CHARACTERISTICS OF PIGS SELECTED FOR RAPID OR SLOW GAIN AND FED AD LIBITUM OR LIMITED RATIONS

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Story in Brief

Two lines of pigs selected for divergent growth rate were evaluated on either ad libitum or restricted diets. A total of 180 barrows from the second, third and fourth generations of selection in a spring-farrowing replicate and 36 barrows from the third generation in a fall-farrowing replicate were either fed individually or as littermate pairs. Carcass data were collected from an additional littermate barrow at the start of each test to allow estimation of lean tissue growth rate of tested barrows. Complete carcass separation data were collected after barrows were removed from test. Barrows from a rapid growth line were faster growing, consumed more feed and deposited more fat than slow growth line barrows when both lines were fed ad libitum. Restricted feeding decreased gain and deposition of fat and improved total body weight feed efficiency of rapid growth line barrows relative to slow growth line barrows.

(Key Words: Swine, Selection, Gain, Intake, Composition.)

Introduction

The primary goal of the swine industry should be to produce each unit of pork as efficiently as possible. With increasing emphasis on lean pork, this goal needs to be modified to an ultimate goal of improving the efficiency of lean tissue production. A number of preweaning and postweaning traits determine the overall efficiency of swine production. Selection for gain, backfat and efficiency has been shown to be successful. However, single-trait selection for one of these traits often results in undesirable changes in one or more other traits.

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The purpose of this study was to evaluate the effect of selection for divergent postweaning growth rate on lean tissue growth rate, lean tissue feed conversion and other growth and carcass traits. Divergent lines were evaluated under ad libitum and restricted intake to determine the role of feed intake in response to selection for growth rate.

Materials and Methods

Lines of pigs selected for rapid (RGL) and slow (SGL) postweaning growth rate were established from litters born during 1981 at the Southwest Livestock and Forage Research Station. Boars purchased from central test stations were mated to a crossbred population of gilts to begin the lines. The tested boars were ranked on an index that gave primary emphasis to increased gain and decreased fat and were puchased in pairs (one high-indexing and one low-indexing boar in each pair). The RGL was initiated by mass selection for rapid gain in pigs sired by high-indexing boars and the SGL was established by mass selection for slow gain among pigs sired by low-indexing boars. Each line was represented in spring- and fall-farrowing replicates. The lines were closed at this point and divergent selection for growth rate continued on both males and females.

Barrows representing two, three and four generations of selection in spring-born litters (n=180 barrows) and three generations of selection in fall-born litters (n=36 barrows) were fed individually or in littermate pairs starting at approximately 80 lb. Barrows from the RGL and SGL were evaluated on either an ad libitum ration or a ration restricted to 83% of predicted ad libitum intake. Ad libitum intake was predicted using an equation based on live weight. This 2 X 2 factorial arrangement of line and ration was blocked nine times per trial. Each test was designed to end when the average weight of the block was 230 lb. Feed intake and weight were measured weekly throughout the test and ultrasonic backfat probes at the first rib, last rib, and last lumbar vertebra were taken weekly starting at approximately 150 lb. Upon removal from test, barrows were slaughtered and carcasses were separated into lean, bone and fat. Carcass backfat, loin eye area and length were also measured. The same carcass data were collected on an additional littermate barrow at on-test weight to establish initial composition of the lines and allow estimation of lean tissue growth rate of the tested barrows.

Results and Discussion

An earlier study of these lines following four generations of divergent selection showed that the RGL gained faster and were more efficient (total

feed/total body weight gain) from nine weeks of age through 220 lb and had more backfat at 230 lb (Clutter et al., 1988) than the SGL. Growth and performance traits for the spring replicate of the current study are presented in Table 1. The line x ration interaction was significant ($P<.05$) for average daily gain (ADG). The RGL gained faster than the SGL on the ad libitum ration ($P<.05$), but there was no difference in gain between the lines when feed was restricted. The line x ration interaction was also significant ($P<.05$) for average daily feed intake, feed efficiency on a total body weight basis (FE) and average probed backfat (BF). The lines were not significantly different for feed efficiency under ad libitum conditions, but the RGL was more efficient ($P<.05$) than the SGL when intake was restricted. On ad libitum intake, the RGL consumed more feed and were fatter than the SGL ($P<.05$), however differences between lines for these traits were not significant when feed was restricted. It appears that a difference in intake was responsible for a large portion of the difference in gain between the two lines and that much of the additional feed consumed by the RGL under ad libitum conditions was used to produce fat. Even though selection in both lines had been under ad libitum conditions, the RGL pigs were able to gain body weight more efficiently than pigs from the SGL when feed was restricted.

