EFFECTS OF BREEDING ON CARCASS TRAITS

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I shall attempt to present a brief sketch of differences in a few of the carcass traits which appear to reflect differences between groups of hogs differing only in breeding. These have been produced, slaughtered and studied in projects of the Regional Swine Breeding Laboratory.

It should be understood that the carcass comparisons are based on samples of hogs from various breeding groups in the projects. Some of the observations were made in a Meats Laboratory at the stations, and others were made in packing plants on stock submitted for sale with that privilege extended by the packer. I shall present my story for each project separately, in alphabetical order.

Two groups of Hampshire in the Illinois project during the last 2 years show interesting differences. At the same slaughter weight -- 220 pounds, the two groups differed by 2 per cent in dressing percentage, .5 inch in length, .1 inch in back fat, .6 as percentage of live weight in primal cuts, 3.75 as percentage of carcass weightin the 4 lean cuts. One group was composed of 3-line crosses, the other was an outbred group of Production Registry stock. Carcass results for the 2 years were in favor of the 3-line crosses except for dressing per cent.

Nine breeding groups were compared in the Indiana project in 1950. Slaughter weights were as near the same as could be obtained practically, means ranged from 211 to 228 pounds. Dressing per cent varied from 68.3 to 72.9 (packing house); carcass length varied from 28.7 to 30.5 inches; average back fat thickness ranged from 1.3 to 2.0 inches; percentage of carcass weight in the five principal cuts varied from 63.7 to 66.

Five of the groups had the same line of dam (Chester White-White King line), 3 others had dams of similar breeding (WK-Wis. Sta. Chester White), the other group was a crossbred control (non-inbred Poland x Chester White). Boars used included Nebraska Duroc; Landroc; Landrace-Large Black; Minn. Poland China; Outbred Duroc; and Outbred Poland China. Mean weights at 5 months ranged from 153 to 183 pounds. The group which produced the fattest carcasses averaged 156 pounds at 5 months, and the leanest carcasses were in a group that averaged 177 pounds at that age.

Eleven different breeding groups in the Indiana project in 1951 produced a little more range of differences than those in 1950. The fattest group was of the same breeding for each year. Four of the 11 groups were by Duroc boars, but the dams differed in breeding. These four groups averaged from 2 to 2.2 inches of back fat for live weights of 216-221 pounds. Length of these groups ranged from 29 to 30.1 inches. The best carcasses were from the group out of White King sows and sired by Yorkshire, Berkshire and Missouri station Poland China boars.

1/ Acknowledgement of cooperation is made to stations cooperating in the Regional Swine Breeding Lab. (Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota and Wisconsin), and to project leaders under whose leadership data were obtained.

In the Iowa project results from inbred lines of Poland China, a line of Landrace and crosses of Poland x Landrace reveal consistent differences in carcass traits through a period of 15 years. Selections were based on performance. Type seemingly did not change during the 15 year period. Numbers for each group are fairly large, the total number exceeded 1000 carcasses including the spring of 1950. Weights at slaughter averaged near 220 pounds. During that period the Poland China exceeded the Landrace in dressing percentage approximately 1.6 points; the crosses were about midway between the parent groups. Yields of the 5 principal cuts as percentage of live weight was consistently about .5 points in favor of the Polands 48.6-48.1) except for those slaughtered at 200-210 pounds, the Landrace was ahead for these. Likewise the percentage of live weight in the 4 lean cuts was about 1 point in favor of the Polands (39.2-38.2). Length of carcasses averaged approximately 29.3 and 29.5, and back fat 1.4 and 1.43 inches for Polands and Landrace respectively. Crosses were approximately intermediate in regard to each of the traits. Yield of belly was about .5 percentage point in favor of the Landrace.

