zealand compared to North American dairy cows. Although lower in postpartum BCS, North American Holsteins have a shorter interval from calving to first ovulation than New Zealand Holstein-Friesian cows. Low BCS in lactating North American Holsteins leads to low pregnancy rates and phantom cow syndrome. New Zealand Holstein-Friesian cows in low BCS have low pregnancy rates and phantom cow syndrome as well but fewer New Zealand cows have low BCS during lactation. Only appropriately developed selection indices with appropriate weightings for fertility and (or) BCS will counteract the current trends for lower reproductive rates in modern dairy cows.

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