Swine lean growth and pork quality evaluation trials

A.P. Schinckel, J.C. Forrest, E. Berg, E. Sheiss, and M.E. Einstein

Department of Animal Sciences

To remain competitive, pork producers must efficiently produce the quality lean pork that consumers demand. Lean growth rate, lean efficiency (the pounds of feed per pound of lean), and total production dollar cost per pound of lean are the important traits for the future. Lean growth trials conducted in the late 1980's at Purdue University and the University of Kentucky, indicated that large amounts of variation exist between different genetic populations or genotypes of pigs. In the early 1990's, new seedstock were imported from Canada and Europe resulting in additional genetic choices.

Two swine lean growth trials were conducted in the spring and fall of 1995. Participants had the choice of delivering either 24 or 32 pigs of the same genotype and sex. Pigs were delivered to the Purdue Segregated Early Weaning units at 10-14 days of age. At 50 days of age, pigs were taken to the old Indiana Boar Test Station. It is an open-front building with ninety-six 6 x 12 foot pens. Pigs arrived at 30-50 lb. live weight and were assigned four per pen. The pigs were on test from approximately 60-250 lbs.

The pigs were weighed weekly and pen feed consumption recorded. The pelleted diets fed contained approximately 1.32, 1.15, 1.05, and .95% lysine, 5% added fat, and 1590 Kcal ME per pound. The pigs were ultrasonically probed at approximately 55, 98, 143, 185, and 220 lb. of body weight and at slaughter. At slaughter, standard carcass measurements were taken, including hot carcass weight, loin eye area, 10th rib fat depth and last rib backfat thickness. Prediction equations from the 1991 Cooperative Lean Growth Trial _ which included the dissection of 448 pigs of seven genotypes, two sexes, and eight slaughter weights _ were used to estimate carcass lean and fat mass. Lean gain, carcass fat gain, and lean feed conversion (lb. feed/lb. lean gain) were estimated.

Trained meat science graduate students scored the exposed loin muscles for color, firmness, and marbling using the NPPC scoring system. Color scores ranged from one (pale, pinkish gray) to five (dark, purplish red). A reddish-pink color to the loin muscle is desired and would have a color score of three. Firmness scores ranged from one (very soft and watery) to five (very firm and dry). Marbling scores ranged from one (devoid to practically devoid) to five (moderately abundant or greater).

The means for growth performance are presented in Tables 1 and 3. Overall, barrows grew faster and were fatter than gilts. Substantial differences exist between genotypes in feed intake and daily fat growth, with higher feed intake genotypes having high daily fat growth and lower ratios of lean:fat growth. Genotype x sex interactions were significant for feed intake in both trials, indicating that the difference between barrows and gilts for feed intake is not consistent across genotypes. Genotype x sex interactions were also significant for average daily gain (both trials). Overall, the pigs in the fall trial were not as efficient as in the spring trial, likely due to less desirable environmental conditions.

Variation between genotypes for lean feed efficiency was substantially greater than the variation in live weight feed conversion. This is because with live weight efficiency, pigs which are eating an excessive amount of feed above that required for maximum lean gain and depositing the excess energy as fat, are

given credit for the fat gain as it is part of the live weight growth. Pigs depositing excessive fat are somewhat less efficient in converting feed to live weight growth, because fat growth requires four times more energy than lean growth. With lean efficiency (pounds of feed per pound of lean gain), pigs are given no credit for their fat growth. However, pigs with high fat growth rates must have consumed excess energy via high feed intakes. For this reason, pigs with high fat accretion rates are substantially less efficient in converting feed to lean growth than genotypes with lower fat deposition rates. Therefore, gilts with only marginally better live weight conversion had significantly lower lean feed conversion than barrows (7.08 vs. 7.84) in the spring trial.

The means for the carcass measurements and pork quality scores are presented in Tables 2 and 4. Large differences exist in backfat thickness, percent lean and pork quality scores. Genotype, sex, and interaction effects accounted for 20-25% of the total variability for color and firmness scores and 35% of the total variation for marbling scores. This indicates that the majority of the variability in pork quality scores was within uniform genotype-sex groups of pigs. Uniform genetics will only partially reduce variation in pork quality. Significant genotype x sex interactions existed for 10th rib backfat thickness (fall trial), last rib backfat thickness (spring trial), and pork quality scores (marbling, both trials; color and firmness, spring trial only).

The data was also summarized to evaluate differences between European and U.S. terminal cross pigs (Table 5). In the spring trial, three European genotypes and four U.S. genotypes (2 Hampshire-Duroc [HD] x Yorkshire-Landrace [YL], one H x YL, one D x YL) were evaluated. In the fall trial, three entirely European and three U.S. genotypes were evaluated (two HD x YL and one D x YL). In both trials, the European pigs grew slower, consumed less feed, and had lower daily carcass fat growth rates. As a result, the European genotypes had higher ratios of lean gain to fat gain, and better lean feed conversion. However, the U.S. genotypes had higher muscle quality scores. Current concerns of U.S. pork processors over pork quality present a challenge in selecting genotypes that have high ratios of lean to fat and still maintain acceptable quality to meet domestic and export market demands.

