GENETIC CONSEQUENCES OF GROWTH RATE SELECTION

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Basic animal breeding theory has been developed for approximately half a century and its theoretical approach based on the fraction one-half is remarkably straight forward and powerful, yet simplistically beautiful. The application of genetics to swine improvement, however, remains a relatively new technology (Fowler *et al.*, 1976). In discussing the genetic consequences of growth rate selection, it seems fit to briefly review selection concepts in order to appreciate and understand both direct and correlated responses to selection.

The primary goal of the swine industry should be to improve efficiency of production of lean, quality pork. Genetic improvement is commonly measured by the change in a population mean from one generation or year to the next. Selection theory relates this improvement to the alteration of gene frequencies at loci influencing the particular trait of interest. Among the systematic forces which can change gene frequency and consequently genotypic frequency, selection is the main tool available to genetically enhance populations. One may define selection as simply differential reproductive rates among individuals, that is, variation among individuals with respect to the number of offspring produced. Selection may be partitioned into two component parts, natural and artificial selection. Natural selection is based on varying innate abilities of individuals to produce offspring, whereas artificial selection refers to breeder control in deciding which animals will become parents. The two forms of selection are not independent of one another and, furthermore it should be noted that natural selection operates in all populations subjected simultaneously to artificial selection.

Genetic improvement occurs when the frequencies of desirable genes are higher in the selected individuals than in the unselected parental population. Therefore, the selection process is essentially concerned with replacing an existing population with one which is genetically superior (Fredeen, 1958). It follows that the effectiveness of selection depends upon the ability of the breeder to accurately identify individuals of high genetic value.

Response to selection, or genetic change, may be either of a direct or indirect nature. Direct response refers to the change that occurs in the mean of a given trait due to the intentional selection applied for that trait and is equal to the product of heritability and selection differential, as has been discussed at previous NSIF meetings (Kuhlers, 1977). Indirect or correlated selection response was observed by Charles Darwin as early as 1872. Correlated response occurs when the mean of a trait changes as the result of selection for another trait. This phenomenon is the result of a gene or set of genes influencing two or more traits, presumably through common biological pathways. Due to the genetic correlation between two traits, selection for one trait may consequently stimulate unintentional selection pressure for a second trait. Whether the correlated response is favorable or unfavorable depends upon the sign of the genetic correlation. The magnitude of the correlated response is a function, among other parameters, of the value of both the genetic correlation and the heritabilities of the traits considered. Historically, direct selection responses have been of primary concern, even though the net effect of the many correlated responses may be of greater importance to the total production system. Direct and correlated responses to growth rate selection will be reviewed shortly based on the available literature.

Before proceeding to a review of growth rate selection experiments, it may be worthwhile to ponder why growth should be examined today. Growth is an extremely complex biological process which may be described in numerous terminologies. For example, one might relate growth to body weight, linear measurements, tissue composition, cell size, cell number or physiological development (Eisen, 1976). Growth may be partitioned into prenatal and postnatal components with the latter classification further subdivided into preweaning and postweaning segments. With respect to swine, characterization of postweaning growth to slaughter weight has received major emphasis for several reasons. First, the greater the growth rate, the lower the cost per unit product of those overheads which are a function of time. Likewise, the risk of loss due to disease or accident is reduced. Secondly, the favorable relationship between growth rate and efficiency of gain increases the profit margin by reducing feed costs per animal. Also, heritability of postweaning growth is greater than heritability of growth during a lighter weight period, thus favoring increased selection accuracy. These combined effects must certainly boost production efficiency by lowering costs per unit of product and increasing genetic progress relative to preweaning growth.

Concern about the possible effect that rapid growth rate has on increased breeding herd mature weight seems to be unfounded with respect to swine. As noted by Wayne Robison at the 1976 NSIF meeting, high mature weights are not realized due to limit feeding of the breeding herd and consequently are of minor importance.

Given this brief justification for examining postweaning growth, let us return to the discussion of the genetic consequences of growth rate selection. There seems to be at least three methods available to evaluate selection response: first, a completely theoretical approach based on selection index theory and assumed genetic and phenotypic parameters; second, an empirical consideration of test station trends over an extended time period; and third, scientific evaluation of designed selection experiments. Selection index theory, although both elegant and extremely powerful, is complex and, by necessity, assumption ridden. While test station trends may indicate industry movement, the cause of such trends and the population that inferences apply to are partially obscured. Therefore, designed experiments with specified selection criteria will be utilized to illustrate the consequences of selection. One must be cautioned, however, that selection experiments are often subject to interpretation difficulties due to both the measurement of selection pressure actually applied and the response to selection.

While reviewing selection experiments, it became apparent that concepts of growth have become increasingly complex with time. This slide presents the development of growth selection concepts. The first stage relates weight and age in various combinations such as live weight at constant age, age at constant live weight, weight per day of age, average daily gain, and others. These traits represent familiar measures of growth like 154-day weight or age at 230 pounds and have frequently been utilized in the past.

The second stage of growth selection criteria development includes an indicator of carcass composition along with live weight and age. Backfat depth, measured either by probe or ultrasonically, has been used most often. This general classification of traits may be termed lean growth. Various selection indexes have been utilized and are currently under evaluation. Alternative methods of measuring lean growth include weight of lean at constant live weight (commonly referred to as percent lean cuts), weight of lean at constant age, age at constant lean weight, weight of lean per day of age, and daily lean gain. Other selection criteria certainly exist. These latter traits seem to more accurately describe important biological functions than the selection index method, yet few people have applied this technology (Fowler et al., 1976).

The third stage of development incorporates feed consumption into the lean growth concept, resulting in a classification of traits that measure efficient lean growth. Early work with feed efficiency (Dickerson and Grimes, 1947), measured as a ratio of feed consumption to weight gain, does not truely fit into the efficient lean growth classification, but serves as an essential beginning. Once again, selection indexes have been constructed around the efficient lean growth concept. Feed efficiency may be refined by describing weight in terms of lean, creating traits such as feed consumption to constant lean weight or feed consumption per unit of lean gain. Several other measures of efficient lean growth are plausible. Many of the current swine breeding research programs at the state or federal level fall into the lean growth or efficient lean growth category. Data generated over the next few years by these experiments should provide valuable information necessary to update growth selection guidelines.

Surprisingly few selection experiments concerned directly with postweaning growth have been reported. This slide presents seven experiments which were chosen to illustrate the genetic consequences of growth rate selection. The experiments are presented in chronological order of initial reporting and relate to the development of growth selection concepts previously described. Each of these experiments will be briefly reviewed to note the direct and correlated responses to selection. Where applicable, the responses will be grouped into three broad phases of swine production; rate of reproduction, postweaning performance and pork quality.

The Illinois selection experiment was based on divergent selection for live weight adjusted to an age constant basis within each generation. Selection was practiced for 180-day weight in 1939, 40 and 41, 150-day weight in 1942 and 1943 and 154-day weight thereafter (Krider et al., 1946). Ten generations of selection for rapid growth and eight generations of selection for slow growth have been reported (Craig et al., 1956). Poor reproduction in the slow growth line resulted in it falling two generations behind the rapid growth line and direct comparisons between lines within years are not entirely appropriate. The table presents the differences between line means that occurred throughout the experiment for weight at birth, 21, 56, 154 and 180 days of age. Differences between lines increased as hogs became older and reached a maximum of 49.8 pounds for 180-day weight in 1949. Realized heritability was estimated to be 16 percent for 180-day weight, which agreed well with the regression estimate of 14 percent. The genetic correlations between 180-day weight and birth weight, 21-day weight and 56-day weight were 0, .33 and .80, respectively. There was no indication that selection response had declined during the 10 year period.

