Relationship Between Growth Rate, Probe Backfat Thickness, and Carcass Traits in Swine[1]

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Identification of superior breeding stock to serve as parents of the next generation is the foundation for all livestock breeding programs. This requires a thorough understanding of what each trait measures and how it is influenced by various other factors. It is also important that all potential breeding herd replacements be evaluated at the earliest possible age so that only individuals with the greatest genetic potential be permitted to reproduce and leave offspring in the herd.

This study was initiated to investigate the inter-relationships between growth rate, backfat thickness, carcass length, loin eye area, and lean cut yield for barrows and gilts. An additional analysis was also undertaken to determine the feasibility of evaluating potential breeding stock for growth rate and backfat thickness when they weighed 175 lbs. as compared to delaying selection until they reached 200 lbs. liveweight.

Materials and Methods

In the spring of 1966, 228 weaning pigs from 76 litters (23 OK14 Hampshire litters, 41 three-line cross litters, and 12 two-line backcross litters) were chosen for this study. Only litters containing at least two males and one female of approximately equal weaning weights and thriftiness were used. Within each litter, one male was randomly castrated in order to obtain boar-barrow-gilt littermate trios. All pigs were self-fed in confinement in groups of six pigs per pen from eight weeks of age to 200 lbs. liveweight.

Probe backfat measurements were taken on all pigs at 175 lbs. and again when they weighed 200 lbs., and age in days at each of these weights was calculated. Barrows and gilts were slaughtered at weekly intervals at Harris Packing Company, Oklahoma City, as they reached 200 lbs. and routine carcass measurements were taken 48 hours after slaughter.

The records were analyzed within line of breeding and sex. The within group correlation coefficients were transformed to z values and weighted by the reciprocal of their variance and corrected for bias. A Chi-square test of adjusted z values was used to determine the probability that the within line and sex correlations were from the same populations. Since the Chi-square values were not significant, the within line and sex z values were pooled to obtain the combined correlation coefficients reported.

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Results and Discussion

Means and standard deviations for traits evaluated in this study are given in Table 1. The pooled correlation coefficients showing the inter-relationships between pre-slaughter and post-slaughter traits are summarized in Table 2, and the correlation coefficients for traits evaluated at 175 lbs. and at 200 lbs. for boars, barrows, and gilts are given in Table 3.

Growth Rate

In this study barrows reached 200 pounds live weight in an average of 147.5 days compared to 158.1 days for their littermate gilts. Pigs with slower growth rates tended to have less backfat and meatier carcasses than those that reached market weight at an earlier age (Table 2). Age at 200 pounds was closely correlated with yield of lean cuts on a live weight basis ($r = 0.57$) and on a carcass weight basis ($r = 0.45$), but was less closely correlated with carcass backfat thickness ($r = -.19$), carcass length ($r = 0.16$), and loin eye area ($r = 0.16$).

Backfat thickness

Backfat thickness was evaluated both on the live pig and on the carcass in this study. Carcass backfat measurements accounted for only about 35 percent of the variation in probe backfat thickness measurements ($r = 0.59$). Longer carcasses tended to have less backfat than shorter carcasses, but no significant relationship was obtained between loin eye area and backfat thickness. Both probe backfat and carcass backfat were negatively correlated with yield of lean cuts, but these relationships were higher when yield was expressed on a carcass weight basis than when expressed as a percentage of live weight (see Table 2). Probe backfat thickness was more closely correlated with lean cut yield than was carcass backfat thickness; therefore probe backfat measurements are a better indicator of muscling than carcass backfat measurements.

Table 1.—Means and Standard Deviations for Littermate Boars, Barrows and Gilts Evaluated in this Study.

Item	Boars		Barrows		Gilts	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Number of pigs	76		76		76	
Age at 175 lbs., days	135.8	10.0	131.8	9.1	139.3	9.9
175 lbs. probe, in.	1.06	0.09	1.17	0.38	1.11	0.12
Age at 200 lbs., days	150.0	11.6	147.5	11.2	158.1	12.9
200 lbs. probe, in.	1.19	0.11	1.36	0.12	1.26	0.15
Carcass backfat, in.			1.33	0.12	1.24	0.14
Carcass length, in.			29.8	0.26	30.3	0.29
Loin eye area, sq. in.			3.95	0.44	4.41	0.48
Lean yield of liveweight, %			37.6	1.69	39.5	1.66
Lean of carcass wt., %			54.2	2.03	56.3	1.70

Table 2.—Relationships Between Pre-Slaughter and Post-Slaughter Traits. Pooled Correlation Coefficients within Line of Breeding and Sex of Pig.

	Backfat probe	Carcass backfat	Carcass length	Loin eye area	Live wt. yield	Carcass wt. yield
Age at 200 lbs.	—.18*	—.19*	—0.16*	0.16*	0.57**	0.45**
Backfat probe		0.59**	— .42**	— .08	— .38**	— .49**
Carcass backfat			— .46**	0.11	— .26**	— .42**
Carcass length				— .29**	— .01	— .08
Loin eye area					0.53**	0.39**
Lean cuts of live wt.						0.83**

*significant at 5 percent level
**significant at 1 percent level

Carcass length

Gilt carcasses averaged 0.5 in. longer than the carcasses from their littermate barrows (30.3 in. vs. 29.8 in.). As shown in Table 2, longer carcasses tended to have less backfat (r = —.46) and smaller loin eye area (r = —.29) than shorter carcasses, but the correlations between length and lean yield were essentially zero.