The line x ration interaction was not significant for any of the traits in the fall replicate (Table 2). The difference in gain between the lines was not significant, but the RGL was fatter, less efficient and had a higher feed intake than the SGL ($P<.05$). Barrows on limited intake gained more slowly, were

Table 1. Least-squares means for growth and performance traits in the spring replicate.

	Line-ration[a]			
	RGL-AL	RGL-LIM	SGL-AL	SGL-LIM
ADG (lb/day)[c]	1.87	1.76	1.76	1.74
FE (feed/gain)[c]	3.50	3.19	3.48	3.37
Intake (lb/day)[c]	6.47	5.58	6.11	5.88
BF (in)[bc]	1.23	1.11	1.17	1.13
LTGR[d]	.457	.447	.451	.442
LTFC[ce]	.068	.080	.075	.076

[a]RGL=rapid.growth line, SGL=slow growth line, AL=ad libitum ration and LIM=limited to 83% of ad libitum.
[b]Average backfat in an average of three probed measurements at the first rib, last rib and last lumbar vertebra adjusted for final weight.
[c]Significant ($P<.05$) for line by ration interaction.
[d]LTGR=lean gain/day.
[e]LTFC=lean gain/feed consumed.

Table 2. Least-squares means for growth and performance traits in the fall replicate.

	Line or ration[a]			
	RGL	SGL	AL	LIM
ADG (lb/day)[d]	1.84	1.86	1.98	1.72
FE (feed/gain)[cd]	3.59	3.40	3.55	3.45
Intake (lb/day)[c]	6.60	6.35	7.03	5.91
BF (in)[bcd]	1.15	1.08	1.20	1.03

[a]RGL=rapid growth line, SGL=slow growth line, AL=ad libitum ration and LIM=limited to 83% of ad libitum.
[b]Average backfat in an average of three probed measurements at the first rib, last rib and last lumbar vertebra adjusted for final weight.
[c]Significant (P<.05) for line.
[d]Significant (P<.05) for ration.

more efficient and deposited less fat than barrows allowed ad libitum intake (P<.05).

Lean tissue growth rate (LTGR) and lean tissue feed conversion (LTFC) was defined as the daily lean gain and the lean gain per feed consumed, respectively. Initial lean content was predicted from littermate barrows slaughtered at on-test weight (80 to 100 lb). Total lean gain was estimated by the difference between total dissected lean and predicted initial composition of lean. Estimates of LTGR and LTFC are not presented for the fall replicate due to the small numbers of barrows and the subsequent error associated with estimating these traits. The line x ration interaction was significant (P<.05) for LTFC in the spring replicate. The SGL tended to be more efficient than the RGL in converting feed to lean when fed ad libitum, with only small differences when the lines were restricted. These results also indicated that the additional feed consumed by the RGL was used for the deposition of fat, with no improvement in lean gain.

In the spring replicate, the line x ration interaction was significant (P<.05) for dissected lean and dissected fat, each expressed as a percent of the chilled carcass weight (Table 3). The RGL had a lower percentage lean and a greater percentage fat than the SGL when feed intake was not limited (P<.05), but line differences for these traits were not significant when feed was limited. Differences in percent bone were not significant. In the fall replicate (Table 4) the RGL had a larger percentage fat and bone (P<.05) and tended to have a smaller percentage lean (P<.10) than the SGL. Differences between rations for percentage fat and loin eye area were also significant (P<.05). In both replicates, means for average carcass backfat were consistent with those for probed backfat on the live pig.

