

## OPPORTUNITY IN SWINE BREEDING

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Necessity appears again to be the mother of invention. The number of animals with records is important in making genetic change in any biological population. Animal breeders working with species having low reproductive rates and long generation intervals and consequently few records have made better use of the few records than breeders working with more plastic species.

Dairy

Couple this with the fact that milk production is sex limited (only half the population can have records), and we must have respect for the dairy breeders who are making a genetic change per year of 1 to 2% in milk. They have capitalized on two things: a record system that is nationwide; and artificial insemination that does two things — allows adequate sire evaluation and the chance to exploit the bulls identified by test to be superior. These factors are synergistic, giving more than the simple sum. Records and AI produce researchable data that leads to better sire evaluation methods that can identify more accurately superior sires that in turn encourages the use of AI and record keeping even more. Over the years, dairy breeders have developed a nationwide breeding program that is extremely successful. Exploitation of heterosis among breeds is not economically important, so within breed selection of sires for increased milk production is the dairy selection program. The statistical procedures developed by dairy breeders for sire evaluation can be utilized by other livestock species, especially if they are modified to capitalize on the advantages offered by more prolific species and other traits measurable at younger ages on both sexes. The key to successful breeding on a nationwide basis is to have the selection units not confounded with factors such as herds. Dairy sires are used AI across herds of the breed. Males used in one herd are confounded with the herd effect. This is the source of the comment that many a sow herd has made the boar.

Beef

The beef industry has applied mixed model prediction procedures to sire evaluation following the lead of the dairy industry. The proud beef breeder learned about genetics in the 1950's by watching the dwarf gene devastate all that was pedigree breeding. A few "nuts" were performance testing, and some breeders were competing with the Charolais in central bull tests. By 1960, Performance Registry International had prodded the breed associations into having programs and giving them lip service. There were numerous state performance organizations. Order was given to beef performance by the Beef Improvement Federation in 1968. This was the time that importation of cattle breeds from the continent of Europe became possible through Canada. Use of AI by the beef industry can be attributed to the necessity created by the "exotics

In 1971, the guidelines for national sire evaluation were approved in BIF. The Simmental breed produced a sire summary that year. Designed sire evaluation programs were implemented in the British breeds, while field records were used for sire evaluation by the newly introduced breeds. By the late 1970's, the traditional beef breed associations realized that their reason for being was the bank of performance records, not the pedigrees. Attention to pedigree breeding waned with the printing of the three generation pedigree on the registration certificate in 1962. Nobody needed herdbooks to build impressive pedigrees.

By the early 1970's, several breeds were providing estimates of breeding values for growth and maternal performance on each animal of a breeding herd. The breeding value of an animal is an evaluation of the animal as a parent. This is just what breeding herds sell, the value of the animal as a parent in the herd of the buyer. Own performance and relative records were used in this breeding value estimation.

The sire listings from the designed sire evaluation programs from 1974 on became more important, especially with the relaxation of the AI rules. By 1980, field data sire evaluation reports were being published. The analysis of beef sire evaluation has used the mixed model prediction procedures developed for dairy. The base of comparison has been the reference sires, sires used in many herds.

The really exciting result from these analyses has been the linear genetic trends over time found in the British breeds from the mid-1960's to present. The genetic trend per year averages around 3 pounds for yearling weight, 2 pounds for pre-weaning growth, and no change in birth weight, in spite of the high correlation of birth weight with other weights. Over some two generations, or 14 years, a 50-pound change in the yearling weight of sires used in the breeds is impressive. The fact that independent breeders can do this in concert without any government is super. Such genetic trends do not come without their consequences.

The fact that the breed population is changing makes the simple methods of ranking animals for selection obsolete. Using ratio deviations calculated within contemporary groups is not satisfactory, since a ratio of an animal 5 years ago is not comparable with a ratio calculated for the current year. Therefore, the beef industry is poised on the threshold of animal evaluation that uses mixed-model prediction both within and over herds. The intent is to utilize own performance records as well as progeny records to evaluate animals. For growth traits measurable on both sexes, the progeny records can best be used as sibs of the sons of a sire. The shows still go on just as they do in dairy, but sound comparative evaluation of sires on traits of economic relevance is becoming the rule.

#### Purpose

The purpose of this paper is to consider the use of mixed-model prediction procedures in swine breeding. However, without records of performance on a breeding structure that is useful, such procedures and their use is academic. Thus, records and breeding structure are issues as well.