Table 1. Means for growth and performance traits (spring 1995 trial)

Line	Sex	Feed Intake, lb/day	Feed Conversion, F/G	Average Daily Gain,lb/day	Protein Accretion, g/d	FF Lean, lb gain/d	Carcass Fat Gain, lb/d	Feed/FF Lean
1-A	G	4.81	2.49	1.93	131.8	.691	.459	7.06
1-B	G	5.05	2.57	1.98	139.9	.720	.467	7.09
2	B	4.84	2.27	2.14	144.4	.756	.552	6.49
2	G	4.36	2.25	1.94	140.3	.691	.400	6.31
3-A	B	4.83	2.31	2.12	147.1	.783	.514	6.30
3-A	G	4.21	2.21	1.91	143.7	.744	.369	5.70
3-B	B	4.79	2.28	2.10	146.5	.766	.509	6.33
3-B	G	4.48	2.32	1.96	148.8	.713	.361	6.38
3-C	B	5.69	2.62	2.20	134.7	.715	.662	8.01
3-C	G	5.24	2.57	2.04	134.1	.690	.512	7.65
3-D	B	5.57	2.72	2.05	139.7	.708	.559	7.92
3-D	G	5.43	2.73	1.99	134.7	.708	.527	7.71
4	B	4.97	2.34	2.15	138.9	.732	.531	6.85

4	G	4.41	2.29	1.95	136.3	.712	.414	6.26
5-A	B	5.21	2.52	2.06	126.6	.661	.635	7.94
5-A	G	5.09	2.61	1.95	126.7	.664	.539	7.69
5-B	B	5.66	2.42	2.33	140.9	.722	.730	7.89
5-B	G	5.66	2.45	2.32	147.5	.703	.562	8.13
6	B	5.36	2.53	2.11	134.1	.688	.604	7.81
6	G	5.11	2.55	2.01	135.8	.717	.503	7.30
7	B	5.45	2.60	2.09	124.7	.695	.691	7.93
7	G	5.15	2.58	2.00	128.4	.670	.576	7.80
Signif.[a]		G,S,GxS	G	G,S,GxS+	G	G,S	G,S,GxS+	G,S

[a] P<.01, + P<.10

G = genotype, S = sex

Table 2. Means for carcass measurements[a] and pork quality scores (spring 1995 trial).

Line	Sex	FD10R	BFLR	LEA	% FFL	Color	Firmness	Marbling
1-A	G	1.03	1.16	5.80	45.5	2.37	2.13	2.25
1-B	G	.76	.94	5.84	47.8	2.86	2.00	2.50
2	B	.85	.96	5.83	46.8	2.54	2.25	2.78
2	G	.65	.90	5.93	48.5	2.57	2.18	2.10
3-A	B	.73	.87	6.59	49.5	2.04	1.54	2.38
3-A	G	.51	.80	7.27	52.9	2.66	2.27	2.10
3-B	B	.85	.93	6.10	47.3	2.12	1.62	1.75
3-B	G	.64	.78	5.91	48.4	1.61	1.23	1.62
3-C	B	1.14	1.20	6.01	45.1	2.15	1.08	1.92
3-C	G	1.03	1.12	6.58	46.9	2.67	3.33	2.75
3-D	B	1.06	1.11	5.30	44.0	2.69	2.62	2.46
3-D	G	1.00	1.08	5.84	45.9	2.36	2.73	2.82
4	B	.83	.91	6.26	48.0	2.50	2.50	2.13
4	G	.68	.86	6.59	49.9	2.62	2.33	2.13
5-A	B	1.28	1.10	5.08	41.7	2.25	1.50	2.10
5-A	G	1.12	.98	5.03	42.8	2.66	2.66	3.33

5-B	B	1.30	1.34	5.08	41.4	3.00	3.08	2.10
5-B	G	1.10	1.09	5.36	43.8	1.97	2.57	2.66
6	B	1.08	.98	4.58	41.7	2.80	3.00	3.20
6	G	.79	.87	4.32	43.9	3.07	2.08	2.10
7	B	1.15	1.34	5.36	43.4	2.56	2.50	2.08
7	G	1.14	1.30	5.59	44.2	2.00	2.54	3.04
Signif[b]		G,S	G,S,GxS+	G,S	G,S	G,GxS	G,S,GxS+	G,S,GxS+

[a] FD10R=Carcass backfat, tenth rib - off midline, in.; BFLR=Carcass backfat, last rib - on midline, in.; LEA=Carcass loin eye area, in2 ; % FFL=% fat-free lean - lean adjusted to contain 0% fat.

