THE RELATIONSHIP BETWEEN BODY MEASUREMENTS AND PERFORMANCE PARAMETERS OF SELECTED BARROWS CARRIED TO HEAVY WEIGHTS

A SCALE (OR FRAME) STUDY LARGE SCALE VS. SMALL SCALE

by

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INTRODUCTION

Throughout the history of livestock production, man has continually searched for methods to determine which animals are best suited to supply his needs. Visual appraisel in the show ring, carcass comparison after slaughter, and production testing are a few examples of the tools used to determine superior animals. As the needs of man have changed, so has the type of animal needed also changed. In the early twentieth century, two distinct types of swine could be found- the lard type and the bacon type. They represented extremes in the selection for economically important products. In the middle part of the century, a third type of pig, the meat type, immerged taking advantage of both leanness and muscling. In the 1970's, the push by packers and people within the industry to carry market swine to heavier weights has brought a fourth type of pig onto the scene, the "big type". The "big type" has been described as big headed, big tailed, deep chested, big boned, deep jawed and late maturing. The theory is that such traits contribute to or indicate potential for improved growth rate and efficiency over the smaller type pigs.

The purpose of this study was to differentiate between large and small scale (frame) barrows by using a body measurement selection index initially, and then to evaluate these theories and determine the relationship between body measurements and performance of these pigs when grown to 136 kg. and then slaughtered.

LITERATURE REVIEW

Phillips and Dawson (1936) conducted a study to determine the accuracy of three methods of obtaining measurements of swine. The three methods studied were: A) direct body measurements taken with calipers and a steel tape measure, B) using a livestock scaling instrument, and C) photographing the animals and taking measurements from lifesize projections of these photographs. Method A delivered more accurate results than the other two methods in all measurements except length from ear to tail and length from shoulder to tail. The direct body measurements by caliper and tape measure also required less time and allowed the researchers to take circumference measurements.

Cole (1942) took measurements on 32 slaughter lambs to try to determine the relationship of type to average daily gain. The results showed that the average width of a lamb (width at the shoulder, rib, loin and rump) had the highest correlation with average daily gain, while depth of rack, width of forerib, average depth and average length of leg only slightly influenced gain.

Hetzer et al. (1953) measured 141 hogs to determine the relative value of certain body measurements for predicting the yield of lean meat. The eight live-hog measurements studied were: length from ear to tail, height at shoulders, width at shoulders, width of middle, width at hams, depth of chest, depth of middle, and circumference at chest. Repeatability of single measurements on the same hog gave values ranging from 0.56 for height at shoulders to 0.77 for width of middle. The predictive value of the measurements was not as high as desired but they felt it could be a valuable tool to estimate carcass yield.

Holland and Hazel (1958) reported on methods of determining fat thickness and lean meat yield. Measurements of body dimensions had only slight value for predicting percent lean cuts. In addition, the average of three backfat probes was the most accurate indicator of lean cuts when compared to other carcass measurements.

Flock, Carter, and Priode (1962) investigated the usefulness of birth observations on Hereford, Angus, and Shorthorn calves. The observations included seven linear body measurements taken within 24 hours after birth to be used for predicting weaning performance, mainly as an aid in preliminary sire selection. They found little value in using these measurements to predict post-weaning performance.

The relationships between linear ear measurements, ear type and performance on about 900 pigs was studied by Boylan, Rahsefeld, and Seal (1966). Measurements were taken at weaning and again at market weight with the results showing little relationship between ear type or size and the effect on postweaning growth rate, age at market, or backfat thickness.

Brown, Brown, and Butts (1974) took ten skeletal measures on bulls at four and eight months and derived the principle components from these measurements, i.e., size and shape. The skeletal measures and principle components were used separately in stepdown regression models to predict post-weaning gain, feed conversion, feed consumption and final test weight. Approximately 25 percent of the variation in test gain and 15 percent of the variation in feed conversion could be explained by models containing the measures.