## Swine Example

All breeders know that the influence of environment in its total is large relative to the expression of genetic differences. This was the reason for the initiation of swine testing stations back in the late 1950's. That is, weaned pigs were brought together in one location, managed alike, and fed the same for a portion of their relevant commercial life. Comparisons among animals were then made where a reasonable fraction of the differences could be considered to be genetic. Breeders made good use of the testing stations. The back fat probe allowed boars to be selected on their own evaluation of fatness. Once muscling differences were exposed, the shows again played their role.

Today, one of the issues in swine breeding boils down to methods of making fair comparisons among animals such that the big environmental differences are circumvented. Rather than bringing animals to a common environment, consider the use of related individuals evaluated in different environments as a method of comparison among animals raised in different environments. Since related animals have a fraction of their genes in common or alike, they are expected to perform in a similar manner. Thus, breeders can use relative likeness to circumvent environmental differences caused by animals being in several different environments.

As an example, suppose six sows are mated to the same boar in both of two herds. The two sets of progeny from the boar provide a means of comparing the pigs born and raised in the two different herds. Data structure is the issue as is the method employed to make fair comparisons among animals.

Consider the simple example of a boar producing 40 pigs on each of two farms. The breeders also use another boar on their own farm and get 40 pigs each. The data structure for days to 230 pounds is as follows:

	Farm 1	Farm 2	Sire Averages
Sire 1 :	130	:	130
Sire 2 :		135	: 135
Sire C :	140	155	: 147.5
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Farm Average :	135	145	140

The performance of the pigs for days to 230 pounds differs on the two farms by 10 days, with the average being 140 days. We could rank the sires on the performance of their progeny as sire 1, sire 2, and sire C. But this is just not correct because sire 1 had his progeny in the best herd only and sire 2 had his in the poorer environment of farm 2. Only sire C has progeny on both farms. We can use this fact to fairly compare and rank all three sires.

Breeders always work with differences, never absolutes; so let us look at the four differences that constitute the data of our example.

	Farm 1	Farm 2	Sire Averages
Sire 1			-5
Sire 2		-10	-10
Sire C	+5	+10	+7.5
Farm Averages :	0	0	

When we look at the data from this perspective, we find that the sires rank differently. Sire 2, sire 1, and sire C is the ranking using the average deviations instead of the absolute averages of progeny performance. This ranking is the way the progeny values rank the sires. Sire 2 produces progeny with faster growth, since they get to 230 pounds in 5 fewer days than do progeny from sire 1. Now let us predict future performance of progeny from these sires. To do this we must regress the differences back toward the average, because the heritability is not perfect nor are the progeny numerous enough to give us perfect accuracy. The predictions of future performance of the sires are as follows:

Sire 1	-3.82
Sire 2	-7.64
Sire C	+6.50

Therefore, sire 2 would produce progeny taking  $7\frac{1}{2}$  days shorter time to reach 230 pounds than the average sire, while sire C would produce progeny taking  $6\frac{1}{2}$  days longer time to reach 230 pounds than the average sire. One would expect the difference between progeny from sire C and sire 2 to be some 14 days different in time to 230 pounds. The main point of this simple example is that it is possible to fairly compare animals producing in different environments if there are related individuals producing in the several environments. That is, the related individuals (progeny from the same sire in the example) act as the control, the check, or the means of comparison.

### Swine Situation

Just consider the possibilities of this sort of comparison used in swine breeding. A breeder could maintain a relatively isolated herd from the disease point of view, and if he used a few outside sires artificially he would have the opportunity to relate the performance of his herd to others of the breed using the progeny of common sires. If many sires could be ranked across herds in this way, the breeders owning the sires, which are products of their creative breeding programs could use the results to design better programs. If their sires were tops in their ranking of the boars, then to borrow money and exploit the superiority while doing some linebreeding to make the breeding values more predictable would not be too bad. If their sires were in the middle or toward the bottom of their ranking, at least the breeder knows where the germ plasm is that he needs to use.

Progeny of the same sire is only one relationship of many that could be used by swine breeders. It happens to be the one exploited by cattle breeders, because AI has increased the reproductive rate of the

male and the female rate is so low. In swine, the reproductive rate of the sow is such (two litters per year compared with .8 of a calf per year) that the opportunity to rank young pigs on their own performance and that of their close relatives (full and half sibs) is excellent. Sows having litters in adjacent seasons could tie seasons together in a herd.