A 72-day feeding trial was conducted during the latter stages of the experiment and revealed marked line differences with regards to daily gain, feed consumption and feed efficiency (Baird et al., 1952). Rapid growth pigs gained .94 pounds per day, compared to .31 pounds for slow growth pigs. Feed consumption was 2.5 pounds versus 1.1 pounds and feed efficiency averaged 2.76 for the rapid line and 3.64 for the slow line.

An index including daily gain from weaning to 150 pounds formed the basis of selection under two levels of nutrition at Washington (Fowler and Ensminger, 1960). One line was full-fed, whereas the second line was restricted to 70% of ad libitum levels. Nine generations of data were reported. Realized daily gain heritabilities were 52% for the high plane of nutrition line and 49% for the low plane of nutrition line. The daily gain changes per generation were .056 pounds and .037 pounds, respectively. It was concluded that daily gain as measured under the two feeding regimes were actually different traits and that low plane of nutrition pigs increased in daily gain due to improved feed efficiency. The genetic correlation between the two traits was estimated to be a favorable -.70 which corresponds very well with literature values reported for daily gain and feed efficiency. This experiment vividly illustrated an interaction between genotype and plane of nutrition and indicated the importance of considering environmental conditions when defining traits.

The development of a minature strain of pigs for medical research was the objective of the Minnesota project (Dettmers et al., 1965). A synthetic population created from four sources of wild stock provided the foundation animals. The selection criterion was decreased 140-day weight. Over a ten-year period the observed decrease was 31.5 pounds or 36.5 percent. The change per year averaged 5.33 pounds since the last introduction of wild stock and no decrease in selection effectiveness was observed.

In 1959 the population was divided into two lines, each selected for decreased 140day weight for an additional nine generations (Dettmers et al., 1971). Figure 1 plots the generation means and presents the linear trends. Line B decreased .71 kilograms per generation for a 28 percent reduction since its formation. Due to a 1.21 kilogram decrease per generation, the total reduction in 140-day weight of the A line represented 40 percent of the foundation mean.

During this ten-year period, litter sizes at birth and weaning were recorded to monitor correlated reproductive responses to selection for decreased 140-day weight. The values of the B line are presented in table 3. Regression of the values on year resulted in an estimated genetic change per generation of -.04 for litter size at birth and .09 for litter size at weaning.

Weights were also recorded at 56 days of age and at 12 months of age (table 3). Very little change was observed in 56-day weight whereas 12 month weight decreased steadily.

Daily gain from weaning at 42 days of age to 90 kilograms was selected for in a controlled experiment conducted by the Canada Department of Agriculture (Rahnefeld, 1971). Eleven generations of selection averaged .013 ± .002 kilograms/generation for a total increase in daily gain of .146 ± .018 (Rahnefeld and Garnett, 1976). The estimate of realized heritability was .198 ± .016, only 61 percent of the anticipate value. The correlation between daily gain and feed efficiency was favorable with a magnitude of .346 (Rahnefeld, 1973). Realized improvement in feed efficiency amounted to .583 kilograms of feed per 100 kilograms of gain per generation.

The effects of daily gain selection on reproduction and preweaning growth characteristics were measured by the genetic trends adjusted for the control line means (Rahnefeld, 1976). Table 4 presents the estimates. It can be seen that reproduction was not affected by 11 generations of selection for daily gain. While number born did increase slightly, preweaning mortality also increased, which resulted in number weaned remaining stable over time. Birth weight likewise was unaffected, although preweaning daily gain and consequently weaning weight both increased significantly. An interesting significant decrease in gestation length also was noted, presumably indicating a negative correlation between gestation length and daily gain.

Divergent selection for lean gain was initiated in 1966 in Norway (Vangen, 1974). The high performance line was selected to give equal weight to increased daily gain and decreased backfat, when both traits were standardized. The low performance line selected for decreased daily gain and increased backfat. A control line was also maintained to estimate environmental trends.

Figure 3 presents the results of five generations of selection with respect to daily gain. Improvement of the high performance line averaged .004 kilograms per generation while a symmetric decrease of .004 kilograms per generation was noted in the low performance line.

Significant correlated responses were noted in feed efficiency due to lean growth selection. The high performance line had a favorable reduction in gross feed efficiency, as measured by feed over gain, of .054 kilograms of feed per kilogram of gain per generation. Less efficient feed conversion of .052 kilograms of feed per kilogram of gain occurred in the low performance line. It was noted that daily feed consumption remained relatively stable during the experiment (Vangen, 1977). This was felt to be a consequence of including backfat in the selection criterion. Appetite differences were not exploited in the high performance line, since animals with large appetites tended to become too fat. The opposite situation applied to the low performance line.

The effect of the feeding regime on the magnitude of the genetic correlation between daily gain and feed efficiency is of utmost importance. Under a restricted feeding scheme measured over a constant weight range, variation in feed efficiency can be practically accounted for by differences in growth. Stated more simply, the genetic correlation between daily gain and feed efficiency approaches unity (Vangen, 1977). Movement from restricted feeding towards full feeding allows greater expression of appetite differences and the genetic correlation between daily gain and feed efficiency is consequently lowered.

A similar selection experiment was reported by Candian researchers that consisted of three selection criteria; increased daily gain (measured from weaning to 200 pounds), decreased backfat adjusted to 200 pounds and a lean growth index combining increased daily gain and decreased backfat equally as in the previous experiment (Fredeen, 1976). Eight generations of data have been summarized. Figure 5 presents the daily gain generation means as a percentage of a control population. Daily gain increased six-tenths of a percent per generation in both the lean growth and daily gain lines, whereas the backfat line declined 1.6 percent per generation. This would suggest a positive genetic correlation between daily gain and backfat within the backfat line population.

The next slide illustrates the genetic trends with respect to average backfat. Backfat decreased 2 percent per generation in the backfat line, 1.8 percent in the lean growth line and six-tenths of a percent in the daily gain line. The trend of the daily gain line is interesting since it indicates a negative genetic correlation between daily gain and backfat. This conflicts with the observed daily gain trend of the backfat line and raises several questions. It is important to note that response in the lean growth line was of the same magnitude as the direct responses of both the daily gain and backfat lines. This must imply that increased daily gain and decreased backfat are compatible within this particular population. This conclusion was supported by the reported estimated genetic correlation between the two traits of -.23. Realized heritabilities of daily gain and backfat were .217 and .294 respectively, both in excellent agreement with paternal half-sib estimates.

Correlated responses of reproductive traits indicated no significant differences among lines. Services per conception, gestation length and litter size at both birth and weaning did not change significantly during selection. These results suggest that reproduction traits are uncorrelated, or at least lowly correlated, with daily gain, backfat and lean growth.

Table 5 presents the ninth generation correlated responses of carcass traits to selection as a percentage of the control mean. The lean growth line improved greatly in all measures of carcass merit as did the decreased backfat line. However, the daily gain line produced smaller loin eyes and possessed less lean in the loin than did the control pigs. This would imply that selection for growth alone may not improve carcass merit even though daily gain and backfat were favorably correlated within the daily gain line. The close correspondence between the backfat and lean growth lines indicated that selection for lean growth did not hinder carcass merit improvement. Correlated responses in pork quality of lean growth pigs were not detrimental with respect to product acceptability.