Irlam, Hodson and Snyder (1975) used 112 crossbred barrows and gilts comparing type of pig (small frame, large frame), ration protein level

(12 vs. 15 percent) and ration calcium-phosphorus levels (0.62 - 0.52% vs. 0.80 - 0.70%). Both types of pigs were lean and meaty, however, the large frame pigs were visually selected to be longer and taller in body structure and less mature (not as round and bulging) in their muscle structure at the start of the trial. Pig type did not significantly affect protein or calcium-phosphorus requirement and ration protein level had no significant influence on calcium-phosphorus requirement at the levels tested. The large frame pigs tended to grow faster than the small frame pigs especially during the latter stages of the test.

Irlam, et al. (1975) took six measurements on the pigs in the previous trial at 36.1 kg. and again prior to slaughter at 106.1 kg. Measurements taken included: shoulder width, heartgirth width, ham width, body or heartgirth depth, heartgirth circumference and body length from poll to the base of the tail. The pigs had been classified into large and small frame classes visually. The large frame pigs had significantly smaller initial shoulder width, heartgirth width, body depth and heartgirth circumference measurements. Also, they had a smaller final shoulder width, heartgirth width, ham width and heartgirth circumference but a greater initial body length. Correlations of measurements with average daily gain include initial heartgirth circumference (.22) final body depth (.21), carcass backfat (.16), final heartgirth circumference (.19), and final body length (-.18). Measurements correlated with ham-loin percent included initial heartgirth width (-.22) and final heartgirth width (-.33). Loin eye area to body measurement correlations included initial shoulder width (.26), final ham width (.28) and final body depth (.25). Correlations of measurements with backfat included initial heartgirth width (.25), body depth (.20), heartgirth width (.34), shoulder width (.25), and heartgirth circumference (.27).

Barrows sent in by Texas purebred breeders were used in a frame study reported by Tanksley (1975). The pigs were assigned to big, medium, or small frame classes by visual assessment conducted by a committee of researchers and they were grown from 27 kg. to 136 kg. The study failed to reveal large or dramatic differences in performance and carcass characteristics of the pigs. As a group the large frame pigs tended to grow faster throughout the test period and were slightly more efficient (a small frame pig did have the highest gain). The study suggested that deep, thick chested pigs with large body volume tend to grow faster regardless of skeletal size class.

Large and medium framed animals had longer carcasses, less backfat, and yielded a higher percent of lean cuts per carcass than the small frame pigs. For most body measurements, skeletal size groups retained the same relative position at 136 kg. as they had at 32 kg. The widest and most consistent difference in body measurements that large framed pigs exhibited over medium and small groups was height off the ground. This suggested to the researchers involved that visual assessment placed most emphasis on length of leg in gauging skeletal size.

Robison (1976) noted the importance of rapid growth in market hogs and studies he summarized established a high relationship between rapid gains and efficient feed utilization. Also, a shorter feeding period increased pounds of pork produced, reduced overhead and labor costs and reduced risk of loss from accident or disease. Postweaning rate of growth appeared to be nearly linear for the ages and weights likely to be utilized in the near future. Backfat, fat or protein deposition in the carcass was nearly linearly associated with increases in weight or age. Since fat increased more rapidly than protein, there was a gradual change in their relative proportions. He felt the decrease in feed efficiency with increasing weights was primarily due to increased maintenance costs and not to increased fat deposition.

Fourteen body measurements were taken on a total of 259 boars at 30 kg. and again at 114 kg. by Conley (1976) to determine the relationship of body size and certain performance parameters. Measurements taken included three about the head, nine on the body and legs, and two on the tail. The leg measurements at 30 kg., front cannon circumference, forearm circumference, and back cannon circumference, were negatively (or desirably) correlated with age at 100 kg. and with feed efficiency from 30 kg. to 100 kg. Chest depth, chest width, and heartgirth at 30 kg. were positively (desirably) correlated with average daily gain the first 35 days on test. However, none of the chest measurements were significantly correlated with average daily gain from 35 days to 100 kg. Chest width at 30 kg. was positively (undesirably) correlated with feed efficiency from 30 kg. to 100 kg. and 114 kg. Additional measurements taken at 30 kg.- width between the ears and eyes, length of body, front leg length, width of stifle, and width of jaw, were poorly correlated with growth or efficiency. Tail circumference showed a negative correlation (desirable) with backfat at 100 kg., but was not significantly correlated with gain or efficiency. Regression analysis using the 30 kg. measurements to predict 100 kg. performance resulted in models with low r-square values.