Loin Eye Area

Gilt carcasses averaged 0.46 sq. in. more loin eye area than barrow carcasses in this study. Loin eye area at the 10th rib is often used as an indicator of carcass merit, but it accounted for only about 28 percent of the variation in percent lean cuts of liveweight (r = 0.53), and for only about 15 percent of the variation in percent lean of carcass weight (r = 0.39). Large loin area is a highly desired trait, but based on this data and other published results, it should not be over emphasized as a measure of overall muscle development in the carcass.

Yield of Lean Cuts

Gilt carcasses yielded approximately two percent more lean than barrow carcasses (Table 1). The correlation between lean cut yield on a live-weight basis and on a carcass-weight basis was 0.83. It is interesting to note that lean cut yield on a live-weight basis was more closely associated with age at 200 lbs. (0.57 vs. 0.45) and loin eye area (0.53 vs. 0.39) than was percentage lean of carcass-weight, but the relationship between backfat thickness and lean cut yield was higher on a carcass-weight basis than on a live-weight basis.

Evaluation at 175 lbs. Compared to Evaluation at 200 lbs.

In breeding programs designed to make genetic improvement, it is important to obtain accurate evaluation data on prospective breeding animals as early as possible to insure continued progress. When boars are selected on the basis of performance testing it is desirable to re-

move them from confinement as early as possible to give them an opportunity to "harden up" prior to breeding; also the test should be terminated before the boars start ranting and additional environmental variation is introduced that further confuses the expression of the trait being evaluated.

In this trial, the 76 littermate boar-barrow-gilt trios were evaluated for growth rate and backfat thickness at 175 lbs. and again at 200 lbs. at which time the barrows and gilts were slaughtered. The correlation coefficients between traits evaluated at these two weights are summarized for boars, barrows, and gilts in Table 3. Weaning weight accounted for approximately 32 percent of the variation in age at 175 lbs. and about 27 percent of the variation in age at 200 lbs. A slightly negative relationship existed between weaning weight and probe backfat, indicating that heavier pigs at weaning tended to have less backfat thickness when they approached 200 lbs., but magnitude of this correlation was quite low.

A close association existed between growth rate to 175 lbs. and growth rate to 200 lbs. The correlation was similar for boars and gilts but was slightly lower for barrows (0.92, 0.93 and 0.88, respectively). The correlation between age and probe was lower at 200 lbs. for boars and barrows than at 175 lbs., but the reverse was true for gilts (Table 3). The correlation between age at 200 lbs. and carcass backfat was also higher for gilts ($r = -.31$) than for barrows ($r = -.08$). No apparent explanation is available for this sex difference except more variation was observed in backfat thickness among gilts than among barrows.

The correlations between probe backfat measurements taken at 175 lbs. and those taken at 200 lbs. were 0.38 for boars, 0.53 for barrows,

Table 3.—Correlations Between Traits Evaluated at 175 Lbs. and at 200 Lbs. Liveweight for Boars, Barrows, and Gilts.

	Boars	Barrows	Gilts	Pooled
42-DAY WEANING WT. and:				
Age at 175 lbs.	— .54**	— .61**	— .56**	— .57**
Age at 200 lbs.	— .56**	— .47**	— .52**	— .52**
175 lb. probe	— .09	— .22*	— .16	— .15*
200 lb. probe	— .09	— .10	— .18	— .12
AGE AT 175 LBS. and:				
Age at 200 lbs.	0.92**	0.88**	0.93**	0.91**
175 lb. probe	— .06	— .25*	— .05	— .12
AGE AT 200 LBS. and:				
200 lb. probe	— .02	— .13	— .23*	— .13*
Carcass backfat		— .08	— .31**	— .19*
175 LB. PROBE and:				
200 lb. probe	0.38**	0.53**	0.66**	0.53**
Carcass backfat		0.57**	0.46**	0.52**
200 LB. PROBE and:				
Carcass backfat		0.60**	0.56**	0.58**

*significant at 5 percent level
**significant at 1 percent level

and 0.66 for gilts. This implies that selecting boars on the basis of backfat probe at 175 lbs. is not a good indicator of their backfat thickness at 200 lbs. while the ranking of gilts on the basis of backfat thickness at 175 lbs. is more nearly the same as their ranking at 200 lbs. The differences in backfat thickness for boars became more pronounced after they weighed 175 lbs.

Summary

Two hundred twenty-eight pigs representing 76 boar-barrow-gilt littermate trios were evaluated to investigate existing phenotypic correlations between growth rate, backfat thickness, and carcass traits, and to determine the relationship between traits evaluated at 175 lbs. and at 200 lbs. liveweight.

Growth rate, backfat thickness, and loin eye area were significantly correlated with yield of lean cuts for both barrows and gilts. Probe backfat thickness was more closely associated with lean yield than was carcass backfat thickness, but both backfat measurements were more closely correlated with lean cut yield on a carcass weight basis than on a liveweight basis. The correlation between loin eye area and percent lean of liveweight was 0.53 compared to a correlation of 0.39 between loin eye area and percent lean of carcass weight. Lean cut yield on a liveweight basis accounted for approximately 67 percent of the variation in lean yield of carcass weight in this study.

Pig weaning weight accounted for 32 percent of the variation in age at 175 lbs. and 27 percent of the variation in age at 200 lbs. The correlation between growth rate to 175 lbs. and growth rate to 200 lbs. was 0.93, 0.92, and 0.88 for gilts, boars, and barrows, respectively. The correlation between probe backfat measurements taken at 175 lbs. and at 200 lbs. was lower for boars than for either gilts or barrows, and the data revealed less individual variation in backfat thickness among boars at 175 lbs. than at 200 lbs. Based on these results it would be advisable to delay backfat thickness evaluation on boars until some point past 175 lbs. liveweight.