TRENDS IN TODAY'S GENETICS

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Change is the major trend in today's genetics. We are nearing the end of a 30 to 40 year era of rapid genetic progress for milk production and conformation, particularly in udder structure. We are entering an era when traits such as fertility, health, and survival have are becoming more valuable than they were in the recent past. These developments are influenced by strong industry trends towards highly specialized dairy production units with many cows, total confinement systems, and total mixed rations formulated for high yields and fed to surplus of appetite. The following are several of the resulting trends that will be discussed in this presentation:

1. Higher prices in the replacement heifer market.
2. Changes in data collection, sire sampling, and semen marketing due to herd size.
3. Increases in inbreeding due to relationships between cows and AI bulls.
4. Acceptance of lifetime economic merit as a breeding objective.

Replacement Heifer Policies

High prices for replacement heifers aren't news any more, but it does have producers talking. Many of the participants in this conference have first hand experience with the dramatic increase in heifer prices. What happened to produce these changes? One of the better summaries that I have seen in print was written by James Miller of the USDA Economic Research Service in the February 25, 2002 issue of Hoards Dairyman. In his article, Dr. Miller said that the "westernization" of dairy management finally used up all the surplus heifers. Between 1975 and 2000, the percentage of cows in the nation that were housed in the Pacific and Mountain region grew from 14 to 31%. Western herd management systems concentrate on the lactating cow. There is little tolerance for sick cows, the hard to breed cow, any cow not in peak yield that doesn't slip right into the management system. She has to be producing almost every day she is on the farm to meet the high variable costs of milk production. Cull rates of 35 to 40% are common under such conditions. At the same time, sustainable rates of replacement heifer production are about 32 replacements per 100 cows per year, and the western management systems wouldn't produce that many. The extra animals had to come from somewhere, and the heifer supply was ultimately exhausted as increasing numbers of large herds adopted the "western" approach and competed for surplus heifers.

At the same time that "westernization" focused on lactating cows rather than heifer rearing, the smaller tie stall and freestall operations were exiting the industry at a rapid pace. Those smaller herds could, or at least were willing, to handle the older cow, the cow with mastitis, and the problem breeder more easily than large freestall operations. Such herds were the source of surplus heifers that used to be available for sale at prices near to or below true rearing costs. These sources of replacement heifers are gone forever. If the industry is to return to a surplus heifer situation, it will be because some fundamental changes took place on the "westernized" dairies. Those changes include more concern for baby calf survival, attention to raising replacement heifers, and (gasp) maybe even more attention to good AI practices and sire selection! A growing number of larger herds are beginning to question use of natural service as the "best" way to shorten calving intervals.

At the same time, some of them are saying, “If I have to spend $2,000 for a springing heifer, I at least want her to have better genetics.” There are two ways to find such heifers: buy herdbook-recorded heifers (so the buyer knows the pedigree) from breeders who use the best bulls, or breed your own. I never thought that heifers sired by herd bulls were worth very much, but in years past the “westernized” herds didn’t pay much for those heifers, either. Uh - -big herds didn’t have to pay much more, if any, for daughters of the best AI bulls. How does a genetics guy like me encourage better sire selection when the replacement heifer market keeps ignoring the value you say is bred into such heifers?

DHI, Research, and Genetic Evaluations

Genetic evaluations depend on performance and pedigree information. Historically, those data have been generated as a by-product of the DHI system. Increases in herd size and technological innovations in cowside milk recording and cow identification systems are really shaking the DHI clientele base. To add to the pressure on the national genetic evaluation database, larger herds have problems with identification of sire and dam on individual cows that smaller herds never dreamed of. Even with good records on service sires and workable systems of eartags, tattoos, and so forth, big herds have lots of calves born every day, usually unobserved. Here’s a big herd ID problem: which of the ten cows that calved in the last two hours is the mother of which calf?

When a number of heifer calves are born unobserved, please don’t guess about parentage. No identification at all is less damaging to the genetic evaluation system than wrong identification. When no sire/dam ID is listed, it is obvious that a production record on a cow contains no useful genetic information. Wrong ID not only suggests that we know more than we really know, it contributes misleading information and reduces the utility of the correct information already in a genetic evaluation system.