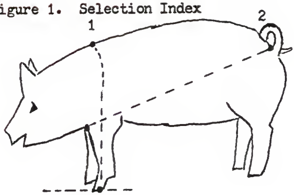
EXPERIMENTAL PROCEDURE

The question that kept arising was how to be objective in differentiating between large and small scale (frame) pigs to make a valid comparison? The previous studies cited in the literature review utilized visual appraisel initially to classify the differences in scale. A definition of scale or frame as a factor of height and length was the basis of this study. A selection index (Figure 1) was constructed by 1) measuring height from the midline at the shoulders to the floor, and 2) length from the point of the shoulder to the tail head. The two measurements were then multiplied together to form a numerical index. Selection indexes were compared in 2 to 3 kilogram intervals so that weight would not be a factor in the index.

Yorkshire barrows, weighing from 35-60 kg., were selected from the Kansas State University swine research herd and used for this trial if they had an index at least one standard deviation away from the index mean in their weight range. Barrows with an index above the mean one standard deviation were considered for use in the large scale pens and barrows with an index one standard deviation below were considered for use in the small scale pens.

Two trials were conducted, one in the summer and fall of 1975 and the other in the winter and spring of 1976. The trials were conducted in the finishing unit at the swine research farm, a fully slatted concrete floored, modified environment building. Pens were 1.8 by 4.9 meters and had a two hole feeder and an automatic waterer. Supplemental heat was supplied during the winter by overhead catalytic heaters. The pigs were fed a standard 16% crude protein milo-soybean meal diet throughout the test (Table 1). Feed and water were supplied <u>ad libitum</u>.

Figure 1. Selection Index



1) Height from the midline at the shoulders to the floor

2) Length from the point of shoulder to the tail head

3) Height x Length = Selection Index

Table 1. Composition of Diet

Ingredient	Percent[a]
Sorghum grain	76.45
Soybean meal (44%)	20.00
Dicalcium phosphate	1.40
Ground limestone	1.00
Salt	0.50
Trace mineral[b]	0.05
KSU premix[c]	0.50
Aureo SP-250	0.10

[a] Crude protein in ration, 15.9%

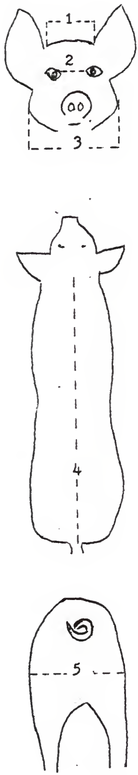
[b] Containing 0.1% cobalt, 1.1% copper, 0.15% iodine, 10% iron, 5.5% manganese and 20% zinc

[c] Amount per kilogram: 880,000 USP units of vitamin A, 66,000 USP units of vitamin D_3, 990 mg. of riboflavin, 2,640 mg. of d-pantothenic acid, 66,000 mg. of choline, 5,500 mg. of niacin, 4,400 I.U. vitamin E, 4.84 mg. of vitamin B_{12} and 12.54 g. preservative (BHT)

Growth parameters studied were start to 95 kg., start to 113 kg., start to 136 kg., and all interval average daily gains and feed per gains. Backfat probes were taken at 95 kg. and 113 kg. and carcass data were collected at 136 kg. Slaughter data included carcass weight, carcass backfat thickness, carcass length, shoulder weight, ham weight, loin weight, loin eye area, ham-loin percent, and lean cuts percent.