During the last 3 years the breeding groups included progeny out of Poland-Landrace and cross line Poland China sows, and by boars of lines of different breeds from other stations. Some changes in procedures were made in the Meat Laboratory. Hams and shoulders were skinned and trimmed closely, less fat was left on loins than in former years. In 1952 hogs were dressed with heads off. Weights at slaughter averaged approximately 206 pounds.

Ranges in means of items measured and yields were: length 28.2-31.1 inches, thickness of back fat 1.2-1.97 inches, dressing per cent 75.4-82.8, primal cuts 42.6-47.6 per cent of live weight, and the 4 lean cuts 42.9-49.3 per cent of carcass weight. The two groups with the highest over-all rating in the same season were cross line Poland China (Iowa lines), and Poland-Landrace crosses (Iowa lines). The Poland group averaged approximately 29.5 and 1.45 inches for length and back fat respectively; the Poland-Landrace group averaged 31.0 and 1.3 inches for length and back fat. Yields were approximately: dressing per cent 81.3, 79.0 (heads on), primal cuts 47.6, 47.0 per cent of the live weight, 4 lean cuts 46.1 and 47 per cent of carcass weight for the Polands and Poland-Landrace respectively.

Records of carcasses from 741 hogs of 50 different breeding groups have been studied in detail in the Minnesota project and published (Minn. Tech. Bul. 195, 1951). More than 40 of these groups were of the inbred lines of Poland China, the Minn. No. 1, the Minn. No. 2, and combinations of crosses between the Poland lines and the 2 new breeds. Other groups were composed of purebreds of breeds in the University swine herd, a group from a farm where a Minn. No. 1 boar had been used for the last cross, and groups selected from the market run of hogs on certain occasions when hogs were submitted from the project to a packer for slaughter and carcass study. Differences due to breeding were evident between the various groups, with respect to yield of the principal cuts, yield of individual cuts, degree of fatness, and items of carcasses measured.

Records were adjusted to approximately 217 pounds live weight and 150 pounds carcass weight. Carcass length averages ranged from 28.7-31.7 inches, back fat averages ranged from 1.27-1.85 inches, percentage of carcass weight in the 5 principal cuts averaged from 67.64-71.78. The fattest groups were purebred Duroc and Chester White. The longest groups were Minn. No. 2 and Minn. No. 1 and the leanest group was Minn. No. 2. Although carcasses

from the various inbred lines were good, the best carcasses from an over-all rating were from crosses of two or more of the lines. That is the usual result in all of the breeding projects.

In the Minnesota project a trial was conducted in which feed was restricted to a different degree in 3 lots of similar breeding during the fattening period to market weight in comparison to a full-fed lot. The results brought out that composition of the carcasses was definitely altered by different levels of feeding. In order for noninbred hogs used in the trial to make yields of the 5 primal cuts, and of fat cuts comparable to those of the best performing crosses, it was necessary to restrict their feed intake to 3 per cent of their body weight and the feeding period was prolonged considerably.

Definite differences between carcasses of breeding groups involving Poland China, Landrace, Hampshire, and Duroc inbred lines and crosses between the lines have been obtained in the Missouri project. But I do not have a summary on these. During several seasons a scheme has been used in the Missouri project for appraising the carcasses on a basis of loin equivalent. Seemingly this scheme reflects definite differences between individual carcasses.

Carcass records have not been obtained for some time in the Nebraska project, because facilities have not been available for that purpose.

Carcasses of Duroc lines, and line crosses of Duroc lines, produced in the Oklahoma project have been studied both in the Meats Laboratory and in a packing plant. These include also crosses with Nebraska lines of Durocs. Differences between the lines of Duroc and between the lines and noninbred Durocs in respect to carcasses have been small. All of these have been too fat. Live weight for the various groups reflected in yield of primal cuts has ranged from about 41 to 46.5 per cent. Averages for back fat range from about 1.7 to 2.2 inches. Use of Minn. No. 2, Beltsville No. 1 and Mont. No. 1 boars on the Duroc sows have resulted in marked improvement of the carcasses. Yield of primal cuts by use of boars of the three lines mentioned, was increased about 1.5-2.0 per cent, back fat was reduced about .3 of an inch, and length increased approximately 1 inch. Crosses of some other lines from different stations with the Durocs have reflected improvement of the carcasses also. Outbred Polands crossed with these Durocs resulted in definite improvement of the carcasses by increasing the length and decreasing the back fat.