The value of cowside milk recording systems provided by the milking equipment dealers increases each year. The equipment becomes more reliable, and more cows are milked in the large herds that have cowside milk recording. Each year, more and more herds question the value of DHI to overall herd management. DHI has countered by offering very flexible testing programs, cost conscious systems, value added record processing, and on-farm cow management programs such as PCDART. One of the slickest moves made by DHI lately has been to open up the DHI databases to consultants (with herd owner approval). When trusted and valued consultants rely on DHI records for the management inputs provided to clients, herds have a reason to stay on test. Programs such as CTAP, DairyMetrics, and PCDART for Consultants are all relatively recent innovations that play an increasingly important role in herd management.

There is no guarantee that DHI records will continue to provide the amount and quality of information for genetic evaluations that have been provided in the past. If (when) bull studs cannot obtain necessary production information for progeny testing of young sires and identification of bull mother through normal DHI data recording systems, they will come up with another way to obtain needed genetic evaluations. Such a change could cause fundamental changes in how AI operates in this country. First of all, the costs of obtaining performance data would have to be provided in the marketplace for semen. Quite possibly, if studs “bought” the performance data, they would not share it openly with others in the industry, leading to proprietary genetic lines with no independent comparisons to genetic lines from other companies. Likely, there would be fewer players in the AI marketplace.

Another casualty of fewer production records or no reliable pedigree data may be dairy genetics research. Traditionally, research has been the last function served by DHI, after within-herd management and genetic evaluations. I have been in dairy genetics research for my entire professional career and I never recall paying a single dime directly to some provider for data. Colleges and Universities and the Cooperative Extension Service helped develop the DHI system, but its continuing evolution is increasingly removed from input from tax-supported institutions. Any claims that those of us in academia have been able to make as contributors to the records collection system and thus as part owners of the data is becoming increasingly tenuous. Dairy producers need to understand that records and research is essentially a closed system. If researchers had to pay for data, then research would not be done if the researchers could not pay the bill. Who would suffer? Not the researcher – he/she would simply opt to conduct investigations in an area where sufficient resources were available to support the work.

Research information, just like genetic evaluations, is not free and never has been. The dairy industry hasn't supported much of it directly through the years, opting to expect government to pay for it instead as part of a cheap food policy. That government support is declining. Research at the universities in this country is increasingly supported by private industry or by government funded research in human health issues. Consequently, the ambitious universities are either hyping their medical school or are seeking partnerships with institutions that have a medical school to hype! Industries that don't support R&D in some way are destined to stagnate. I hope dairy isn't such an industry, but the research dollars available to support studies such as genetic improvement of fertility in dairy cattle are fewer and farther between. The dollars that are available buy less than they used to.

Trends in Inbreeding

Make no mistake about it; dairy cows and bulls in AI are more closely related each year. It's a natural by-product of effective selection for a few traits within a breed. When parents are related, offspring are inbred. When offspring are inbred, at least some inbreeding depression takes place. Inbreeding depression costs about $24 in lifetime net income for each 1% increase in inbreeding in Holsteins – and that's just the cost for cows that survive to calve at least once. Many of the undesirable effects occur before a cow enters the milking string. Conception, calf survival, growth rates, and heifer fertility are all adversely affected by inbreeding.

One of the major impacts of increasing levels of inbreeding in the dairy breeds has been an increased attention to potential inbreeding in offspring prior to matings. Producers have some control of how much inbreeding occurs in their replacement heifers. They can assign mates in such a way that cow and sire are less related than they would be if inbreeding were ignored. The most extreme way to do that is to crossbreed. That way, the sire and dam are always unrelated as long as they come from different breeds. We have a separate discussion on crossbreeding at this conference, and I will refer the reader that paper and turn to control of inbreeding under a purebred mating program. Inbreeding control in purebred systems requires complete, accurate, and relatively deep pedigrees on both cow and potential mates. Good computer systems are needed to perform the computations. Many commercial herds will struggle to control inbreeding effectively because they won't have good pedigree data on their cows. Also, if a dairy producer is going to manage inbreeding, AI is absolutely necessary for a variety of pedigree choices and to individually mate cows. Very few commercial dairies would consider pedigree diversity when buying natural service bulls, and they certainly wouldn't pen mate individual cows even if certain herd bulls would generate less inbreeding.