Thirteen body measurements were taken at 95 kg. and again at 136 kg. Instruments used in taking the measurements were a cloth measuring tape, wooden calipers, a backfat probe and knife, and a hog snare. Measurements taken (refer to Figure 2 and 3) included three about the head, nine on the body and legs, and one on the tail. Head measurements included width between the eyes taken from the inside corner of one eye to the inside corner of the other eye, width of skull between the ears, and width of jaw taken at the widest part of the jaw directly below the ears. The tail circumference measurement was taken at the base of the tail as close to the body as possible.

The measurements on the body included length taken from the atlanto-occipital joint to the base of the tail, heartgirth taken immediately behind the shoulders, and chest depth taken from the backbone to sternum just behind the elbow. Width of chest floor was measured immediately back of and parallel to the elbow. Stifle width was measured at the widest point of the ham. Front leg length was taken from the point of the elbow to the base of the hoof with the pig standing as correctly as possible. Forearm circumference was measured around the point of the elbow keeping the tape parallel to the floor and as close to the body as possible. The front cannon circumference was taken at the smallest part of the cannon bone equal distance between the knee and the pastern.

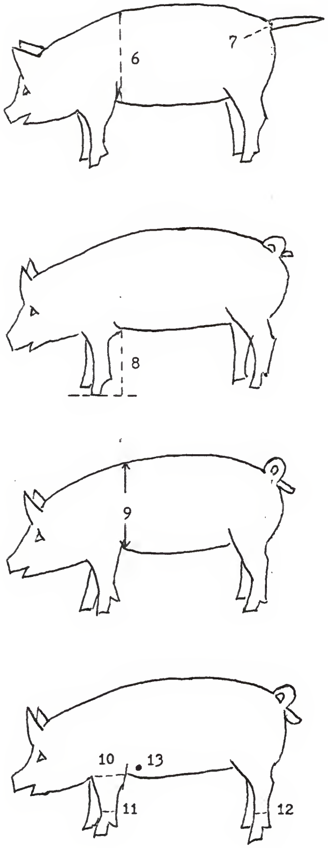


1. Width between ears
2. Width between eyes
3. Width of jaw

4. Length of body

5. Width of stifle

FIGURE 2.



6. Heartgirth
7. Tail circumference
8. Front leg length
9. Depth of chest
10. Forearm circumference
11. Front cannon circ.
12. Back cannon circ.
13. Chest floor width

FIGURE 3.

The back cannon circumference was taken midway between the hock and the pastern.

The experimental design (Figure 4) was a 2 x 2 factorial with two trials and two scales. Trial one had three pens each of large scale and small scale pigs repititioned on weight, sire, and scale, and initially having five barrows per pen. One large scale pig had pneumonia and never made the 136 kg. final weight. Trial two had two pens each of large scale and small pigs with one pig in the small scale group dying and one having pneumonia and never reaching the 136 kg. final weight. Feed efficiency was collected and calcutated on a pen basis which made a sample size of ten observations and led to problems in calculating correlations and regression equations. Measurements and probes were taken as close to 95, 113, and 136 kg. as possible to minimize error attributed to weight difference. Data were analyzed by the method of least squares. Simple correlations were determined and regression analysis was performed using the 113 kg. and 136 kg. performance and measurements as the dependent variables. The 95 kg. measurements were used as independent variables.

Figure 4. Experimental Design

		SCALE				
		Large		Small		Total
TRIAL 1	1	5 pigs	1	5 pigs	6 pens
	2	4 pigs	2	5 pigs	29 pigs
	3	5 pigs	3	5 pigs	
TRIAL 2	1	5 pigs	1	4 pigs	4 pens
	2	5 pigs	2	4 pigs	18 pigs
	5 pens	24 pigs	5 pens	23 pigs	10 pens 47 pigs

Trial 1 - Summer 1975

Trial 2 - Winter 1975-1976

RESULTS AND DISCUSSION

A. Selection Index

A difference was shown between the initial selection indexes (Table 2) of the large and small scale pigs (however, not significant at the $P < .05$ level). Using the same measurements at 95 kg. and at 136 kg. to form an index value, the difference between large and small scale pigs became negligible.