Averages for 5 different breeding groups in the South Dakota project in 1952 ranged from 28.8 - 30.0 inches in length and 1.4 - 1.8 inches in back fat. Slaughter weights were approximately 210 pounds. The longest group was a 4-breedline cross, and the fattest was a line of Durocs.

I do not have a summary on carcasses from the Wisconsin project.

Results from some of the projects in the Swine Breeding Laboratory have been studied in respect to rate of gain and carcass composition. (Tech. Bul. 195, Univ. Minn. Agr. Exp. Sta., 1951, and Ia. Agr. Exp. Sta. Bul. 354, 1947 are of particular interest in that regard.) Interpretations differ somewhat in some respects. But there is general agreement among the men, that through the crossing of selected stocks, it is not only possible but practical to produce carcasses with approximately the characteristics desired. Furthermore, that this can be done without sacrificing growth rate

or economy of gain. These points are supported by results being obtained from each of the projects.

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MR. PIERCE: Dr. Craft brought out several items of interest in his report, showing some conflicting data in the results obtained at different stations. For example, I might mention the Illinois work in which they used the two Hampshire groups. They found that the type of the two Hampshire groups remained approximately the same throughout their period but that the carcasses of the inbred line crosses were definitely superior, as I think Dr. Craft said, to the carcasses of the outbred Hampshires.

Also at Indiana, information was produced which is almost a direct refutation of what we usually think; that our fast-gaining pigs produce the leanest carcasses and that the fattest carcasses are the ones which are produced from the hogs which reach only 156 pounds at five months of age, while the most desirable ones are from those that reach 177 pounds at the same age.

Another statement brought out is the fact that, as a general rule, the most desirable carcasses are almost always brought about by crossing two or more inbred lines. Dr. Craft referred to the work at South Dakota. Just a brief item in summary on that work. We tested, I think in 1951, five different breeding groups, and we found that our most desirable and most productive group was our 4-breed line cross, in which we produced carcasses that were approximately an inch longer throughout than were the carcasses from our other groups, and when these hogs were slaughtered at an average weight of approximately 210 pounds, we found in determining age that this group required approximately 20 days less in age to reach the same market weight. Of the five different breeding groups, the carcass lengths ranged from 21.8 to 30 inches, and the back fat ranged from 1. to 1.8 inches.

MR. WILDER: Dr. Craft made the statement that by the use of certain lines you improve some of the carcass characteristics of your other lines, just as Pierce indicated with the 4-breed line cross. We also found that with the use of certain lines we could decrease the desirability of the carcasses at the midpoint where we got more back fat than from the shorter carcasses.

MR. COLE: Dr. Craft, in analyzing carcass data are there any certain desirable carcass characteristics that are highly inheritable? Could you give us, say, an estimate of the inheritability coefficient?

DR. CRAFT: We are at considerable disadvantage in trying to derive estimates of inheritability from carcass data. First of all, we have a small sample from any breeding group and you men know a great deal about that. We will have anywhere from a small number, in some cases five or six carcasses, up to perhaps a hundred. A hundred is about the maximum sample size that we have gotten hold of for any one breeding group. The error in such estimates obviously we would expect to be very large, and the estimates that we have derived from such data indicate that they are.

The degree of inheritability of carcass traits seems to line up about this way: Those that are most highly inheritable are dimensional length, length of leg and length of body. There is considerable difficulty in interpreting our differences of inheritability as to thickness of fat back and thickness of muscling as we measure the loin and determine the loin-length area. Seemingly all of the carcasses on which we have attempted to derive estimates are of rather high inheritability. That is, perhaps 25 to 40 per cent of the variations as we are finding them might be expected to be inheritable. If it is that high, certainly we should be able to get response to our selection effort if we really try.