In 1972, the increased daily gain and decreased backfat lines were terminated and absorbed into the lean growth line (Sather, 1978). Barrows and gilts born in 1976 were assigned to individual feeding pens to provide complete data relating to performance. Pigs were fed ad libitum and slaughtered at 200 pounds. Table 6 presents various measures of performance

Differences between the lean growth and control lines were significant for each trait.

The lean growth pigs were superior to control pigs for all traits. Pigs of the lean growth line were heavier at birth, 42 days of age and 56 days of age, grew faster during the finishing phase and consequently reached market weight at a younger age than control pigs. Lean growth pigs also consumed less feed more efficiently, were leaner and had more desirable carcasses than pigs from the control line. Overall production efficiency apparently had been greatly improved through lean growth selection. The monetary value of the increased production efficiency was approximated to be $6.21 per pig.

The final lean growth selection experiment to be reviewed concerns research in Ohio aimed at evaluating alternative measures of lean growth (Leymaster et al 1978a,b). Lean growth was measured as weight of lean cuts at 160 days of age (WLC) and as weight of lean cuts at 180 pounds live weight. The later trait is typically referred to as percent lean cuts (PCLC). The traits were measured ultrasonically and select lines established for each trait.

Figure 7 shows the direct response to selection for weight of lean cuts and the correlated response of the percent lean cut line. Change per generation averaged .50 kilograms for the weight of lean cut line, while no obvious trend for the percent lean cut line was apparent. The next slide presents the direct response to selection for percent lean cuts and the correlated response of the weight of lean cut line. The percent lean cut line improved .38 percent per generation compared to .23 percent for the weight of lean cut line. Realized heritability values were 17.4 percent for weight of lean cuts and 32.5 percent for percent lean cuts. The genetic correlation between the two traits was estimated to be .22.

Associated changes of reproductive traits to lean growth selection are presented in table 7. The traits percent showing estrus and percent nonreturns were measured only on replacement animals. The percent lean cut line tended to have a higher percentage of gilts show estrus than the weight of lean cut line; however, this trait was quite variable from year to year. The two lines were very similar to one another for each of the remaining traits. In general, lean growth selection has influenced reproductive traits only slightly, if at all.

The estimated genetic change of correlated performance traits to lean growth selection is presented on the next slide. Ultrasonic backfat decreased in both lines but more rapidly in the percent lean cut line as expected. Conversely, daily gain increased at a rate twice as fast in the weight of lean cut line than the percent lean cut line. Also, the weight of lean cut line increased with respect to 160-day weight, whereas the percent lean cut line decreased approximatley half a pound per generation.

Table 9 presents correlated genetic changes per generation of carcass traits to selection for lean growth. Hogs of both lines increased in carcass length, decreased in backfat and increased in percent lean cuts. Weight of lean cut pigs decreased in loin eye area, whereas percent lean cut pigs increased. Trends of pork quality indicators were minor in each line and PSS or PSE symptoms have not been observed.

This review of swine growth rate selection experiments should demonstrate that growth rate may be defined in a virtually endless number of ways. The conclusions drawn from selection experiments are consequently made with understandable caution. Although direct and correlated responses often vary among experiments, one must realize that there is no basic necessity for agreement to occur. Breeds and even strains within breeds differ in their genetic composition, both relative to one another and over time. This implies that re-evaluation of genetic and phenotypic parameters may be necessary to fully utilize genetic theory.

Earl Lasley (1977) has developed a graph which I believe adequately illustrates the relationships among daily gain, backfat and feed efficiency that generally exists in the U. S. swine population. It shows that selection for daily gain favorably affects feed efficiency while increasing backfat. These relationships may not be linear, as he has indicated, and a point of diminishing returns could certainly exist. The inclusion of feed consumption into the set of traits increases the complexity further.

The genetic and phenotypic parameters assumed in developing the central test station selection index are presented in table 9. The resulting index fits into the efficient lean growth category discussed previously. Index selection should be rather effective and result in increased growth, more efficient feed conversion and improved carcasses. Correlated responses in the important areas of reproduction and pork quality should be very minor.

The swine industry is blessed with an animal that is extremely flexible with regards to genetic change. If swine producers avoid fads and short-term goals and apply available technology over an extended period, production efficiency and profits can be greatly increased. The determination of swine producers to effectively apply selection pressure must be encouraged and promoted.

After reviewing these growth rate selection experiments, it is obvious that precise answers to our questions are not always available. A more basic problem, however, lies in simply asking the appropriate questions. Further development of selection quidelines must involve more than the application of improved parameter estimates to selection index theory, although this is a necessary part of development. One must eventually clearly define and measure the biological functions that truly relate to pork production efficiency. The challenge rests with swine breeding researchers to explore new technologies and to be creative in their research programs.

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DEVELOPMENT OF GROWTH SELECTION CONCEPTS

1. Consideration of live weight and age (Growth)
    - a) live weight at constant age
    - b) age at constant live weight
    - c) weight per day of age
    - d) average daily gain
    - e) others

2. Consideration of live weight, age and composition (Lean Growth)
    - a) various indexes
    - b) weight of lean at constant live weight
    - c) weight of lean at constant age
    - d) age at constant lean weight
    - e) weight of lean per day of age
    - f) daily lean gain
    - g) others

3. Consideration of live weight, age, composition and feed consumption (Efficient Lean Growth)
    - a) feed efficiency
    - b) various indexes
    - c) feed consumption to constant lean weight
    - d) feed consumption per unit of lean gain
    - e) others

TABLE 1

GROWTH RATE SELECTION EXPERIMENTS

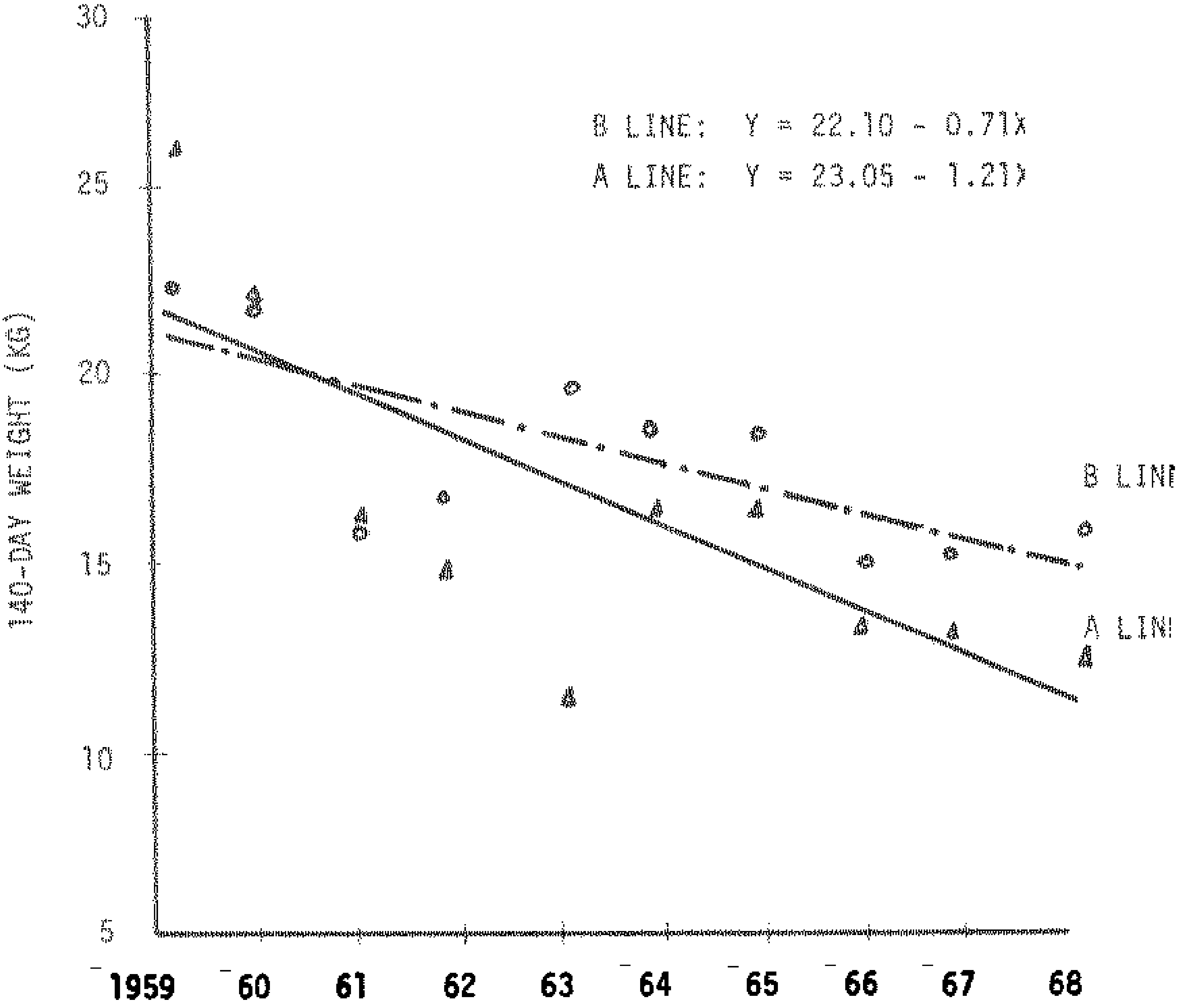
Location	Initial Report	Criteria
Illinois	1946	Divergent selection for weight at constant age
Washington	1960	Index including daily gain at two levels of nutrition
Minnesota	1965	Decreased 140-day weight
Canada	1971	Increased daily gain
Norway	1974	Divergent selection for lean growth
Canada	1976	Increased daily gain, decreased backfat, increased lean growth
Ohio	1978	Alternative measures of lean growth

