

from its amino acid composition. Assuming one mole of methionine per mole of protein, a value of 8,782.7 is attained. If 7 methionine residues were present per molecule of G-actin, the molecular weight would be about 61,479. If molecular weight is computed in terms of tyrosine residues, the result is about 60,781. Partially supported by Market Quality Research Division, ARS, USDA, Cooperative Agreement 12-14-100-9348 (51).

Swine

Selection For Crossing Ability In Swine

I. T. Omtvedt

The basic objective of Project 808 is to study the feasibility of selecting purebreds on the basis of their ability to cross. Sow productivity traits generally exhibit considerable hybrid vigor in crossbreeding studies, but unfortunately, these traits are lowly heritable and show very little response to direct selection. The hybrid vigor obtained in crossbreeding is "one-shot improvement" and breeders cannot expect to obtain increased performance due to additional heterotic response each generation. In this project an effort is made to make continued improvement in two-breed crossbred gilts by selecting the two parent lines on the basis of their crossing ability. The basic procedure is to select the Duroc and Beltsville boars and gilts for breeding on the basis of their Duroc-Beltsville crossbred half-sisters' productivity (litter size and 21-day weight).

The project is currently in the sixth generation of selection. Productivity of the crossbreds has been very desirable but continual improvement in the crossbreds over the controls each generation is not readily apparent at this time. This procedure is widely used in plant breeding and research with laboratory organisms indicated that it may have application in swine breeding, but results to date are not very encouraging. This project will be phased out at the end of sixth generation.

The project is currently in the sixth and final generation of selection. The productivity of the Duroc-Beltsville No. 1 crossbred gilts compared to the productivity of the control line gilts will be used to evaluate the effectiveness of selection for crossing ability. An analysis of the control line data from 1961 to 1970 showed that performance and productivity

for this line remained relatively stable during the course of this experiment so should be a valid basis for comparing possible improvement in the selected lines. Preliminary analyses of the records do not reveal any steady divergence in productivity of the 2-line cross from the control live gilts. In the sixth generation, the selected line farrowed larger litters (10.5 vs. 10.1) of heavier pigs (2.6 lb. vs. 2.2 lb.) but the differences in litter size at 21 days were relatively small (8.8 vs. 8.7). The average pig 21-day weight was 11.6 lbs. for the crossbreds compared to 10.5 lbs. for the controls.

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Genetic Evaluation Of Purebred And Crossbred Performance Of Duroc, Hampshire And Yorkshire Swine

I. T. Omtvedt

The fact that approximately 90 percent of the pigs marketed in the U.S. today are estimated to be of crossbred origin indicates that swine producers recognize the benefits of crossing. The two basic reasons for crossing are:

1. To obtain hybrid vigor or heterosis.
2. To combine the strong points of the different breeds.

Much of the crossbreeding research with swine has been conducted at Oklahoma and the general response expected for most traits has been established. In general, crossbred sows farrow and raise larger litters than

the average for the breeds making up the cross. In addition to crossbred pigs being more rugged and having greater livability, they are heavier at weaning and gain faster during the postweaning period thus resulting in their reaching market weight at an earlier age. No consistent advantage of crossbreds over purebreds for either feed required per unit of gain or carcass merit has been demonstrated.

Even though the general results expected from crossings are known, data on specific crosses and crossing sequences that will yield maximum performance in a breeding program are not available. Most of the early investigations involved inbred lines and breeding stock typical of that time under management conditions quite different from those recommended today. Breed differences in productivity, growing ability and carcass merit are known to exist, but how to best combine the breeds to obtain maximum overall performance is not known. How important is maternal influence? In a 2-breed cross, does pig performance vary depending on which breed is used as the sire and which breed is used as the dam? In a 3-breed cross, which breed combinations make the best female and which combinations result in best overall performance? These are very important questions to a swine producer when he lays out his crossbreeding program.

In an effort to answer these questions and to re-evaluate the response expected from crossbreeding using modern-type breeding stocks, project 1444 was initiated to evaluate the combining ability of the Duroc, Hampshire and Yorkshire breeds in 2-breed and 3-breed crosses.

Three purebred herds were established at the Experimental Swine Farm at Stillwater to provide the seedstock for this project. In Phase I purebreds are compared to the 2-breed crosses while in Phase II the productivity of crossbred gilts and purebred gilts from Phase I are evaluated in 3-breed and 2-breed crosses. Phase II involves 135 matings and Phase III 144 matings during each 6 month period. One-third of gilts in each group will be slaughtered one month after breeding to determine ovulation rate and embryo survival. Sow productivity will be evaluated at birth, 21 days and 42 days. Postweaning growth rate, feed efficiency, probe back-fat thickness and carcass data will also be obtained.