The American Jersey Cattle Association recently released a computer-mating program that considers the impact of inbreeding on the genetic merit of calves born. This system checks both the amount of inbreeding a sire contributes to a mating and the genetic merit of the sire. A genetically superior sire that produces considerable inbreeding may be the best choice if the only alternative to avoid inbreeding is to use a much lower ranking bull. The AJCA system offers a way to use those pedigree records on registered stock. In today's market where just about any replacement heifer is worth quite a bit of money, the use of pedigree data for within herd mate assignment may be one of the best returns on investments in registration papers. The AJCA program is mentioned as an example of recent developments in mating programs, but it is not the only game in town. Several mating services now make mate assignments with inbreeding considered.

Selection for Lifetime Economic Merit

Perhaps the biggest change in genetic improvement programs in the last 10 years has been emphasis on total lifetime economic merit of the cow as a breeding objective. Prior to this shift, almost all emphasis was on production traits, udders, and feet and leg structure. We also bred cows to be bigger, though we now have evidence that we may not have may them more profitable in the process. The traits we changed were important to lifetime economic merit, but they weren't inclusive. We omitted some important performance measures, and changes are underway to mend our ways.

A better measure of lifetime economic merit would also include traits such as growth rates, fertility throughout life, and health costs, and survival. The trends underway today make more comprehensive use of what we know about cows after they calve for the first time than selection programs used to. The change began when USDA released an index called "Net Merit" in 1994, but that was really just a first step to encourage producers to make some use of the then new genetic evaluations for productive life (PL) and somatic cell score (SCS).

The big change came in August 2000, when a new version of Net Merit was released that really targeted lifetime performance. For instance, a bull may transmit genes for higher milk production than another bull, but his genetic evaluation for PL might be lower. Do his daughter produce more profit across their lifetimes if the superiority of production has fewer months of PL in which to generate income? The new Net Merit index considers just such interrelationships between important traits.

Table 1 shows the traits included in Net Merit, or its sister index for fluid milk markets, Fluid Merit, the relative emphasis given to each trait, and the genetic progress made in each trait compared to single trait selection for that trait. Notice that both type and production traits are included in this index. In fact, even more type traits are used than the ones that are shown, because linear type data is used to calculate genetic evaluations for PL on younger bulls with daughters still alive and producing milk. The genetic evaluation for PL carries information about all those linear type traits into the Net or Fluid Merit indexes.

Net Merit is an index designed for producers in many parts of the country whose milk is used for a combination of purposes, both fluid and manufacturing. The Fluid Merit index is designed specifically for dairies where almost all milk produced is sold directly for fluid milk purposes. Florida fits that description about as well as any state in the country. The real difference between Net and Fluid Merit is in the way genetic evaluations for protein are used. Producers have to buy and supply feed to the cow to produce protein, but in most fluid milk markets, it has no direct value. That is not the case in manufacturing milk markets, where multiple component pricing results in direct payments for protein. Table 1 shows that PTA Milk gets a small positive weight of 5% in Net Merit, but a much larger positive weight of 43% in Fluid Merit. PTA Protein receives a strong positive weight of 36% in Net Merit, but a slight negative weight of –12% in Fluid Merit. The weights given to the non-production traits are slightly larger (more different from zero) in Net Merit than in Fluid Merit because milk is less valuable in manufacturing milk markets than it is in fluid milk markets. Traits that reduce costs such as survival, lower cell counts, and better udders, are relative more valuable when milk prices are lower.

The last two columns in Table 1 show how much genetic progress will be made in the different traits compared to single trait selection. Production traits will continue to improve, but at slightly slower rates than if production were the only trait under selection pressure. The Merit indexes will also improve PL, but at about 60% of full speed. Changes in somatic cell score, size, udder composite, and feet and legs composites will be very small. Size, for instance, won't decline as the relative emphasis column suggests, but rather will stay almost constant. There will be slight improvement in both somatic cell score and feet and leg composite.

Table 1. Relative emphasis on the traits used to calculate Net Merit, Fluid Merit, and Cheese Merit.