TABLE 2

DIFFERENCES IN WEIGHT AT FIVE AGES BETWEEN UNSELECTED PROGENIES OF THE RAPID AND SLOW LINES FROM DAMS OF THE SAME AGE

	Generation		Line differences at indicated ages, lb. (R-S)				
Year	Rapid	Slow	Birth	21 days	56 days	154 days	180 days
1940	1	1	.05	-.3	-1.0	8.0	14.8
1941	2	2	.10	.4	1.3	8.2	9.9
1942	3	3	.00	5	2.4	26.1	33.3
1943	4	4	.18		3.6	20.2	22.9
1945	6	5	11	.3	6.8	36.9	46.0
1946	7	6	-.07	.0	3.6	24.4	30.8
1948	8	7	-.04	1.9	3.0	29.7	33.5
1949	10	8	-.36	.3	5.3	41.6	49.8
Unweighted difference			.00	44*	3.13**	24.39**	30.13**

Figure 1.

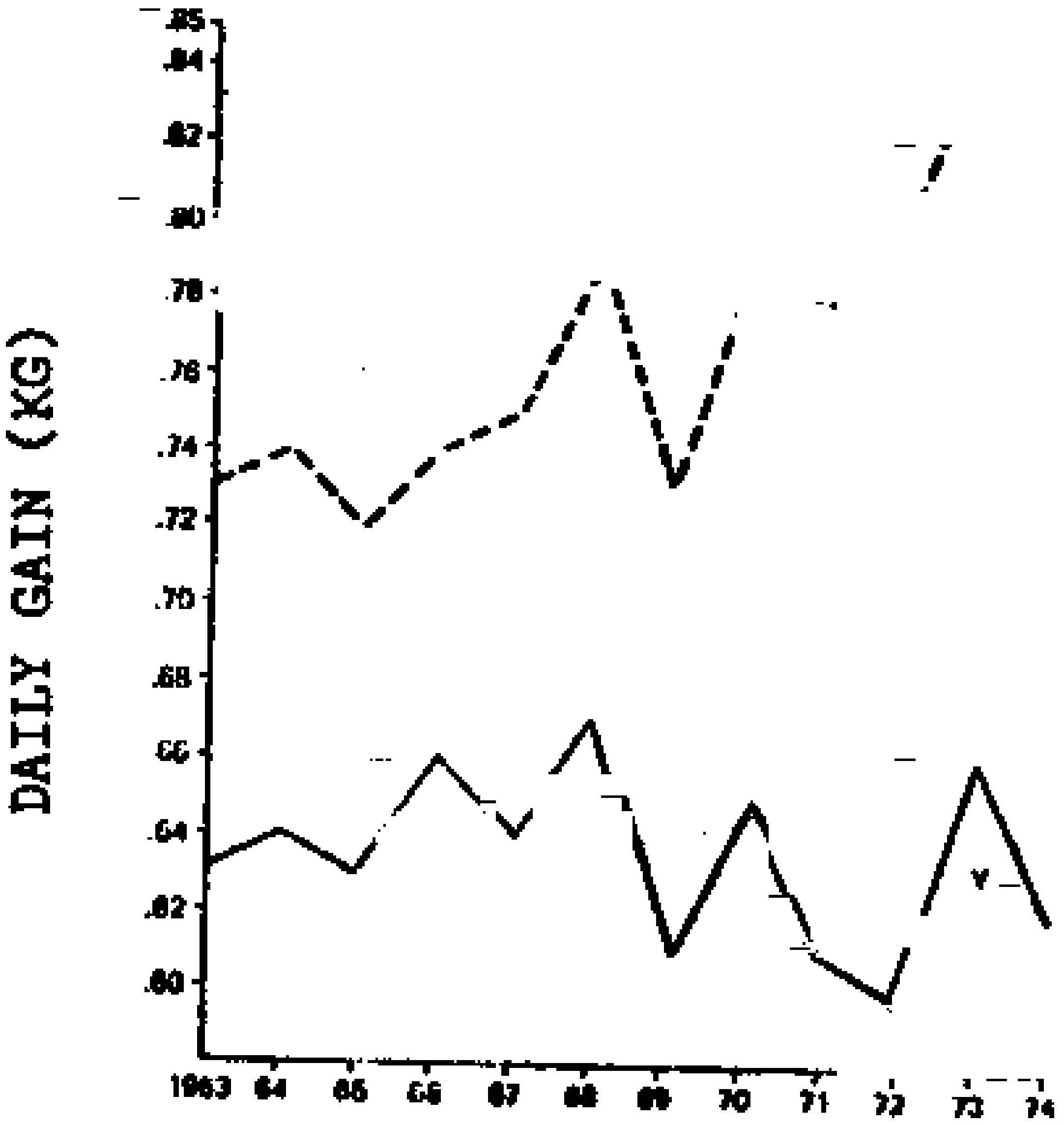


YEARLY MEAN FOR 140-DAY WEIGHT

TABLE 3