Table 3. Least-squares means for carcass traits in the spring replicate.

	Line-ration[a]			
	RGL-AL	RGL-LIM	SGL-AL	SGL-LIM
% Lean[bc]	58.71	63.32	62.76	63.29
& Fat[bc]	29.22	24.40	25.67	25.37
% Bone[c]	12.07	12.28	11.57	11.34
Length (in)	31.8	31.9	31.5	31.3
Loin eye area(in^2)[b]	4.43	4.73	4.45	4.33
Average backfat[b]	1.22	1.03	1.12	1.08

[a]RGL=rapid growth line, SGL=slow growth line, AL=ad libitum ration and LIM=limited to 83% of ad libitum.
[b]Significant (P<.05) for line by ration interaction.
[c]Expressed as percent of chilled carcass weight.

Table 4. Least-squares means for carcass traits in the fall replicate.

	Line-ration[a]			
	RGL	SGL	AL	LIM
% Lean[bef]	58.92	61.47	58.27	62.11
& Fat[bcd]	29.60	25.93	30.33	25.30
% Bone[bc]	11.48	12.61	11.51	12.58
Length(in)	30.0	31.1	31.0	30.8
Loin eye area(in^2)[d]	4.20	4.32	4.57	3.95
Average backfat[c]	1.12	.98	1.10	1.00

[a]RGL=rapid growth line, SGL=slow growth line, AL=ad libitum ration and LIM=limited to 83% of ad libitum.
[b]Expressed as percent of chilled carcass weight.
[c]Significant (P<.05) for line.
[d]Significant (P<.05) for ration.
[e]Significant (P<.10) for line.
[f]Significant (P<.10) for ration.

Growth curves for the spring replicate, estimated by regressing weight on age, are presented by line x ration subclass for each of the three generations of selection (Figures 1a, 1b and 1c). In all generations, curves for the RGL ad libitum pigs tended to have the steepest slope. The curves of the SGL for both rations were very similar for all three generations. This indicates that SGL pigs were limited less than the RGL by the restricted

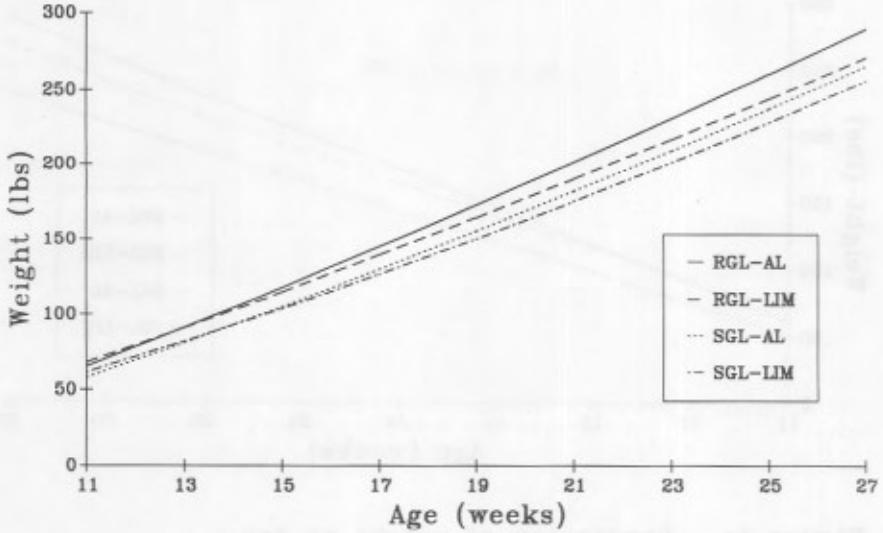

Figure 1a. Regression of weight on age.
Generation 2: Spring replicate.