The type, from small to large and from large to small, through the years has been highly inheritable. Breeders have been able to push types around, using those terms, a good deal.

Seemingly the variation within a type group, so far as type is concerned, is something like 30 to 40 per cent inheritable, and the variations between means of type are in a much higher category, in a category, say, of 70 or 80 per cent. That simply means that if we are selecting between groups our selection is very effective; selection within groups is much less effective but should still be effective.

MR. ENGLAND: I should comment on a statement of yours, Mr. Pierce, and this is not meant to be a partisan statement. With regard to the fast-gaining pigs and carcass quality, it has been the rather consistent result of the Minnesota project that the pigs with the fastest rate of gain have produced the best carcasses. You will find that reported either in Bulletin 364 or Bulletin 400.

MR. PIERCE: That brings up a correlation with the work at the Minnesota station. I think Dr. Craft mentioned limited feeding was required for the non-inbred groups in order to get the yield of their five principal cuts up to the approximate level of those of the best performing crosses. There I think we are measuring yield only, and the question I think I brought up was that most generally we think that the leaner carcasses are produced by the hogs that gain the slowest rather than desirability of carcass.

MR. HANKINS: A question frequently brought to our attention is whether a reduction in fatness through breeding necessarily carries with it a reduction in dressing percentage for those yields. Perhaps all of you have had that same question put to you. Mr. Kerr referred to a piece of work we did at Beltsville which I think could stand just a little elaboration. We selected from Beltsville-produced pigs a group of 40. These pigs varied widely in breeding, but they all approximated 225 pounds final weight and, of course, were all fed and handled under uniform conditions. We selected for wide variation in type, fatness and muscling and, as best we could judge it, prospective yield of preferred cuts, etc.

We slaughtered these pigs. The first thing we did was determine the net body weight, or empty body weight. Then we went ahead and carried out our usual routines of measurements, cutting, etc. In the analysis of these data we paired these pigs -- on the basis of the best possible equalization of dressing percentage, so that we wound up with 20

pairs of pigs. Of course, we calculated the yield of preferred cuts; we calculated the yield of fat cuts, residual, etc.

The pairs that had the highest yield of preferred cuts were put in one group, which we called group 1, and the other pigs were in group 2. The over-all difference in yield of the preferred cuts was about 2.5 per cent. The variation was from less than 1 to something more then 4 per cent in yield of preferred cuts. The differences in yields of fat cuts and residuals operated in the opposite direction, so that we got a counterbalancing of yield of preferred cuts on one hand and combined yield of fat cuts and residuals on the other hand under a condition of equalized dressing percentage. We reduced the fatness on these pigs and we had no sacrifice in dressing percentage. Our over-all No. 1 group was practically identical in dressing yield, but with these differences I have given you with respect to yield of preferred cuts on one hand and fat and residuals on the other hand.

We feel that that is one of the most significant things that has come out of our work on pigs at Beltsville in recent years, and it means to us that it is possible to produce that kind of a pig. We can produce a leaner pig with a higher yield of these cuts if we want to without any sacrifice in dressing percentage. The problem is to be able to recognize those pigs on foot. We don't look upon that as an impossible job at all. We take the view that these boys who are buying hogs every day are pretty smart, and keen in their ability to recognize and select these pigs of the kind I am trying to tell you about.

MR. PIERCE: Eventually we may be able to work out a system whereby we can predict the growth and the outcome of the hog sufficiently far in advance that breeding men can utilize the information at times in their selection practices. The probing technique is a step in that direction, and if we can perfect it and determine the inheritability of different characteristics, we may be able to enhance the carcass a little earlier and more rapidly.