In addition, the outer extremity pigs (the two highest index pigs in large scale and two smallest index pigs in the small scale pens) were looked at to further separate the groups to significantly different levels ($P < .05$). The initial indexes showed this difference, but again at 95 kg. and at 136 kg. the indexes became similar with the small scale index average even being larger on trial 1 at 95 kg. (Table 3).

B. Performance

Average daily gain. A significant difference ($P < .05$) was found on average daily gain between large and small scale pigs (Table 4) from start to 95 kg. with large scale gaining 0.89 kg. compared to small scale at 0.83 kg. However, from start to 113 kg. and to 136 kg., no difference was noted. Figure 5 shows the interval average daily gain trend from 95 kg. to 136 kg. The gain dropped to 0.63 kg. and 0.69 kg. per day for the large scale and small scale groups from 95 to 113 kg. From 113 to 136 kg. the average daily gain dropped farther to 0.59 and 0.61 kg. per day for the large and small scale groups respectively. This negative trend is undesirable from a producers standpoint for both scale groups as they were grown to the heavy market weight.

Feed efficiency. Feed per gain from start to 95, 113, and 136 kg. (Table 4) showed no significant difference for either scale group.

Table 2. Average of Selection Index by Scale

	Initial Selection Index	95 kg. Selection Index	136 kg. Selection Index
Large Scale	3852	7395	9606
Small Scale	3367	7295	9490
Test 1 - LS	3922	7256	9515
Test 1 - SS	3311	7256	9316
Test 2 - LS	3781	7534	9697
Test 2 - SS	3423	7334	9664
Overall Average	3612	7325	9514
Standard Deviation	515	335	377

Table 3. Average of Selection Index by Scale - Extremes

	Initial Selection Index	95 kg. Selection Index	136 kg. Selection Index
Large Scale	4071*	7340	9699
Small Scale	3224*	7330	9525
Test 1 - LS	4200*	7190	9611
Test 1 - SS	3140*	7324	9468
Test 2 - LS	3943*	7490	9611
Test 2 - SS	3307*	7336	9582
Overall Average	3652	7319	9597
Standard Deviation	605	327	310

* Denotes significant difference $P < .05$

Table 4. Average of Performance Parameters by Scale and Trial

AVERAGE DAILY GAIN (Kilograms)	Start-95 kg. ADG	Start-113 kg. ADG	Start-136 kg. ADG	95-113kg. ADG	113-136kg. ADG
Large Scale	0.89*	0.79	0.73	0.64	0.59
Small Scale	0.83*	0.78	0.73	0.69	0.62
Trial 1	0.85	0.77	0.71	0.65	0.61
Trial 2	0.87	0.80	0.74	0.67	0.60

FEED EFFICIENCY	Start-95 kg. F/G	Start-113 kg. F/G	Start-136 kg. F/G	95-113 kg. F/G	113-136 kg. F/G
Large Scale	2.93	3.13	3.50	3.90	4.45
Small Scale	2.89	3.13	3.59	3.92	4.56
Trial 1	2.99	3.28	3.61	4.03	4.53
Trial 2	2.84	2.98	3.48	3.79	4.48

Table 5. Average of Carcass Parameters by Scale and Trial

BACKFAT-cm.	95 kg. Backfat Probe	113 kg. Backfat Probe	136 kg. Carcass Backfat
Large Scale	2.9	3.2	3.8
Small Scale	3.1	3.4	4.0
Trial 1	3.1	3.3	3.9
Trial 2	3.0	3.2	3.9

CARCASS	Carcass Length (cm)	Loin Eye (cm^2) Area	Lean Cut Percent	Ham-Loin Percent
Large Scale	85.6	39.7	57.8	39.9
Small Scale	84.7	39.7	57.5	40.1
Trial 1	85.9	40.2	57.8	40.5
Trial 2	84.4	39.2	57.5	39.5