Results not yet available. The first pigs for this project were produced at Stillwater between February 24 and April 20, 1970 and consisted of 21 Duroc litters, 25 Hamp litters and 25 York litters. From these litters, 45 gilts and 5 boars from each of the 3 breeds served as the seedstock for Phase II at Ft. Reno. In November, each of these 15 boars were mated to 3 gilts of their own breed and 3 gilts from each of the other 2 breeds. Fifteen gilts from each breed (one gilt from each mating type for each boar) are being sacrificed 25 days postbreeding to evaluate ovulation rate and early embryo survival. The other 30 gilts of each breed will be carried

full term to produce the seedstock for Phase III. In 1970 fall, 24 Duroc litters, 28 Hamp litters and 23 York litters were farrowed at Stillwater and pigs from these litters will be mated at Ft. Reno in 1971 spring to serve as the second replication of Phase II. New boars are continuously being introduced into the 3 foundation herds at Stillwater to maintain a broad genetic base for each breed.

The Effect Of Ration Ingredient Change On Pig Performance

W. G. Luce and C. V. Maxwell

One trial was conducted involving sixty-four growing-finishing swine to measure the effect of ration ingredient change.

Treatments involved were: (1) A basal milo-soybean meal ration fed throughout the trial; (2) The cereal grain portion of the rations (milo, corn and wheat) was rotated every 7 days; (3) The protein source (all soybean meal, $\frac{1}{3}$ meat and bone scraps and $\frac{2}{3}$ soybean meal, and $\frac{1}{3}$ peanut meal and $\frac{2}{3}$ soybean meal) were rotated every 7 days; (4) Both the cereal grain and protein sources, as outlined in treatments 2 and 3, were rotated every 7 days (9 different combinations). Average daily gains, average daily feed intake, and feed efficiency were similar for all treatments.

The data is presently being further analyzed. Another trial is also being planned at a later date.

The Effect Of Temperature And Humidity Upon The Performance Of Growing Swine

R. A. Battaglia

The first replicate of a study to determine the effects of adverse environmental conditions upon "doing ability" in growing swine has been completed.

Six gilts, averaging 40 pounds in weight were allotted, three each, to either a 90 degree F. group or to a 70 degree F. group. The relative humidity was held constant in the 45-50 percent range. The replicate lasted for 28 days, during which time the gilts were maintained in the environmental chambers on the Stillwater campus. Floor space allotment was 6.8 square feet per animal, with one half of each of the floor area being expanded-metal and plywood. Feed and water was available *ad libitum*. Rectal temperatures and respirations rates were taken at 6 a.m. and 6 p.m. daily.

Results for the cool (70 degree F) group and hot (90 degree F) group respectively are as follows: rectal temperature, 102.7 vs. 103.5; respiration rate, 27 per minute vs. 75 per minute; daily feed consumption, 3.5 pounds vs. 2.6 lb; average daily gain, 1.59 lb. vs. 1.16 lb.; total gain for 28 days, 44.7 lb. vs. 32.5 lb.; water consumption 3.5 qt. vs. 4.6 qt. All figures, where applicable, are group averages for 28 days.

It is the purpose of this study not only to demonstrate differences such as those listed above but also to elucidate what physiological phenomena are responsible for these differences. With this in mind, histological preparations are being made of the appropriate endocrine glands from one gilt taken from each group at the completion of the study.

Nutrient Requirements For Artificially Reared Young Pigs

C. V. Maxwell, James A. Coalson and J. C. Hillier

Ninety-one baby pigs, obtained by caesarean section on the 113th day of gestation, were used to perfect artificial rearing techniques in a total of five trials. Each pig was placed in a sterile cardboard incubator equipped with a metal feeding tray and was provided with a constant supply of heated, sterilized air. Pigs were fed five times daily beginning at 6:00 a.m. and terminating at 10:00 p.m.

The diet was 21 percent milk solids fortified with minerals and vitamins. Feeding was accomplished with the use of a 50 cc plastic syringe equipped with a 12 gauge needle. The needle was inserted through a rubber stopper to place the diet in the metal feeding tray. The initial amount of feed was 30 milliliters. This was increased by 5 ml. at each successive feeding provided the diet had been consumed within 30 min-

utes. Percent survival ranged from 83 to 100 percent for the different trials with an average survival rate of 90 percent.

Total gains for the 21 day period ranged from 8.72 pounds to 10.83 pounds with an overall average gain of 9.21 pounds. Efficiency of gain as measured by pounds of dry matter intake per pound of gain ranged from 0.76 to 1.15 for the five trials. The gains obtained with this artificial rearing system were comparable to those obtained under normal rearing conditions.