GENERATION MEANS OF VARIOUS TRAITS OF LINE B PIGS

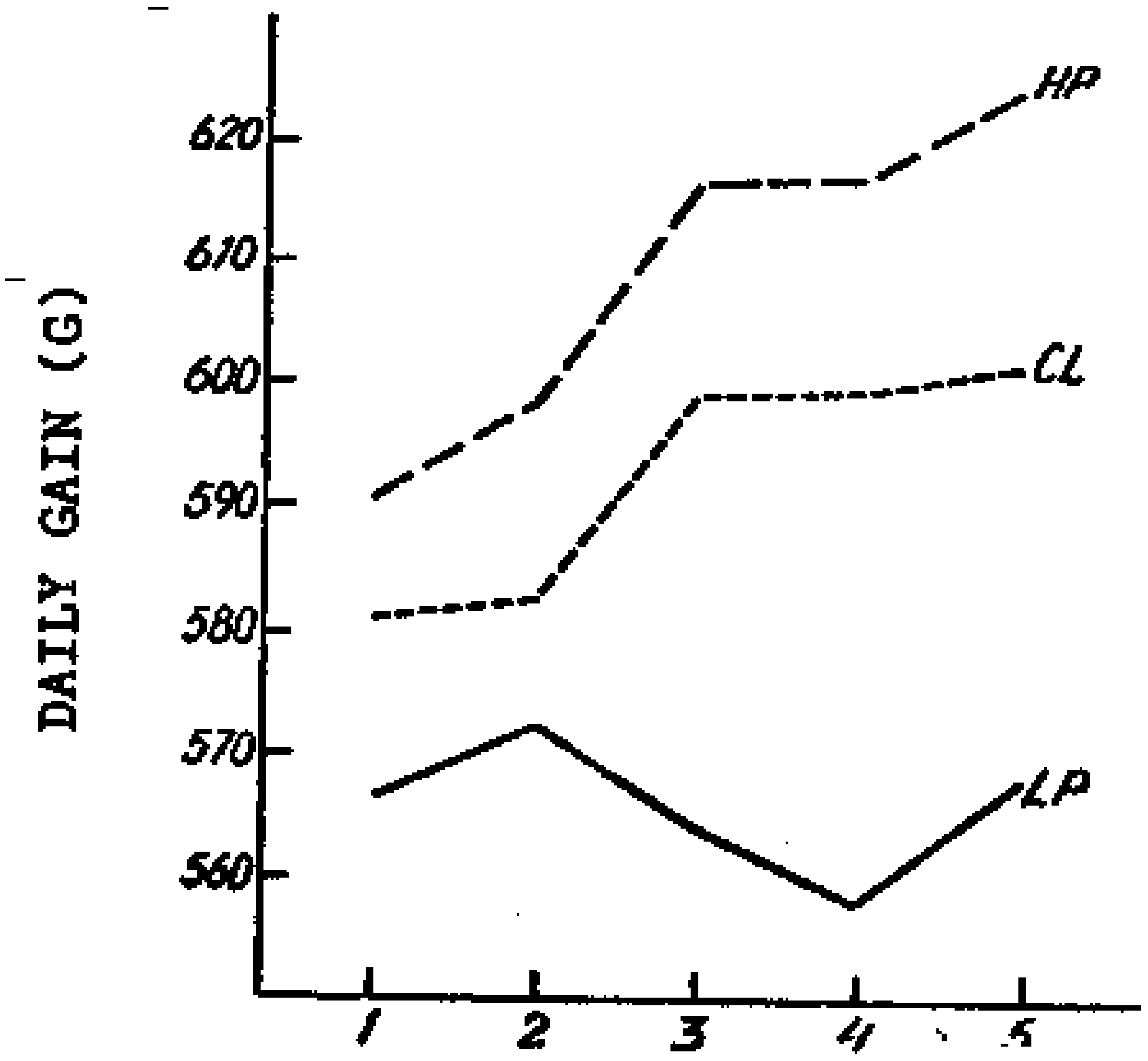
Year	No. of litters	Litter size		Live weight (kg)		
		Born	Weaned	56 days	140 days	12 months
1959	37	6.6	5.7	7.0	23.3	88
1960	32	6.7	4.4	6.4	21.3	83
1961	31	6.1	5.2	5.8	16.8	74
1962	25	5.6	3.9	5.4	17.0	84
1963	24	6.0	5.0	6.6	20.3	76
1964	30	5.7	4.6	5.9	18.8	66
1965	27	6.0	5.2	6.0	18.5	75
1966	28	5.6	5.2	6.1	15.1	78
1967	36	6.2	5.4	7.0	15.3	74
1968	22	5.1	4.3	6.8	15.7	57



YEARLY MEANS FOR DAILY GAIN
FIGURE 2

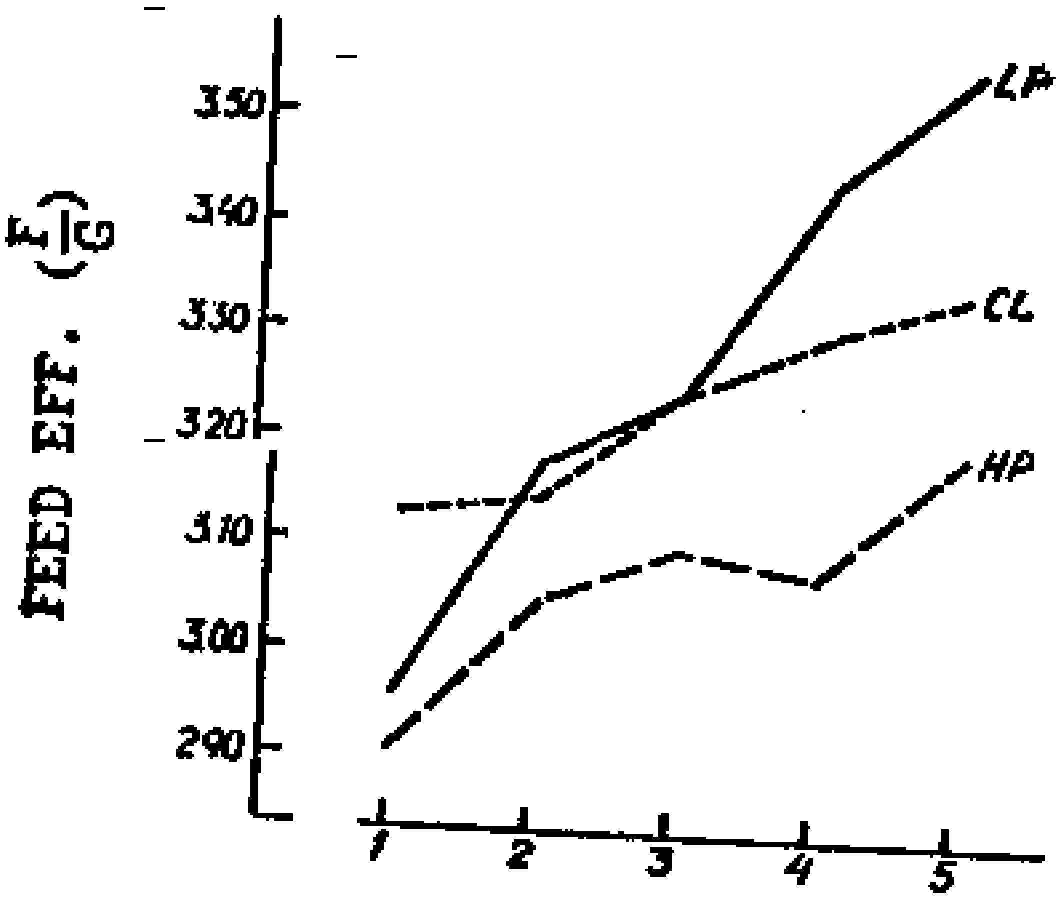
TABLE 4
CORRELATED RESPONSES OF REPRODUCTIVE TRAITS AND PREWEANING GROWTH TO DAILY GAIN SELECTION