Carlson (1980) has used a mixed-model procedure to rank boars over testing stations. This was done using own performance records and the relationship of every boar to every other boar in the stations that season and several previous seasons. The relationship ties created the links between the stations that allowed fair comparisons among all boars tested in a season. Problems arise using such a procedure, since the starting dates and sales are staggered in time, and only after all the data is in could such predictions of future progeny performance using own performance records be made. Fair comparisons among large numbers are possible using such prediction procedures.

The swine industry has some real problems to solve in order to use the procedures employed in both dairy and beef breeding today. The problems all come down to just who are going to become the swine breeders of tomorrow.

No question exists concerning the use of genetic groups to cross in the production of the sow herd or the market animal. Both heterosis and complementarity are used today in market hog production. Fair comparisons among breeds and breed crosses will need continued update so that producers can select the combination that best turns their resources into a profit. Within pedigree isolate or breed selection of parents is the only directional force available to any breeder to make genetic change. Here is the area where accurate predictions of the value of an animal as a parent can be put to use. Selection of superior individuals by the producer will result in improved production, as will the use of the best cross combination.

Because beef breeds are useful in commercial crossbreeding, national sire evaluation programs are conducted within each breed using the data accumulated from their performance programs. This does several things. First, it helps the associations have a real reason for being, and for pedigree isolates to be available for use in commercial crossing requires an organization with loyalties and so on. Second, each breed can emphasize the improvement of traits that will enhance the relevance of the breed to commercial production. The British breeds are still working on improved growth, while the Simmental breed stresses the evaluation of calving ease and other traits that will lead to its adaptation to U.S. beef production. When breeds collect the records and process them for use, they tend to get used more than if some government group did the same service for all breeds. In part, this is the reason in beef that we have had such rapid utilization of breeding technology.

The possible use of swine breed associations and the loyalties already present, assumes that the member breeders really want to be swine breeders in this age of technology and record keeping. Just having interest enough to drag high selected animals around to shows will not

get the job done today. Collecting records from many herds is imperative, as well as the use of animals across herds. This takes a degree of cooperation among association members. Possibly being a real swine breeder is just not that important in the scheme of things for most farmers in the cornbelt.

The reproductive potential of swine is such that breeding companies have developed. Such organizations have created proprietary genetic groups and merchandized the cross after multiplication. These companies can use the prediction procedures in their elite breeding herds to make more effective use of their detailed record keeping. Use of relationship ties can be very useful to link the several elite herds maintained in case of disease problems.

### Summary

Dairy breeders and now beef breeders are making use of mixed-model prediction procedures to evaluate sires in particular so that selection among them can be more effective. Beef breeders with sires evaluated in fair comparisons now can design creative breeding programs in which sires can be selected from among those of an entire breed. Because of the documented genetic trend for growth found in beef breeds, breeders will soon have the opportunity to rank animals across herds on their own performance and that of their sibs through the use of mixed-model prediction procedures. Bringing animals together to control environmental differences will be a thing of the past in beef breeding.

Swine breeders have made good use of boar testing stations in the past, especially in the early years when the backfat probe was in vogue. If artificial insemination can be perfected, this increase in the reproductive potential of the boar can do three things for swine breeders. First, breeders can with a little cooperation adequately evaluate a population of young boars each season. Second, the use of boars over herds will provide relationship ties such that own performance records within herds can be fairly compared across herds, thus providing a means to select young boars to be evaluated sequentially on their progeny performance over herds. And third, the opportunity exists to exploit the superior germ plasm once it has been recognized through AI. These three things are synergistic. One stimulates the other. Further, the opportunity exists to evaluate maternal traits of young boars using the female relative information.

All this record analysis using the latest mixed-model prediction procedures adapted to capitalize on the reproductive advantage of swine presupposes a data base generated from many herds of a breed. Without record keeping on the individual farm and a structure to collect and process it, the rest is but a pipe dream. The fact that swine breeders can achieve fast generation turnover and thus rapid rates of genetic change just will not be exploited. Real opportunity exists; use it!

### Literature

Carlson, J. P., II. 1980. A comparison of procedures to evaluate centrally tested boars. Ph.D. Thesis, Iowa State University, Ames.