In a separate study, the sows used in the above surgical procedures were rebred after 2 estrus cycles following surgery and allowed to go to term. The six Yorkshire and six Hampshire sows farrowed an average of 8.5 and 9.5 live pigs, respectively. Five stillborn pigs occurred in two of the Yorkshire litters. For this same time period, 23 Yorkshire and Hampshire sows in the University herd farrowed litter averages of 9.9 and 9.3 live pigs, respectively. Caesarean section surgery had no apparent effect on the rebreeding and subsequent litter size of the 12 sows used in this study.

Publications

The following articles were published from this project during the past year:

- Coalson, J. A., C. V. Maxwell, E. C. Nelson and J. C. Hillier. 1970. Studies of the Ca and P requirements of young SPF pigs. *J. Animal Sci.* 31:198 (Abstract).
- Coalson, J. A., J. C. Hillier, R. D. Washam, E. C. Nelson and C. V. Maxwell. 1970. Calcium and phosphorus studies with young pigs. *Okla. Agr. Exp. Sta. Mp-34:65.*
- Maxwell, C. V. 1970. Calcium requirements for young pigs. *Proceedings of the 12th Annual State Swine Short Course, Stillwater, Oklahoma.* Page 28.
- Coalson, J. A., I. L. Anderson, C. V. Maxwell and J. C. Hillier. 1971. Effect of Caesarean surgery on sow performance. *J. Animal Sci.* 32:375. (Abstract)
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The Effect Of Protein And Amino Acid Nutrition On The Reproductive Performance Of Sows And Gilts

C. V. Maxwell

A total of 30 Yorkshire gilts were fed diets containing 8, 14 or 20 percent crude protein from 135 days of age until they were slaughtered at 28 days post coitum. These diets were fed at the rate of 5 pounds per head per day from 135 to 180 days of age and 4 pounds per gilt per day after 180 days of age. Constant amino acid ratios were maintained by diluting the 20 percent protein diet with cornstarch.

A higher weight gain was noted for each increase in level of crude protein. Gilts fed the high and low levels of protein showed increased age at puberty. No differences were noted in the number of corpora lutea present at 28 days post coitum. There was, however, a decrease in the number of embryo observed as the level of protein was decreased. Percent embryo survival decreased from 93.4 percent in pigs fed the high level of protein to 79.2 percent in pigs fed the low level of protein.

Publications:

- Maxwell, C. V. 1970. The effect of protein and amino acid nutrition on the reproductive performance of gilts. Proceedings of 12th Annual State Swine Short Course, Stillwater, Oklahoma. Page 16.
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Effects of High Ambient Temperatures On Sow Reproductive Performance

I. T. Omtvedt, E. J. Turman and D. F. Stephens

Two trials involving a total of 126 gilts were conducted to investigate the effect of high ambient temperatures immediately following breeding, during second week postbreeding, during midpregnancy and during late pregnancy on the reproductive performance of first-litter gilts. Although exposure to heat stress during the first and second weeks postbreeding resulted in fewer viable embryos at 30-days postbreeding, exposure during the second week had the greatest adverse affect on embryo survival.

Productivity of gilts subjected to either the control chamber or hot chamber during midpregnancy was comparable to those maintained outside full term. Pronounced adverse effects of high ambient temperatures were noted during late pregnancy. Gilts subjected to the hot chamber in late pregnancy farrowed fewer live pigs and more stillborn pigs. There was a trend for pigs from heat-stressed gilts to be lighter at birth but these differences were not significant. Results indicate that high ambient temperatures have an adverse effect on sow productivity during early and late pregnancy with gilts being more resistant to this stress in midpregnancy.

Another trial involving 60 crossbred gilts was initiated to evaluate the influence of heat stress during estrus. The gilts were confined to the environmental chambers on the 15th day after being observed through at least two normal estrous cycles. The hot chamber was maintained at 96°F for 8 hours and reduced to 90°F for the remaining 16 hours during each 24 hour period with the control chamber maintained at 74°F continuously. Ten gilts maintained in each chamber were slaughtered between 53 to 69 hours after first service to evaluate fertilization rates and the other 20 gilts allotted to each chamber were slaughtered 25 days after breeding to evaluate early embryo survival.

The hot chamber gilts were transferred to the control chamber two days after breeding and maintained with the control chamber gilts until they were slaughtered 25 days postbreeding. Although the data are being analyzed at the present time, it appears that heat stress prior to and during estrus caused no sizeable adverse affects on either ovulation rate or embryo survival.

Publications:

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