Trait	Genetic Change Per Generation
Litter size	
Born	.072 ± .080
Born alive	.046 ± .082
Weaned	-.001 ± .069
Birth weight (kg)	.000 ± .005
Weaning weight (kg)	.177 ± .061
Preweaning mortality (%)	.69
Preweaning daily gain (kg)	.004 ± .001
Gestation length (days)	-.109 ± .001



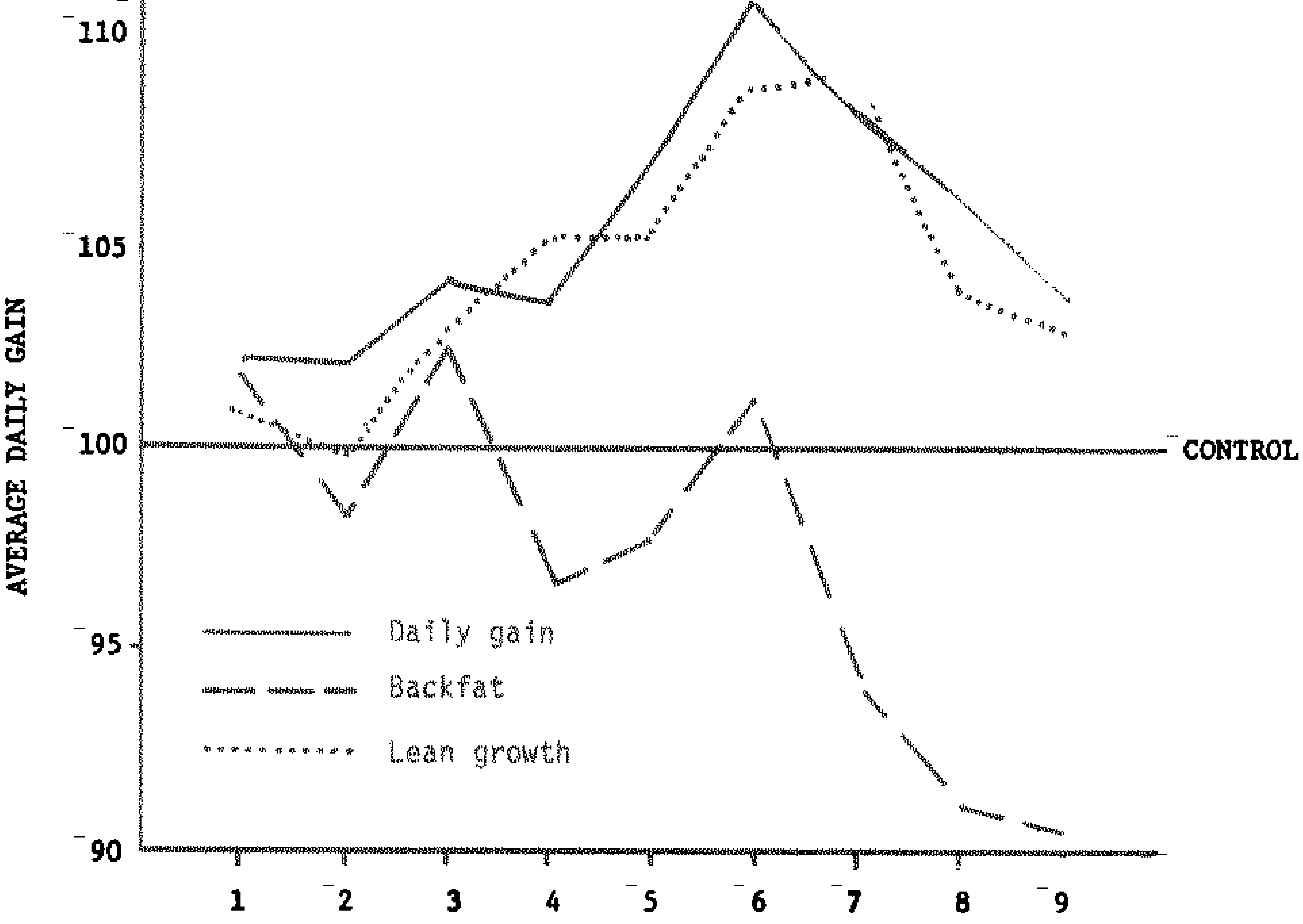
GENERATION MEANS FOR DAILY GAIN

FIGURE



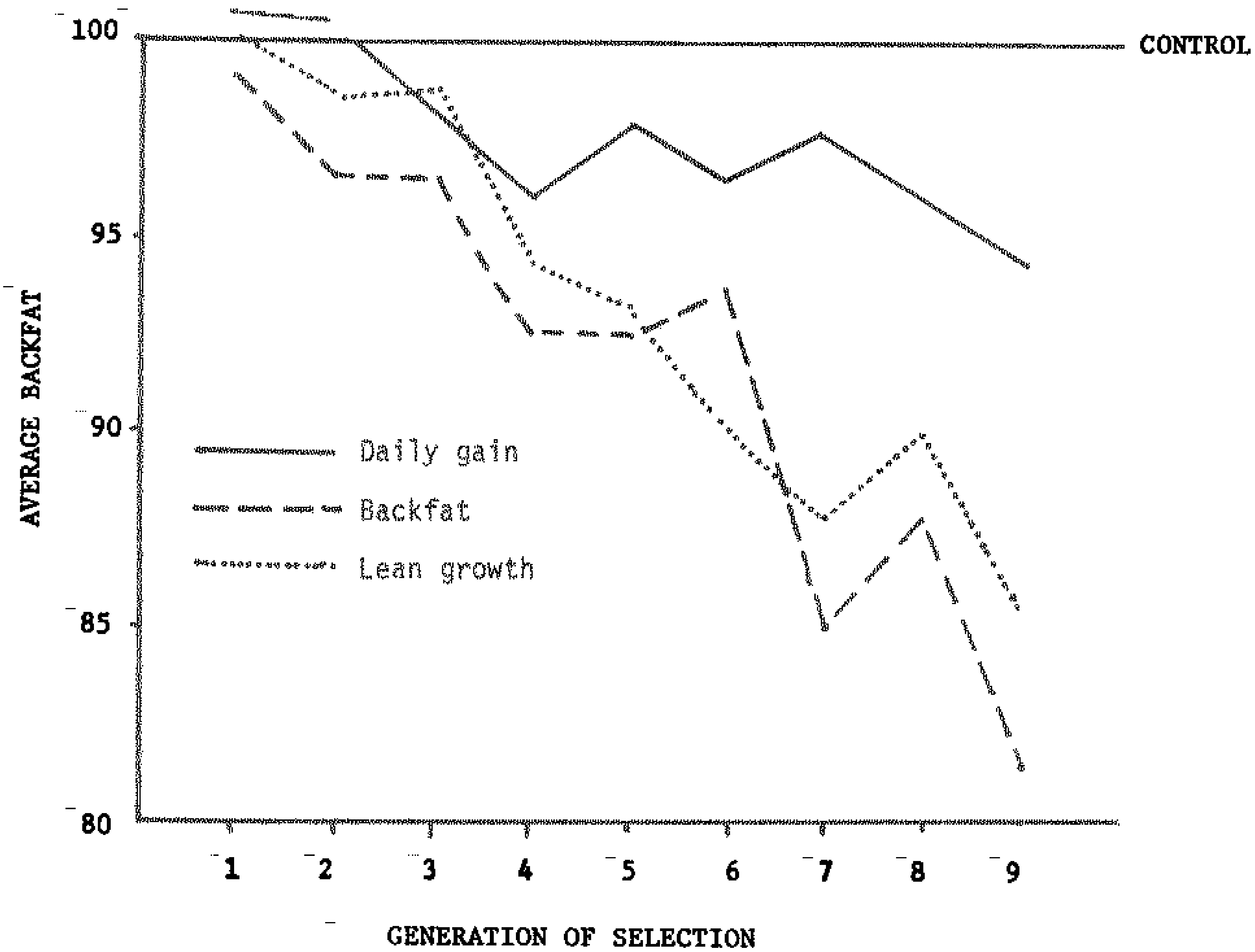
GENERATION MEANS FOR FEED EFFICIENCY

FIGURE 4



AVERAGE DAILY GAIN AS % OF CONTROL LINE

FIGURE 5



BACKFAT AS % OF CONTROL LINE

