Is there a need for different genetics in dairy grazing systems?

H.D. Norman, J.R. Wright, and R.L. Powell
Animal Improvement Programs Laboratory,
Agricultural Research Service, U.S. Department of Agriculture
Bldg. 005, Room 306, BARC-West, 10300 Baltimore Ave., Beltsville, MD 20705-2350, U.S.A.
E-mail: dnorman@aipl.arsusda.gov

Genetic evaluations for milk yield and a number of fitness traits are provided to U.S. dairy producers by the U.S. Department of Agriculture (USDA) every 3 months. Bull evaluations have been calculated for milk and fat yields since before 1936 and for protein yield since 1977. As a result, considerable genetic improvement has been made for those traits. The genetic trend for yields has been rather constant at around 250 pounds per year for over 25 years. Bull evaluations for several fitness traits were added later: service-sire calving ease, 1980; mastitis resistance, 1994; productive life, 1994; daughter calving ease, 2002; daughter fertility, 2003; service-sire stillbirth, 2006; and daughter stillbirth, 2006. Genetic trend for productive life was positive before implementation of sire evaluations for direct selection, because it has a positive genetic correlation with milk yield. Several other fitness traits changed marginally over time. Unfortunately, the ability of cows to combat mastitis deteriorated somewhat, and the readiness of cows to conceive declined even more, primarily because of the negative genetic correlation of those two traits with milk yield. Now that genetic evaluations for those two fitness traits are available for males and females, producers have an opportunity to select directly for them.

A growing interest in grazing has led a few producers to alter their bull selection practices. Some grazers are trying nontraditional alternatives to obtain cattle with better fertility or other characteristics that they perceive as desirable. One of those alternatives is to use bulls from countries that practice grazing. Another is to mate cows to a bull of a different breed, either to integrate new qualities or to capitalize on heterosis for traits of interest. Reports are prevalent that the extent of dairy crossbreeding has increased (VanRaden and Sanders, 2003), and breed associations have developed programs to enroll animals that have multiple breeds in their pedigrees. Obviously, they expect that practice to continue or even to grow. Producers practicing grazing and seasonal calving need to know whether either of those alternatives is likely to be successful. If not, they may suffer adverse economic consequences for some time.

The decline in cow fertility has had a negative impact on all dairy producers, especially those that practise seasonal calving with pasture-based dairying. One alternative that is being tried in the United States by a few graziers who are interested in improved fertility is to use bulls from New Zealand because New Zealand producers have practised grazing and seasonal calving for many years. However, the possibility of an interaction between genotype and environment is a concern; genetic correlations that have been derived by the International Bull Evaluation Service (2006) between bull rankings from different countries usually are lower for New Zealand than for other countries. Therefore, a study was initiated to compare the performance of daughters of Holstein artificial-insemination (AI) bulls from New Zealand with daughters of other Holstein AI bulls (predominantly from the United States) that were in the same U.S. herd and calved at the same time.

Study: Performance of daughters of New Zealand bulls

Methods

Milk, fat, and protein yields; somatic cell score (SCS, an indicator of mastitis); and days open (an indicator of fertility) were examined for the first three parities of Holstein cows. Traits were standardized for environmental effects in the same manner as for current USDA genetic evaluations. Cows were required to have first calved from January 2000 through March 2005 to allow time for them to express the performance traits. Data for first-parity yield traits and SCS were from 552 daughters of 26 New Zealand bulls and 6,266 daughters of 1,119 other bulls in 159 herds. Second- and third-parity yield traits represented 394 and 213 New Zealand daughters of 19 and 14 New Zealand bulls and 5,212 and 3,170 daughters of 1,464 and 1,036 other bulls in 136 and 90 herds, respectively. Data for first-parity days open were from 513 daughters of New Zealand bulls and 5,823 daughters of other bulls in 148 herds. Conformation data were available for only 79 New Zealand-sired daughters and were compared with data from 308 U.S.-sired contemporaries. Comparisons for calving ease and stillbirth have not yet been examined.

In addition to studying all herds that used New Zealand bulls, a spring-calving subset was defined based on calving pattern. When more than 3 times as many calvings in a herd were in March to May as in September to November for 3 consecutive years between 2002 and 2005, the herd was assumed to be a “spring-calving” herd. That criterion identified only 11 herds (7%) of the original 159 as spring-calving herds, but those herds had 25% of the New Zealand daughters. Although milk yield was lower for those 11 herds (19,063 pounds) than for all herds (20,763 pounds), a grain-supplemented diet in those spring-calving herds is likely, because a larger yield difference would have been expected for totally pasture-based herds. Separate results were summarized for the 11 spring-calving herds

Results

Strain differences for trait averages are shown in Table 1. Average first-parity milk and protein yields were lower by 1,060 and 11 pounds, respectively, for daughters of the New Zealand bulls than for daughters of other bulls. Average second-parity milk and protein yields were lower by 1,261 and 15 pounds, and third-parity means were lower by 1,056 and 11 pounds. Corresponding averages for fat yields were higher by 2, 2, and 7 pounds (none were significant).

