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Outline for Dairy Sire Selection

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Dairy managers have two alternatives when they desire and need to replace the current milking herd with cows that have more potential for profit. They may buy better cows or breed better cows, the latter being more common. To produce replacements within the herd most successfully, dairy managers must produce the maximum number of heifers, reduce involuntary cow losses, and choose parents wisely. This guide covers bull selection.

Limitations

Two factors limit replacement of cows with more profitable offspring: (1) the number of replacements available and (2) the accuracy of choosing parents for these offspring.

Nature places limitations on the number of replacements. A cow has her first calf at two years of age; with a gestation period of 280 days and the need for a 52-day dry period, the cow has only one calf per year. These facts combine to produce a long generation interval. A long generation interval does not necessarily restrict progress, but it certainly slows down the rate.

Management, too, plays a role. In practice, the 12-month calving interval becomes more like 13 months. Of the heifers born, probably 15 percent or more die or fail to calve. This limits the number of replacements available and the number of unprofitable cows that can be culled. Management also affects the number of good cows lost each year due to infertility, disease, and accidents. Replacing these cows may use up most of the best replacements.

The other limiting factor is ability to choose parents for offspring. You must be able to choose parents whose offspring will be more profitable than the cows that are replaced.

Accuracy of Selection

Accuracy of selection and *heritability of milk production* have the same meaning. Frequently, heritability of milk production is blamed when herd management, often referred to as the environment, tends to mask the genetic difference between cows. But there is nothing complex or peculiar regarding the inheritance of the potential for high milk production.

Every animal receives one-half of its genes from each parent. The offspring is an average of the parents. The following data for a large population with and without selection illustrates the effects of accuracy or heritability.

Michigan has two large cow populations: one is the tested Dairy Herd Improvement (DHI) herd and the other the non-tested herds. Currently, the DHI herds average 14,200 pounds of milk, and the non-DHI herds average 11,000. Over time, the annual increase in DHI has been 200 pounds, with the non-DHI increasing at a slower rate. If herd management did not change and no selection of parents were made, then production would remain constant, forever. Production would not tend to decrease as some would think. In fact, decreasing production by selection would be as difficult as increasing production by selection. Thus, offspring must be an average of parents.

Suppose a decision were made to increase production by 1,000 pounds in both groups. This could be done by removing enough of the low-producing cows to move the average up 1,000 pounds. The bottom 30 percent of cows and their offspring would be culled, and with the continuation of random mating, both populations should increase 1,000 pounds. However, we do not get the increase expected from the selection. In the non-DHI herd, no change would occur because, without production records, accuracy of choosing the bottom 30 percent would be zero. Heritability of milk production under these conditions would be zero. In the DHI population, production would settle down at 14,400 or at a 200-pound increase. Heritability would be 20 percent since we selected for 1,000 and realized 200 pounds.

Cows are permanently different in potential ability to produce milk, due to genes inherited from parents. Temporary management, or environment, affects each lactation enough to at least partly mask the genetic difference among cows. In the example used, note that if selection had been done six months or a year later or earlier, different cows would have been culled. Ability to predict a cow's next record from the current one is approximately 50 percent. This value is referred to as *repeatability*.

Conclusion: If dairy managers are only 50 percent accurate in predicting the next record of a cow from the current record, they cannot expect to be this accurate when predicting what a daughter might do.

Improving Accuracy

How can you improve accuracy of selecting parents and speed up improvement?

Repeated records on the same cow tend to cancel out some of the environmental effects and should improve accuracy. Production records on the cow's parents improve accuracy. Information on other close relatives also improves accuracy of selection. This improvement, however, is most useful when selecting dams of bull calves. Cows kept for milking must also be used as dams of herd replacements.

Accuracy of choosing parents of bull calves should be the same as for heifers. Not many bull calves are needed; therefore, you can choose as parents those animals with complete pedigree information, thereby increasing accuracy of choosing parents.

By milking a bulls' daughters in sufficient numbers, you can approach 99 percent accuracy in predicting the performance of his future daughters. However, obtaining this degree of accuracy may be too costly in time and money. Strive for a balance that maximizes progress and profit.

A current solution to improve accuracy of selection is to use some less than 30 percent of the first service to a young bull and to strive for an accuracy provided by 20 to 50 daughters in 20 to 50 different herds, with testing completed before the bull is six years old.

Bulls to Sample

Not many young bulls can be sampled because of cost. Therefore, you should be as accurate as possible in the choice of parents for young bulls to be tested. Carefully plan matings to produce bulls for sampling.

Accuracy increases as information on the parents increases. Animals selected as parents of bulls should be those whose performance indicates they are genetically superior and whose records allow you to be reasonably sure they are superior.