FIGURE 6

TABLE 5

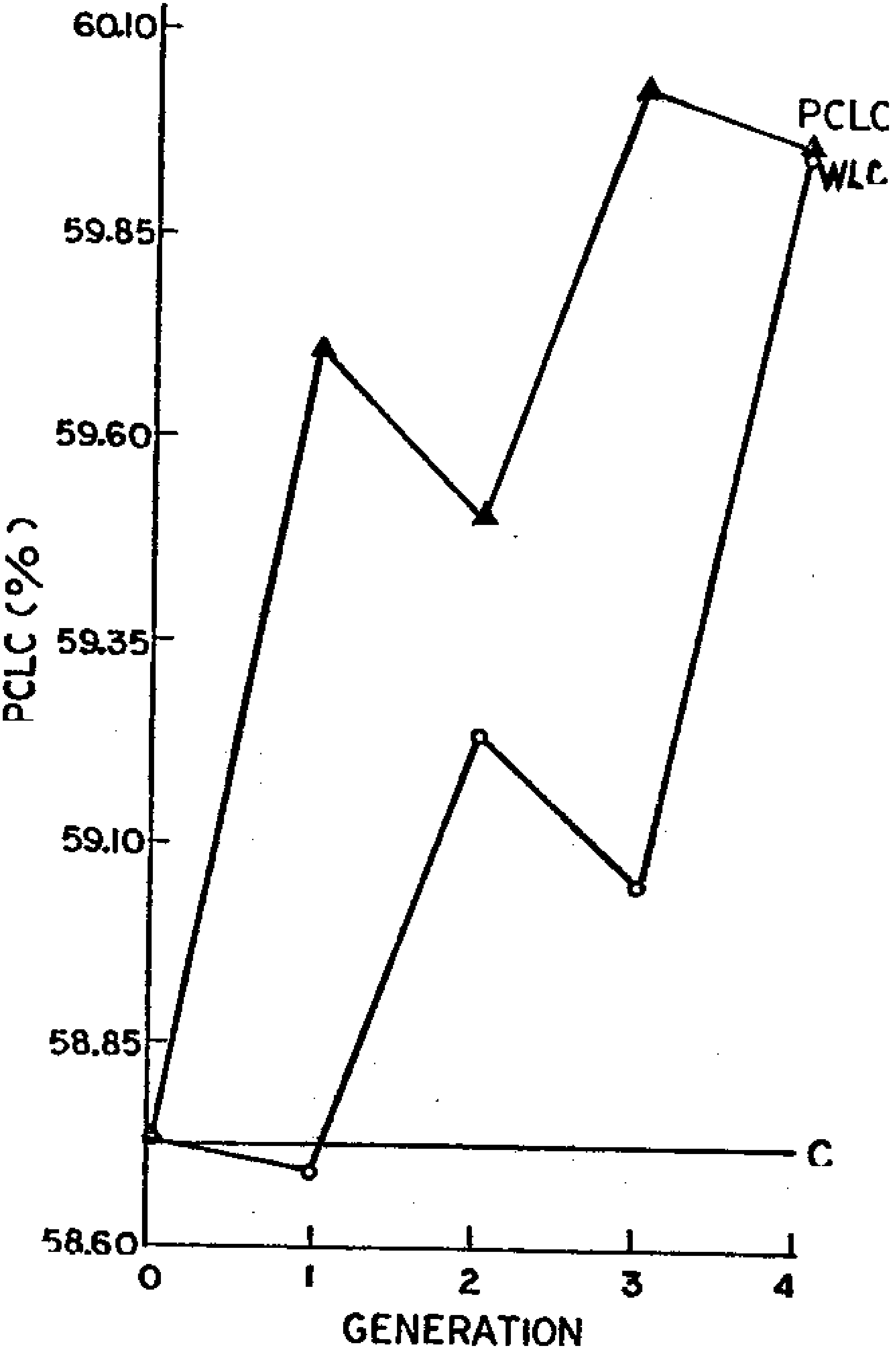
GENERATION 9 SELECTED LINE MEANS OF CARCASS TRAITS EXPRESSED AS PERCENTAGE OF CONTROL

Trait	Line Increased daily gain	 Decreased backfat	 Increased lean growth
Total fat	97	88	89
Grade index	101	104	103
Loin eye area	95	105	103
Percent lean of ham	101	108	111
Percent lean of loin	98	111	111
Age at slaughter	96	106	97
Number of pigs	95	93	131

TABLE 6

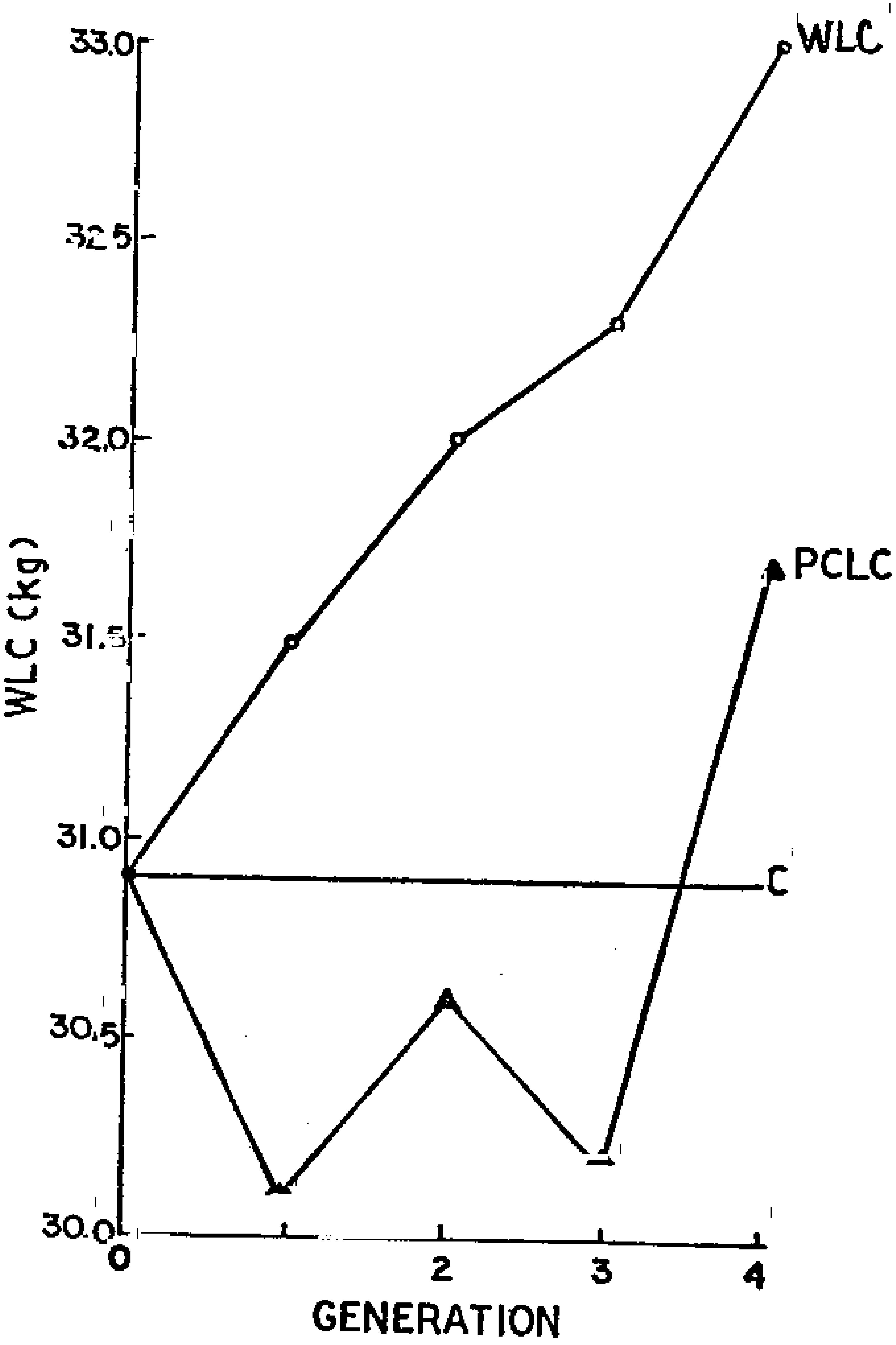
GENERATION 9 MEANS OF LEAN GROWTH AND CONTROL LINES FOR VARIOUS PERFORMANCE TRAITS