Table 1. Performance comparison of Holstein daughters of New Zealand AI bulls with daughters of other AI bulls by parity[1]

Trait	Parity 1	Parity 2	Parity 3
Milk (pounds)	–1,060***	–1,261***	–1,056***
Fat (pounds)	2	2	7
Protein (pounds)	–11**	–15***	–11
SCS	0.22***	0.10	0.06
Days open	–7*	–8*	–2

[1]Significance of strain difference (New Zealand minus other daughters) designated at probabilities of ≤ 0.05(*), ≤0.01 (**), and ≤0.001(***).

First-parity daughters of New Zealand bulls had higher average SCS than did daughters of other bulls by 0.22, 0.10, and 0.06. That difference was significant for first parity daughters of New Zealand bulls averaged 7, 8, and 2 fewer days open during the first three lactations, which was significant for the first two parities. Differences in conformation were significant for only 4 of the 15 traits scored by the Holstein Association USA (Brattleboro, VT). New Zealand-sired daughters averaged lower scores by 1.6 points for final score, 2.3 points for stature, 2.6 points for rear-udder height, and 3.2 points for udder depth. Although the smaller size of New Zealand-sire daughters may be an advantage, some concern about the lower udder scores may be appropriate.

Results for the 11 seasonally calving herds (Table 2) were in general agreement with those for all herds.

Table 2. Performance comparison of Holstein daughters of New Zealand AI bulls with daughters of other AI bulls by parity[1] for herds with predominantly spring calvings

Trait	Parity 1	Parity 2	Parity 3
Milk (pounds)	–774***	–1,186***	–1,642***
Fat (pounds)	7	4	13
Protein (pounds)	–9	–18*	–29**
SCS	0.24*	0.16	0.11
Days open	–6	–1	–1

[1]Significance of strain difference (New Zealand minus other daughters) designated at probabilities of ≤ 0.05(*), ≤0.01 (**), and ≤0.001(***).

Another Alternative: Increase Emphasis on Genetic Measures of Fertility

Herd fertility can be improved a great deal through genetics. Although the herd's reproductive management program is even more important, effective management practices require a sustained effort every day, whereas genetic improvement is the result of choosing the right bulls now and reaping the benefits for generations after the daughters calve. Unfortunately, the low heritability of reproductive traits (often less than 5%) has led to a misunderstanding over the past 50 years on how much impact genetics can have on herd reproduction.

In 2003, USDA began providing cow fertility evaluations expressed as daughter pregnancy rate (DPR), which is the percentage of open (nonpregnant) cows between 50 and 250 days in milk that will become pregnant within the next 21 days. Breed averages for days open and DPR are shown in Table 3. Breed averages for days open ranged from 127 days for Jerseys to 151 days for Guernseys, which resulted in a range for breed-average DPR from 20.5 to 26.5%. The average DPR for Holsteins was 21.2%.

Genetic improvement in cow fertility is possible with AI bulls that are currently being marketed. Holstein bulls with a predicted transmitting ability (PTA) of +2.0% for DPR will raise the average herd DPR from 21.2 to 23.2%. Although that increase is only a 2% improvement in the percentage of all cows that are pregnant, it is an increase of 9.4% in the number of pregnant cows (2% increase in DPR divided by 21.2% for an average bull = 9.4% increase in cows expected to become pregnant). For every 1% increase in DPR, days open decreases by 4 days. Thus, a bull with a DPR of +2.0 can reduce days open by 8 days in an average herd because of earlier conceptions for daughters of bulls with the best daughter fertility. The extent that dairy producers should emphasize fertility depends on their management system. All dairy producers would be wise to consider evaluations for service-sire fertility and DPR when choosing herd sires, especially those striving for seasonal calving and reliance on grazing.

Table 3. Average days open and DPR[1] by breed

Breed	Days open	DPR (%)
Ayrshire	143	22.4
Brown Swiss	143	22.4
Guernsey	151	20.5
Holstein	148	21.2
Jersey	127	26.5
Milking Shorthorn	135	24.5

[1]DPR = 0.25(2.33 – days open).

As U.S. cows became more productive, their fertility deteriorated (VanRaden et al., 2004). For almost all livestock species, reproductive performance has a negative relationship with weight loss (such as caused by negative energy balance from high milk yield). As milk yield of U.S. dairy cows increased over the last 40 years, average days open increased by 37 days (Figure 1); 17 days of that increase was associated with genetics, and the other 20 days was attributed to changes in management practices. By using bulls with DPR that average +2.0% (equivalent to 8 fewer days open), nearly half the genetic decline in fertility from using high-producing bulls for 40 years could be recovered in one generation.