* Significant difference $P < .05$

Figure 5. 95, 113, and 136 kg. Interval Average Daily Gain and Feed per Gain

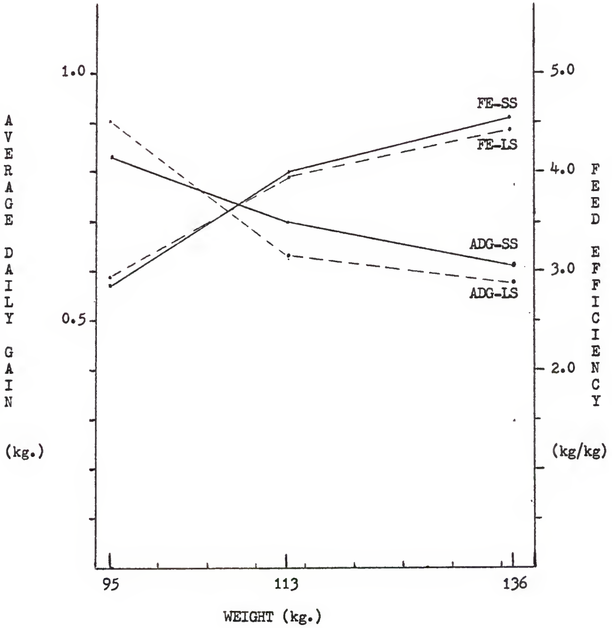


Figure 5 shows the undesirable trend for interval feed efficiency (from 95 to 136 kg.) when the pigs were carried to the heavy market weight. At 95 kg. the feed per gain ratio was less than 3 kg. of feed per kilogram of gain as compared to 4.5 kg. feed per kilogram of gain at 136 kg. An inverse relationship between average daily gain and feed per gain can be seen in Figure 5, agreeing with Robison's (1976) and Conley's (1976) observations. Feed intake per day during this time dropped for the large scale pigs. Feed intake from start to 95 kg. was 2.62 kg. per day, it fell to 2.45 kg. per day from 95 kg. to 113 kg. and dropped to 2.19 kg. per day from 113 to 136 kg. The small scale group daily feed intake was 2.44 kg. per day from start to 95 kg. In the 95 to 113 kg. interval, feed intake rose to 2.78 kg. per day, but fell to 2.39 kg. per day from 113 to 136 kg. Some of this decrease could be attributed to the pigs becoming stale because of the long period in the same pen (on concrete slats) for the entire test (4 to 5 months).

Carcass information. (Table 5) Backfat was not significantly different ($P < .05$) between large and small scale pigs, though the small scale pigs tended to be fatter at 95, 113, and 136 kg. There was also a noticeable increase in backfat depth from 95 to 136 kg. In addition, no significant difference was shown between different scale pigs for carcass length, loin eye area, lean cuts percent, or ham-loin percent.

C. Measurements

Analysis of variance revealed only one significant difference (Table 6) at 95 kg. ($P < .05$) in that chest depth was greater for large scale pigs (33.2 cm. to 32.7 cm.). At 136 kg. the only significant difference was that the large scale pigs had a longer front leg (37.0 cm. to 35.7 cm.).

Table 6. Measurement Averages By Scale

At 95 kg.	Eyes	Ears	Jaw	Tail C.	Front Cannon	Back Cannon
Large Scale	11.9	10.9	17.3	11.0	17.2	17.2
Small Scale	12.1	11.2	17.2	11.2	17.0	17.2
At 136 kg.						
Large Scale	13.6	12.8	19.5	12.6	18.3	18.3
Small Scale	13.4	12.9	19.3	12.5	18.2	18.2

At 95 kg.	Forearm	Front Leg Length	Length	Heart-Girth	Chest Width	Chest Depth	Stifle Width
Large Scale	37.4	32.7	113.1	105.6	18.5	33.2*	31.3
Small Scale	37.5	32.1	111.6	106.4	18.7	32.7*	31.6
At 136 kg.							
Large Scale	41.8	37.0*	128.0	120.3	20.6	38.3	33.8
Small Scale	41.5	35.7*	126.5	120.6	20.5	37.8	34.5

* Significant difference $P < .05$

This agreed with Tanksley's study that showed that height off the ground was the most consistent difference in body measurements.