Trait	Line Increased lean growth	 Control	Standardized response
Birth weight (kg)	1.83 ± .04	1.65 ± .04	.68
42-day weight (kg)	14.8 ± .3	13.9 ± .3	.35
56-day weight (kg)	21.5 ± .4	20.0 ± .4	.52
Slaughter age (days)	133 ± 1	142 ± 1	-1.07
Daily gain (kg/day)	.887 ± .010	.818 ± .010	.94
Feed consumption (kg)	193 ± 2.2	213 ± 2.2	-1.22
Feed efficiency	2.81 ± .03	3.02 ± .03	-1.07
Backfat	1.65 ± .03	1.96 ± .03	-1.51
Carcass index	105.3 ± .4	102.0 ± .04	1.21



DIRECT RESPONSE TO SELECTION FOR PCLC AND CORRELATED RESPONSE IN WLC LINE

FIGURE 8



DIRECT RESPONSE TO SELECTION FOR WLC AND CORRELATED RESPONSE IN PCLC LINE

FIGURE 7

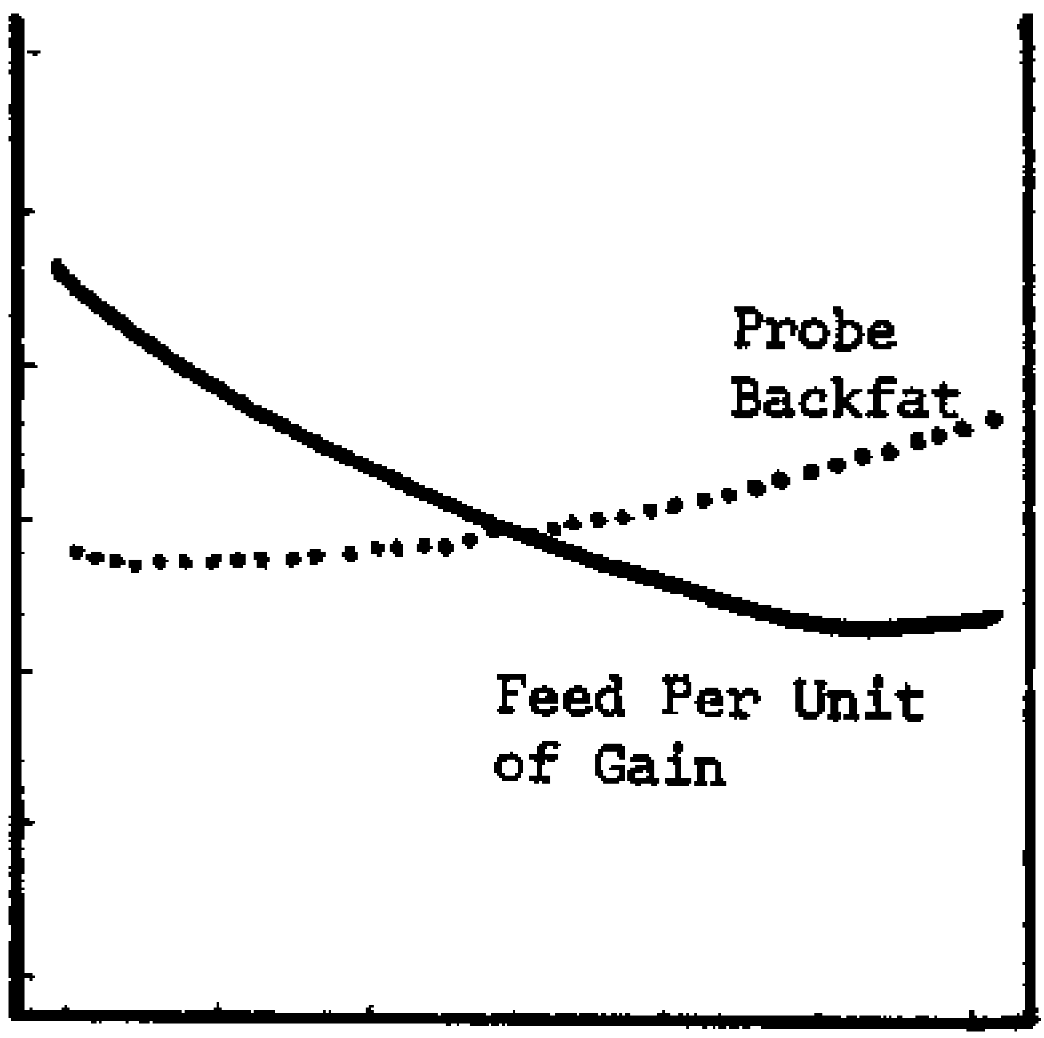


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TABLE 7
CORRELATED GENETIC CHANGE PER GENERATION OF REPRODUCTIVE TRAITS TO SELECTION FOR LEAN GROWTH (PRELIMINARY ESTIMATES)

Trait	Line	
	WLC	PCLC
Percent showing estrus	-2.25	
Percent nonreturns	-1.89	
Litter size per gilt exposed	.58	.27
Litter size per gilt mated	.50	.50
Litter size, birth	.12	.13
Litter size, 21 days	.03	.05

TABLE 8
CORRELATED GENETIC CHANGE PER GENERATION OF PERFORMANCE TRAITS TO SELECTION FOR LEAN GROWTH (PRELIMINARY ESTIMATES)

Trait	Line	
	WLC	PCLC
Backfat (in)	-.01	-.04
Daily gain (lb)	.04	.02
160-day weight (lb)	2.21	-.47

TABLE 9
CORRELATED GENETIC CHANGE PER GENERATION OF CARCASS TRAITS TO SELECTION FOR LEAN GROWTH (PRELIMINARY ESTIMATES)

Trait	Line	
	WLC	PCLC
Length (in)	.44	.11
Loin eye area (in^2)	-.11	.09
Backfat (in)	-.02	-.05
Percent lean cuts	.48	.54
Color	-.11	-.10
Firmness	-.13	.04
Marbling	-.05	.16