Conclusions

Comparison of daughters of bulls from grazing management regimes with those from more traditional U.S. feeding regimes showed differences for several performance traits. Daughters of U.S. bulls had higher milk and protein yields than daughters of New Zealand bulls. First-parity daughters of U.S. bulls also had lower SCS, but daughters of New Zealand bulls had fewer days open in the same first lactation. New Zealand-sired daughters were lower for final score and stature and had lower udders. Sire selection in New Zealand is based on a lower nutritional and production levels; udder conformation, therefore, may not be as much of a concern there as in the United States. Producers should consider the economic values of all performance traits, and those should be combined into an index appropriate for expected economic conditions. Producers who practice grazing with seasonal calving should place more weight on fertility traits than is recommended for the general dairy cattle industry because of their higher economic value in a grazing environment. For herds that may have used New Zealand semen to improve performance, only fertility was improved.

An alternative to using bulls only from countries that practice grazing is to select for improved reproduction from the best sources available. Selection based solely on DPR is not recommended, but use of an index for overall economic merit (for example, the USDA lifetime merit indexes; VanRaden et al., 2006) allows breeders to select for many traits by combining the incomes and expenses for each trait into an accurate measure of overall profit. Some producers, such as seasonal grazers, may need to emphasize certain traits more than a typical U.S. producer would. Herd managers that are struggling with herd fertility also should seriously consider placing greater selection emphasis on fertility. Good reproductive management practices are absolutely essential for good herd reproductive performance.

However, selection of bulls with superior daughter fertility combined with good reproductive management can help to eliminate the disappointing fertility that producers have lived with in the past

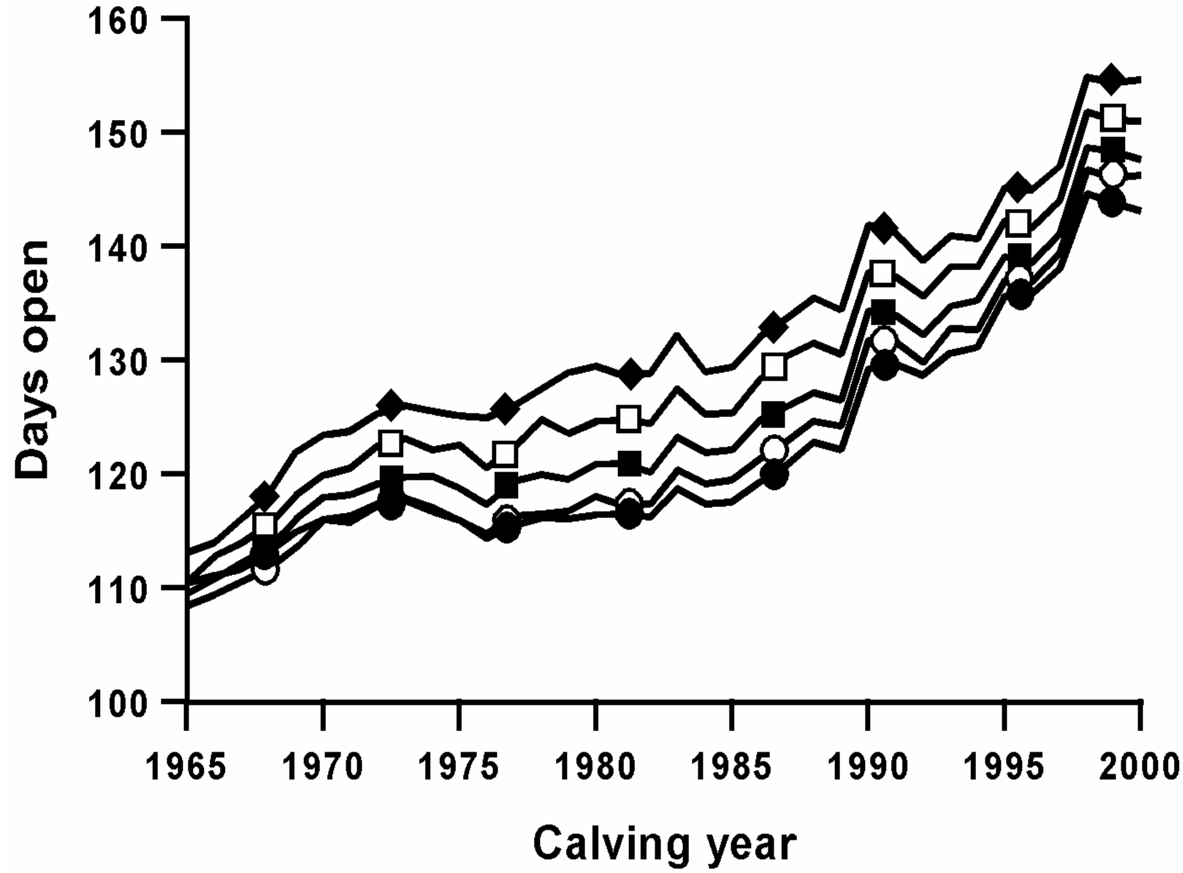

Figure 1. Phenotypic trend for days open for Holsteins by parity (● = first parity, ○ = second parity, ■ = third parity, □ = fourth parity, and ◆ = fifth parity).

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