MR. BREIDENSTEIN: The statement has been made that we formerly assumed that the more rapidly gaining hogs gave the fattest carcasses. Will somebody tell me on what that assumption was based? And now they say that the more rapidly-gaining hog gives the leanest carcass.

MR. FARWELL: The paper reported this morning on McMeekan's work supports the statement that the slower-gaining hogs produce the more superior carcasses from the standpoint of leanness. But I don't think the two necessarily disagree. Many other factors are involved.

MR. BREIDENSTEIN: The paper to which I referred did not make the flat statement that the inherited tendency to gain more rapidly was the tendency to lay on fat and not to gain in growth tissue.

MR. FARWELL: Some of McMeekan's work showed these gain relationships up to eight weeks and then gains in 16 weeks in which he did show development of tissue. I believe that supports that first theory.

MR. HILLIER: I think when you go through the literature you can find one thing is stated here with definite authority and another thing there. I believe most of the kind of information that is indicated

here comes from situations where you have one line of breeding. You sit right down on one line of breeding within one breed. Then I think perhaps you get the answer that was mentioned here. The fast gainers are the fat ones. But when you spread out over all types of breeding, and so on, you can get the other answer, that you can find individuals in there and groups of individuals that are fast gainers and produce good carcasses, too.

In looking at this carcass information, we have to be very careful and consider the sample that we are dealing with to begin with. I know that has been true in our situation in our hog department at Stillwater.

DR. CRAFT: Could I add to that, that I think that so far as I know anything about it at all I concur with Mr. Hillier's statement.

I mentioned in my remarks that there are two studies on this point that are of special interest because there is some difference in interpretation. One is from Minnesota, and the other is by Dickerson, who made a study of the Iowa data. I am not sure that I fairly harmonize the differences between those interpretations. Some of it I am confident is within the category Mr. Hillier mentioned. When we confine our study data to that of one breeding group, I think unmistakably there is a correlation between rate of weight increase and amount of fat that we get from the carcass.

That is confirmed by feeding yellow and non-yellow litter mates. The yellow has a tendency to put on fat very rapidly. The yellow litter mate has more appetite and eats and lies down and sleeps. The non-yellow litter mate eats and runs off a lot of energy. The net result is that the yellows produce their gains considerably more economically than the non-yellows.

Some of the same thing is observed in the pig. Differences between two lines at the Illinois station give support to that, and differences between stocks at Iowa and Oklahoma I think in particular.

Then there is one other thing that has been mentioned, and I think we see it in the Minnesota data and we see it in the data at Iowa in particular. That is, when we spread our breeding, as Mr. Hillier mentioned, over a very large group of animals we may get away from some of these things that are seemingly biological constants by picking up something else and that something else is hybrid vigor. If we have enough growth push in these animals to give them appetite and early growth, so that they can get up to the weights we want them, 210 and 220 pounds, fairly early, before that period for accelerated rate of fattening comes on, we get one thing, whereas if their growth lingers a little and they are fed more heavily toward the last part of that period, they may end up producing a little different kind of carcass than in the former case. Where we have enough vigor to give us the push that saves us two to three weeks in time in reaching a certain weight, apparently that is where we get the fastest growth and the leaner carcasses.

As I see data at Indiana, Iowa, Minnesota, and elsewhere, that is where we are getting those so called best carcasses that make the most rapid rate of gains. There may be an exception to that occasionally,

but by and large within a group of Durocs or within a group of Chester Whites or Poland Chinas we can expect that if the rate of gain increases with it we have some degree of increase in the fatness of the carcasses.

MR. KLINE: If a symposium on pork is to be complete we certainly must consider the importance of feeding and management on the ultimate end product. We have selected two papers, the first of which is on the effect of pastures and roughages on pork carcass characteristics. We knew of no group better qualified to give that than the North Carolina group who have done a considerable amount of work and study. So we asked Tom Blumer to present this paper.

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