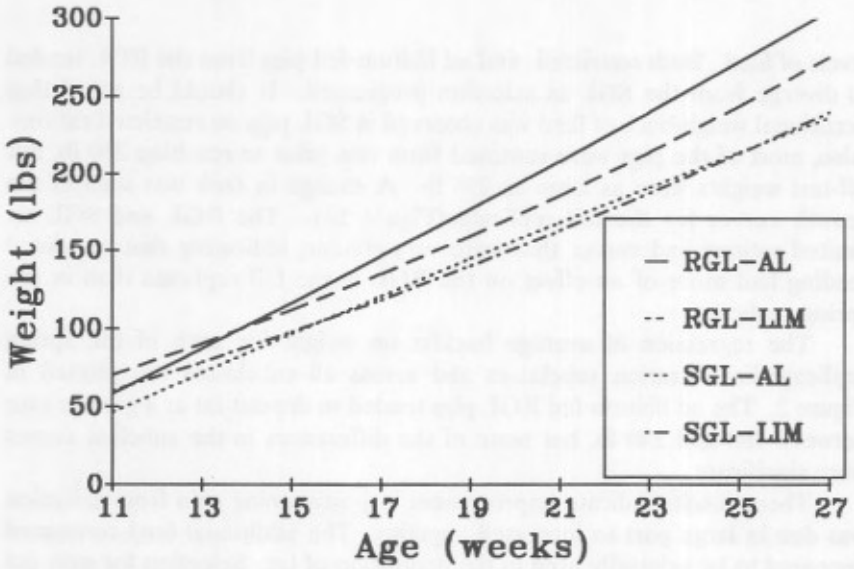

Figure 1b. Regression of weight on age.
Generation 3: Spring replicate.

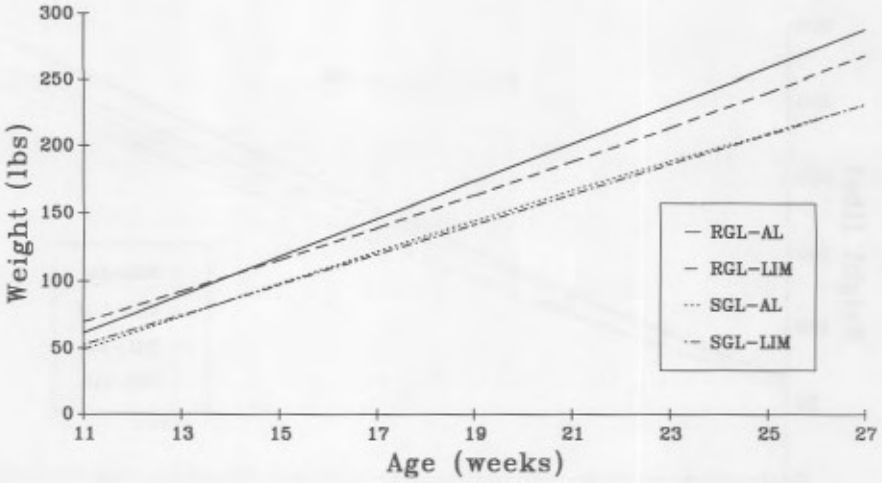

Figure 1c. Regression of weight on age. Generation 4: Spring replicate.

levels of feed. Both restricted- and ad libitum-fed pigs from the RGL tended to diverge from the SGL as selection progressed. It should be noted that occasional weigh-back of feed was observed in SGL pigs on restricted rations. Also, most of the pigs were removed from test prior to reaching 250 lb, but off-test weights were as large as 296 lb. A change in rank was seen in the growth curves for the fall replicate (Figure 1d). The RGL and SGL on limited rations had curves that were very similar, indicating that restricted feeding had more of an effect on the RGL in the fall replicate than in the spring replicate.

The regression of average backfat on weight for each of the spring replicate line x ration subclasses and across all subclasses are plotted in Figure 2. The ad libitum fed RGL pigs tended to deposit fat at a greater rate between 180 and 240 lb, but none of the differences in the subclass curves were significant.