Artificial breeding units have a distinct advantage in planned matings for bull calves. They have personnel devoting full time to locating the best females of the breed, and they have access to semen of all bulls that have proven to be outstanding. AI units also have an advantage in the sampling of a young bull. They can supervise semen collection, distribution to herds, and semen use to insure a reliable multiherd proof. A disadvantage is the risk and cost of storing large numbers of bulls while awaiting the sampling results.

The results of testing bulls to estimate performance of future daughters are given in Table 1.

When determining why two cows differ in the amount of milk produced, consider the genetics, the environment, and the amount of information available.

Sampling Results

				— Predicted Difference —			
Bull	No. Herds	No. Dams	% repeat-ability	Milk (lbs.)	%	Fat (lbs.)	$ Value
A	326	500	95	1,615	−.13	38	120
B	19	24	48	812	−.18	3	46
C	1	11	18	75	+.02	6	9

Genetics of Breeding

One-half of the inheritance comes from the sire and one-half from the dam. In bull proofs, we are only interested in the sire's contribution; the effects of the dam's contribution must be eliminated. The most accurate way to do this is to mate the bull to a random group of cows. Bulls sampled in AI are usually mated to 400 to 500 cows in 40 to 50 herds with little or no selection of mates. Thus, there's not much chance dams bias bull proofs.

A number of non-genetic factors affect each record of a cow in a similar manner and can be corrected or adjusted. These are:

- number of times milked daily,
- number of days milked,
- year of calving,
- season of calving,
- days open,
- region of calving.

Each record of every cow enrolled in DHI, regardless of days milked, is adjusted to a common base of: 2 x 305/region/season/mature equivalent.

The environmental influence is common to only one group of cows, and that is the herd in which the cow is milked. To compare cows milked in different herds, eliminate herd management by comparing each cow with all other herdmates of similar ages, calving in the same herd, year, and season. This procedure results in each record of every cow being expressed as a difference from daughters of other bulls.

Since all herds do not use the same bulls, nor the same quality of bulls, adjust for genetic difference among herds by including the breeding value of the sires of herdmates.

Three other non-genetic factors that affect a cow's records are mostly due to chance, and the effects should be cancelled by the number of daughters tested.

- Non-repeatability of records on the same cow results from the good and bad things that happen to a cow for a particular record. With large numbers of daughters of a bull and herdmates, the plus and minus effects cancel each other out.
- When each offspring receives a sample half of the parents' genes, by chance some will get a good sample, some a poor sample, but most will get an average. Twenty or more daughters will cancel these effects.
- Furthermore, the number of days a cow is pregnant during the first 305 days of lactation is important. There are accurate adjustments for days carried calf, but the information is not readily available on each cow. However, there shouldn't be any difference in the average days pregnant for a daughter of a bull and herdmates. This is important when selecting dams of bull calves.

A final problem is the limitation of information available, or reliability of our estimate. The reliability of the estimate of a bull's breeding value is determined by the number of herds in which the daughters are milked, the number of daughters, and the number of herdmates. These numbers are properly considered and expressed as a repeatability value. The least reliable estimate used is derived from 10 daughters in a single herd, which is 15 to 18 percent. The most reliable, of course, would be 99 percent, a value approached by 300 daughters in 300 herds.

Use of Proofs

There are five items of information in published sire proofs that can be used for selection. Each bull can be compared with other bulls on the bases of predicted difference (PD) for milk, butterfat test, fat, and dollar value. (Dollar value is derived from a combination of milk price and butterfat differential.) Bulls can be ranked on any of these items. The percent repeatability is your confidence factor when choosing one or more of the bulls available.

When selecting sires, use the best bulls available to you at the time you need to breed a cow or your herd. The best bull will be the highest ranking bull based on predicted difference (PD) for what you consider important: milk, butterfat test, fat, or dollar value.

You should expect the bulls' daughters to rank the same in your herd as the PD ranks the bulls. Level of production in your herd will not affect ranking. Repeatability reflects the amount of information available for estimating the PD. Information on a bull that includes daughters in 20 or more herds should not lead to many errors in the choice of bulls.

Summary

These management steps for selecting herd replacements will result in a highly satisfactory breeding program:

- Enroll the herd in DHI.
- Identify each animal by date of birth, sire, and dam.
- Keep heifer losses below 5 percent.
- Feed the herd for maximum profit.
- Keep involuntary cow losses to a minimum.
- Strive for a 365-day calving interval.
- Use up to 30 percent of your first services for sampling young bulls.
- Breed the balance of the herd to the highest PD bulls available.
- Replace poor cows with these heifers.

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