	Relative emphasis on trait		Annual progress as a fraction of the maximum possible	
PTA for Trait	Net Merit	Fluid Merit	Net Merit	Fluid Merit
Milk	5	43	.814	.903
Fat	21	16	.819	.732
Protein	36	-12	.904	.827
Productive life	14	11	.591	.581
Somatic cell score	-9	-7	-.061	-.061
Size	-4	-3	-.003	-.003
Udder	7	5	.013	.012
Feet and legs	4	3	.083	.083

Be Careful About Thinking of Semen as a Commodity

Large herds expect salesmen to cut them a deal. Semen cost overwhelms sire selection for many large herds. The attitude seems to be that extra investment from higher-ranking sires can't be recovered in a large, commercial dairy herd. Perhaps the idea is that only smallish purebred dairies can get full benefit from those better genetics. Maybe the idea is that you shouldn't buy one unit of semen for $25, if you could by three or four units at the same price. That's "semen is a commodity" thinking. Bull to bull differences in genetic merit must be ignored to reach that conclusion. Interestingly enough, if herd management conditions provide plenty of high quality feed, decent freestalls or shade or other cow-comfort inputs, the daughters of high-ranking bulls return even more to the investment in semen than the bull proofs suggest. If you have a well-managed herd, good herd health, and high production, you can justify more investment in semen from high-ranking bulls than the herd that doesn't provide such a good environment.

The point here is that semen makes a pretty strange commodity. It can't even be compared to seed corn that produces a crop and then has to be replaced. Good genetics makes a permanent change in the productivity of the herd. It accumulates over generations in the dams of calves born. And it doesn't get flushed out of the barn like the remnants of the investment in soybean oil meal, which is a true commodity. It is tempting to try to bid semen strictly by the unit, but those units are variable in quality and therefore in value to the dairy business. The daughters of herd bulls, low ranking AI bulls, or the very best bulls available are not equally productive or profitable.

Large herds can expect a break on semen price if their purchases increase net returns to the semen provider. While seeking semen at the lowest price, dairy managers, even those who buy herd bulls from some other breeder, need to remember that profitable bull studs are important. Herd bulls are almost always sons of the better bulls in AI. If they weren't, their daughters would perform poorly enough for all to see. The casualty rates among bull studs have been high for many years, with lots of mergers increasing the size of surviving studs while reducing their number. This has been a necessary process to improve efficiency with which genetically superior semen is delivered to dairies. But we're now down to 5 major studs in the United States. How many fewer can the industry tolerate? We need enough capitol flowing into the AI industry to support the investment necessary to provide the products that all too many dairy producers take for granted. If semen really is a commodity (and the dairy industry will make that decision by how they buy semen), the AI industry will be forced to come up with cheaper ways to produce it. And the end product won't produce the results that users now accept as automatic.

Concluding Thoughts

Changes in the genetic improvement side of the dairy industry will continue as resources shift from small herds to large, from eastern dairies in humid areas of plentiful rainfall to western dairies in the high, dry, thin mountain air. One other resource shift worth watching is the "internationalization" of the genetic improvement business. Many of you already milk daughters of bulls bred and progeny tested in other countries. For years, the United States AI industry increased the size of its progeny test program using profits from semen exported from this country. Exports resulted in sales of some semen from top bulls overseas, but we also increase dramatically the market for semen from lower ranking bulls that US dairy producers really didn't need. Now several of our trading partners have invested enough in their own progeny test programs to produce all the semen they need from "lower tier" bulls.

I hear talk of studs reducing their sampling programs to cut costs. It costs $25,000 to $40,000 to progeny test a bull, and, when you cut the throats of 9 out of ten or even more, the investment per proven bull returned to service is enormous. If the market for "lower tier" bulls internationally declines (maybe "declines further" is a better expression), then the more of the true cost of progeny testing will be borne by the US dairy farmer. That means either higher semen costs or reduced genetic progress from smaller sampling programs. This is one of those issues where about all any of us can do is watch and wait. It does not seem reasonable, at least to me, to expect the international semen market to continue to support young sire sampling program where the best bulls are used in the US and the lower ranking bulls are marketed internationally. The dairy farmer, wherever their farm is located, most willing to pay the top dollar for top genetics will be the dairy farmer who makes the purchase.