[b] P<.01, +P<.10

G = genotype, S = sex

Table 3. Means for growth and performance traits (fall 1995 trial).

Line	Sex	Feed Intake	Feed Conversion	ADG	Lean Gain, lb/day	Carcass Fat Gain, lb/d	Lean Feed Conversion
1	B	6.58	3.05	2.14	.707	.604	9.46
1	G	6.01	3.11	1.93	.693	.492	9.18
2	B	5.75	2.89	1.99	.715	.487	8.09
2	G	5.04	2.93	1.71	.794	.406	6.11
3	B	6.31	2.94	2.14	.676	.518	9.39
3	G	5.52	2.80	1.96	.685	.392	8.16
4	B	6.50	3.23	2.00	.776	.458	8.60
4	G	5.68	2.97	1.89	.673	.421	8.54
5	B	5.44	2.92	1.86	.634	.392	8.97
5	G	5.84	2.85	1.77	.685	.388	8.63
6A	B	5.59	3.01	1.86	.651	.425	8.70
6B	G	5.29	3.16	1.67	.687	.392	7.67
7	B	6.79	3.11	2.18	.706	.553	9.77
7	G	5.76	2.92	1.97	.719	.454	8.23
8	B	5.89	2.87	2.05	.671	.423	8.84
8	G	5.13	2.88	1.78	.686	.357	7.50
9A	B	5.80	2.94	1.97	.722	.459	7.99

9A	G	5.30	2.89	1.83	.777	.392	6.69
9B	B	7.09	3.21	2.21	.754	.604	9.40
9B	G	5.36	2.97	1.80	.722	.454	7.35
9C	B	5.76	3.20	1.80	.801	.452	7.27
10	B	6.09	3.23	1.88	.697	.478	8.83
10	G	6.03	3.31	1.82	.835	.485	7.03
11A	B	5.89	3.08	1.91	.661	.496	9.02
11A	G	5.49	3.08	1.78	.642	.406	8.65
11B	B	5.83	3.31	1.76	.658	.454	9.00
Signif[a]		G,S,GxS	G,S	G,S,G*S	G,GxS	G,S	G,S,GxS

[a] P<.01

G = genotype, S = sex

Table 4. Means for the carcass measurementsa and pork quality scores (fall 1995 trial).

Line	Sex	FD10R	BFLR	LEA	Color	Marbling	Firmness	%FFL
1	B	.99	1.27	5.74	2.81	2.77	3.11	45.1
1	G	.76	1.09	6.03	2.71	2.42	3.08	47.4
2	B	.73	1.04	6.80	2.31	1.35	2.50	49.5
2	G	.59	.95	7.25	2.49	1.28	2.42	51.4
3	B	.96	1.17	5.46	2.51	2.13	2.57	45.5
3	G	.68	.97	6.59	2.26	1.51	2.46	49.7
4	B	.78	1.09	6.02	2.83	1.84	3.20	47.8
4	G	.73	1.05	6.65	2.78	2.43	3.01	48.7
5	B	.77	.95	5.62	2.51	1.35	2.74	48.0
5	G	.66	.94	6.14	2.37	1.15	2.42	49.0
6A	B	.83	1.12	6.75	2.50	1.61	2.47	48.6
6B	G	.68	1.05	6.80	2.14	1.18	1.92	49.4
7	B	.92	1.16	5.23	2.88	2.27	3.38	45.1
7	G	.77	1.07	6.09	2.91	1.91	2.98	47.7
8	B	.81	1.23	6.87	2.70	1.76	2.76	47.8
8	G	.65	1.05	7.54	2.42	1.54	2.19	50.7
9A	B	.70	1.09	6.40	2.59	1.83	2.89	49.2
9A	G	.54	.89	6.77	2.75	1.26	2.79	49.0
9B	B	1.04	1.09	5.39	3.48	2.96	3.98	46.0

9B	G	.64	.93	7.60	2.98	2.71	3.24	50.5
9C	B	.63	1.05	6.53	3.09	1.80	3.33	49.0
10	B	.78	1.08	6.61	2.57	1.47	2.60	48.7
10	G	.76	1.04	7.69	2.81	1.29	2.30	49.4
11A	B	.83	1.09	6.20	2.61	1.88	2.96	47.7
11A	G	.74	1.02	6.39	2.50	1.24	2.54	48.8
11B	B	.79	1.05	5.91	2.69	2.53	3.40	47.6
Signif[b]		G,S,GxS,WT	G,S,WT	G,S,WT	G	G,S,GxS	G,S	G,S,GxS

[a]FD10R = Carcass backfat, tenth rib - off midline, in.
BFLR = Carcass backfat, last rib - on mideline, in.
LEA = Carcass loin eye area, in2
%FFL = % fat-free lean - lean adjusted to contain 0% fat.

[b]P<.01

G = genotype, S = sex, WT = liveweight.