These results indicate improvement in postweaning gain from selection was due in large part to increased appetite. The additional feed consumed appeared to be primarily used in the deposition of fat. Selection for gain did not appear to change LTGR and tended to decrease LTFC. Restriction of feed in the RGL resulted in a 5.9% decrease in gain, an 8.9% improvement

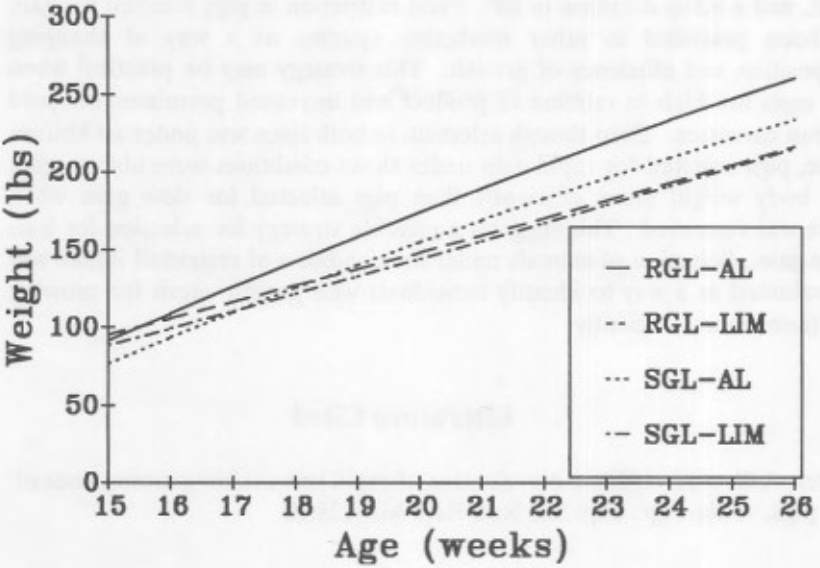

Figure 1d. Regression of weight on age. Fall replicate.

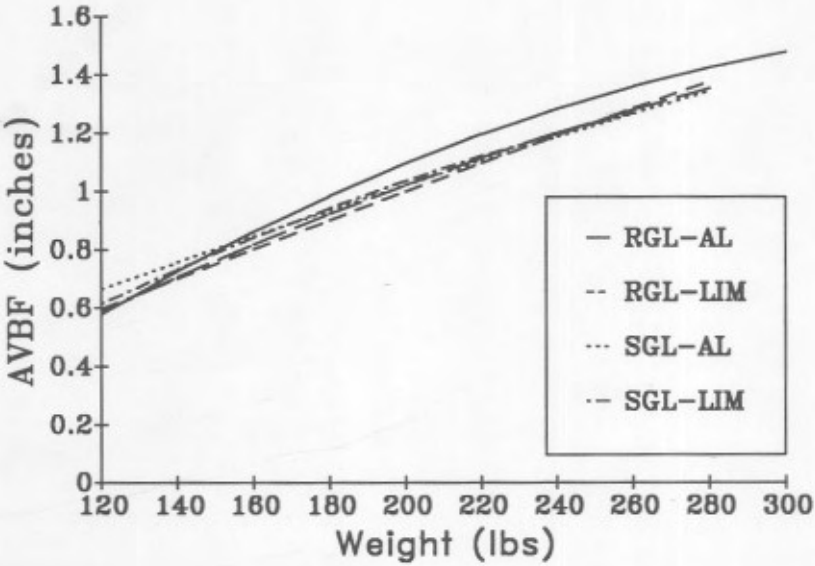

Figure 2. Regression of average backfat on weight. Spring replicate: Across generation.

in FE, and a 9.8% decrease in BF. Feed restriction in pigs selected for gain has been practiced in other marketing systems as a way of changing composition and efficiency of growth. This strategy may be practical when feed costs are high in relation to product and increased premiums are paid for lean carcasses. Even though selection in both lines was under ad libitum intake, pigs selected for rapid gain under these conditions were able to gain total body weight more efficiently than pigs selected for slow gain when intake was restricted. This suggests a possible strategy for selection for lean tissue gain. Selection of animals under the condition of restricted intake will be evaluated as a way to identify individuals with genetic merit for growing lean tissue more efficiently.

Literature Cited

Clutter, A.C. et al. 1988. An evaluation of rapid versus slow growing lines of pigs. Okla. Agr. Exp. Sta. Res. Rep. MP-125:10.