THE GENETICS OF LEAN GROWTH

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Introduction

In recent years, the pork industry has faced numerous challenges. As consumer resistance to fatter meats has increased, the industry has had two options, 1) argue against popular opinion that fat consumption posed a health risk or 2) strive to reduce the fatness of their products. Since the first option is highly unlikely, the NPPC and commodity leaders have moved rapidly, decisively, and aggressively to promote and reposition pork as a vital, healthful part of the U.S. diet.

Pork consumption from 1965 to 1985 was reasonably stable (1965, 45 lb; 1985, 44.2 lb). Demand has been stable to declining in recent years. However, Glenn Grimes, University of Missouri economist, says pork consumption increased about 3% last year, despite higher prices and stiff competition. Certainly, pork producers can be proud of what has been accomplished, but to be certain that pork remains competitive, progress must be made in reducing fatness of the pork carcass. Additional concerns for the industry are uniformity of the product, convenience for the consumer, and price competitiveness. New buying systems encourage production of lean, uniform lots of market hogs, often at heavier weights than in previous years. For many producers, this may require a change in breeding and production systems.

(Key Words: Genetic Selection, Carcass Leanness, Lean Growth, Pig.)

Basic Genetic Principles

Genetic improvement in swine depends on the interrelationship of selection differential, heritability of traits, and number of traits selected for. Selection differential, sometimes referred to as reach, can be defined as the difference between the selected individuals and the average for the herd from which they are selected. Obviously, the greater the performance of the selected boars or gilts, the greater the genetic gains. Producer limitations on the amount of reach or selection differential include 1) amount of money available, 2) number of superior boars available, and 3) accuracy of identification of superior seedstock.

Heritability estimates for various traits are listed in Table 1. The heritability estimate is a measure of the proportion of a trait that is passed from one generation to another. Every animal performs at a given level because of a combination of genetic and environmental factors. The higher the heritability, the greater the effect of genetics and the lesser the effect of environment on expressed performance. For instance, litter size is lowly heritable and highly controlled by environmental variables, such as nutrition of the sow herd, boar power, temperature, housing, etc. On the other hand, carcass traits, such as backfat thickness and loin eye area, are considered highly heritable. For these traits, like produces like. Lean boars sire

lean market hogs. These traits offer the greatest potential to improve by genetic selection. Producers of the 1960's remember the days of ultra-lean, heavily muscled hogs. If incentive to increase muscling and improve leanness is great enough, producers can rapidly change carcass traits. Selection for extremes in leanness may result in reductions in performance or reproductive efficiency.

An additional factor that influences genetic improvement in swine is the number of traits selected for by the producer. Single trait selection results in the greatest improvement in any given trait. However, if we look at the total production picture, this means of selection may be detrimental to profitability of the swine operation.

Table 1. Heritability of Swine Traits

Trait	Heritability estimate
ADG	.30
Days to 230	.25
F/G	.30
Feed intake	.24
Backfat	.41
Length	.56
% Lean	.48
Loin eye area	.48

Source: NC-103.

Most producers feel we need to improve the quality of our product. Progress will be slow because, in order to remain profitable, we must also select for reproductive and performance traits. One avenue that allows improvement in numerous traits is genetic correlation.

Genetic correlations for several swine traits are listed in Table 2. To understand these numbers, we must first define the concept of correlation. A correlation is a statistical term that measures the relationship between two variables and has a range of −1 to +1. A correlation of +1 is considered "perfect" and indicates that an increase in one variable is associated with a predictable increase in a second variable. Correlations can also be negative, indicating that an increase in the first variable dictates a decrease in the second variable. A correlation of 0 is no correlation. In other words, no relationship exists between variables. Generally, correlations have intermediate values or intermediate degrees of relationships between traits.

Knowledge of genetic correlation is important because it allows us to use information on one trait to predict performance for another trait. For example, if we reduce 10th rib fat we can drastically improve percent lean in the carcass because of a genetic correlation of −.87. Genetic correlation often affects the results of selection. If two traits are genetically correlated, selection for one will cause change in the other, sometimes beneficially, but at other times detrimentally.

It is often said that we can't know where we are going unless we know where we've been. Few data are available on the fatness or leanness of the population past or present. A recent study by the NPPC has tried to determine the fatness of the swine population. Over 500,000 carcasses were sampled, and the average 10th rib backfat is shown in Table 3.

Table 2. Genetic Correlations between Growth and Carcass Characters

Item	10th rib fat depth	Loin eye area	Percentage lean	Length
Average daily gain	.21	−.10	−.15	.10
Days to 230 lb	−.18	.05	.10	−.10
Backfat	.94	−.35	−.85	−.28
Lb feed/lb gain	.31	−.35	−.43	−.07
Average feed intake	.45	−.40	−.25	NA

Source: NC-103.

Comparing USDA data from 1968, 1976, and 1980, we see an increase in the percentage of hogs grading U.S. number 1 and apparently considerable reduction in backfat thickness. However, the general perception of the public and producers has been that pork still needs to be leaner.

Table 3. Average 10th Rib Backfat Readings Taken from Five Packing Plants[ab]

Plant	10th rib fat depth, in.	SD
1	.94	± 6
2	1.02	± 6.9
3	1.04	± 6.8
4	.96	± 6.1
5	1.04	± 6.4

Meeker NPPC, 1989.
[a]Measures taken with lean meter.
[b]Carcass wt range 130 to 210 lb.

Several experiments have been conducted to measure success of lean growth selection. Five generations of selection for increased lean growth rate were completed at the University of Nebraska. The boars and gilts were selected for gain and backfat thickness. Barrows from the control and selected lines were evaluated and the results are presented in Table 4.

Selection decreased fat growth rate by 9.1% and improved lean growth rate by 19.8%. The most significant change is the 18.0% improvement in lean tissue conversion. These data indicate that selection can be effective in improving growth and carcass traits.

With understanding of genetic principles and the right seedstock, producers can rapidly change the carcass composition of their market hogs. The lack of improvement can be attributed to several factors, including:

Table 4. **Performance and Carcass Characteristics of Select and Control Line Barrows**

Trait	Select Line	Control Line	Difference, % of control
Average daily gain, lb	1.707	1.55	+9.7
Backfat	.98	1.18	−17.0
Feed/gain	3.18	3.44	−7.6
Carcass lean gain/d, lb	.61	.51	+19.8
Carcass fat gain/d, lb	.34	.37	−9.1
Feed/carcass lean gain	8.83	10.77	−18.0

1. lack of adequate financial reward for leaner, heavier muscled hogs;
2. greater concern for noncarcass traits such as reproductive efficiency;
3. lack of genetically superior seedstock at a reasonable price;
4. fear of return to PSS, PSE, and production problems of the 60's;
5. selection for fads, trends, or noneconomically important traits.

Pork producers should produce what consumers want. Unfortunately, producers don't have a direct line to consumers' wishes or desires. The packer and retailer play a much larger role in producer feedback. Theoretically, if the consumer wants leaner products, this should be reflected in price incentives to the producers of lean, heavily muscled hogs. The total dollars spent on hogs will probably not go up, but rewards for good hogs and discounts for poor hogs will undoubtedly increase in the future.

The future will see improvements in measuring leanness at slaughter; higher incentives for lean pork production; and a sound selection program that emphasizes carcass meat, growth, and efficiency, while maintaining reproductive efficiency. These things can and will play a major role in meeting the challenge of lean pork for the 90's.