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Inbreeding: Effect on Milk Production Reduction

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A study of lactation records showed that inbreeding can result in a significant decrease in milk production over an entire lactation.

Inbreeding is the mating of individuals that have common ancestors in the pedigree. Interest in inbreeding has increased recently because the Artificial Insemination (A.I.) sires available in the major A.I. organizations tend to be from similar bloodlines, and the advent of super ovulation and cloning has increased the potential for sires to have ancestors in common.

Inbreeding can result in the offspring having a genetic abnormality. Many producers are familiar with results of an undesirable effect due to inbreeding dairy cattle. One of the most widely known is mulefoot. Although mulefoot is not common in the Holstein population, it took only one sire carrying the gene to result in many cases showing up in offspring.

It takes only two animals — a male and a female — carrying the gene to produce the abnormality; however, while there are perhaps many abnormalities in the dairy cattle population, the resulting problems are seldom seen in offspring because the incidence of the trait is so small that the opportunity for both parents to carry it is very small. If the incidence in the population is 1 percent then the probability of two carriers to mate is .01 x .01 or .0001, or 1 in 10 thousand matings. This is why we see very few abnormalities in all species of animals, including humans.

When dealing with quantitative traits that involve many genes influencing the offspring, such as production traits in dairy cattle, the results are not readily apparent. Milk production, for example, may only decrease by a few pounds — hardly a noticeable result when looked at as part of the total daily production. However, mating animals with a common ancestry can result in a significant decrease in milk production over an entire lactation.

This inbreeding study involved several hundred thousand lactation records used to estimate the amount of milk lost due to inbreeding. The estimates were calculated using sophisticated statistical procedures that allowed effects for differences in inbreeding to be quantified. The results are presented in *Table I*.

The table can be interpreted as differences in production from "no" inbreeding. There are essentially no differences in production until about 6 percent inbreeding is reached. From this point forward, decreases are significant. At 6.25 percent inbreeding which occurs, for example, from mating a sire with its great granddaughter, results in a decrease of 34 pounds whereas an 18.75 percent inbreeding results in an 852-pound loss in production. To avoid these inbreeding depressions, it is important to know the ancestry of both animals and the sire used.

The figures presented in *Table I* are not smooth — actual estimates show some inconsistency, which is expected when using field data. The general trend is what is important: As inbreeding increases, milk production decreases.

Table I. Milk production decreases as inbreeding increases.

Inbreeding Percentages	*Milk Production Loss*	*Inbreeding Percentages*	*Milk Production Loss*
1	+27	17	-883
2	+45	18	-883
3	+52	19	-834
3.125	+52	20	-736
4	+43	21	-611
5	+18	23	-377
6	-22	25	-326
6.25	-34	26	-424
7	-75	27	-609
8	-138	28	-872
9	-212	29	-1207
10	-294	30	-1606
11	-384	31	-2061
12	-480	32	-2566
12.5	-530	34	-3691
13	-581	36	-4921
14	-682	37.5	-5877
15	-772	38	-5877
16	-842	40	-7477

Two examples of inbreeding matings that can result in lower milk production are listed in *Table II*.

Table II. Common matings and the resulting inbreeding percentage, along with the resulting loss in milk production in pounds (from *Table I*).

Mating a bull to:	*Percent Inbreeding*	*Expected milk loss in pounds*
Its daughter	25%	-326
Its half sister	12.5%	-530

To avoid problems, it is important to plan matings so animals that have ancestors in common are not mated.

When using A.I. sires, it is easier to avoid inbreeding because the animal's ancestry is known. Problems arise more often when a dairy producer purchases a herd sire from someone who doesn't know the animal's history. Inbreeding can also become a problem when a sire is kept in a herd too long and eventually mates with its daughters. This is especially likely if the sire runs with the herd for an extended period.

It is important to keep track of the pedigrees on both sires and cows. If you don't, problems can show up in production traits and you'll run the risk of uncovering a serious genetic defect such as mulefoot.

The current amount of inbreeding in the Holstein breed is about 6 percent. Considering the number of A.I. sires that may have some common ancestry, this is not a large percentage. The two sires that account for a large portion of inbreeding are Pawanee Farm Arlinda Chief and Round Oak Ragapple Elevation. Both Chief and Elevation were the most heavily used to produce A.I. sires in the past. These two sires have been dead for a number of years but their influence on the pedigrees in the Holstein breed is still significant.

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