Trial differences (Table 7) were readily apparent on the head measurements at 95 and 136 kg. The average measurement for eyes, ears and jaw width was larger ($P < .05$) on Trial 2 in all cases. In addition, chest depth at 136 kg. was larger in Trial 1 (38.6 to 37.5).

D. Correlations.

Correlations discussed include all necessary ones except feed efficiency which was left out because of the unrealistic figures caused by the small sample size (10 pen observations). Correlations are discussed by measurement group and are divided into overall, large, and small scale groups.

1. Average Daily Gain

a. 95 kg. Measurements.

Overall data. (Table 8 and 9) There were very few statistically significant correlations ($P < .05$) when comparing 95 kg. body measurements to average daily gain for overall data. Back cannon circumference was desirably correlated with S-113 kg. average daily gain (.32) and front leg length was undesirably correlated with S-113 and S-136 kg. average daily gain (-.39 and -.33, respectively).

Large scale. (Table 10 and 11) Correlations ($P < .05$) differing from the overall data were evident in three measurements. Chest width at 95 kg. was negatively (undesirably) correlated with S-136 and 113-136 kg. average daily gain (-.41 and -.42, respectively). Heartgirth was favorably correlated with 113-136 kg. average daily gain (.42) but tail circumference was negatively (undesirably) correlated with the same parameter (-.47).

Table 7. Measurement Averages By Trial

At 95 kg.	Eyes	Ears	Jaw	Tail C.	Front Cannon	Back Cannon
Trial 1	11.3*	10.4*	16.7*	10.9	17.1	17.2
Trial 2	12.7*	11.7*	17.7*	11.3	17.1	17.2
At 136 kg.						
Trial 1	12.9*	12.4*	16.7*	12.7	18.3	18.3
Trial 2	14.1*	13.2*	17.7*	12.3	18.1	18.2

At 95 kg.	Forearm	Front Leg Length	Length	Heart-girth	Chest Width	Chest Depth	Stifle Width
Trial 1	37.7	32.6	113.7	105.5	18.9	33.1	31.2
Trial 2	37.1	32.2	111.1	106.5	18.4	32.7	31.6
At 136 kg.							
Trial 1	42.0	36.3	128.9	120.0	20.1	38.6*	33.9
Trial 2	41.3	36.4	125.7	121.0	21.1	37.5*	34.4

* Significant difference $P < .05$

Table 8. Correlation Coefficients For Selected Performance Parameters and 95 kg. Measurements - Overall Data

	Eye	Ear	Length	Forearm	Front Cannon	Back Cannon	Heart-girth
S-95 kg. ADG	.05	-.10	-.04	-.17	.12	.28	-.19
S-113 kg. ADG	.16	.05	-.11	-.08	.11	.32*	-.05
S-136 kg. ADG	.11	-.01	-.05	.04	.00	.21	.13
95-113 kg. ADG	.08	.08	-.11	-.02	.05	.20	.01
113-136 kg. ADG	-.04	-.13	.03	.15	-.12	.05	.26
95-136 kg. ADG	.05	.02	-.05	.08	-.03	.13	.15
95 kg. Backfat	-.24	.08	-.06	-.12	-.33*	-.24	.38**
113 kg. Backfat	-.13	-.01	-.08	-.18	-.33*	-.16	.43**
136 kg. Backfat	-.02	.09	-.28	-.03	-.21	-.06	.28
Carcass Length	-.33*	-.13	.12	.27	.23	.15	-.49**
Loin Eye Area	-.15	-.17	.10	.04	.09	-.01	-.06
Lean Cuts Percent	.02	-.11	-.09	.13	.23	.15	-.46**
Ham-Loin Percent	-.11	-.21	.02	.12	.17	.12	-.54**

* $P < .05$

** $P < .01$

Table 9. Correlation Coefficients For Selected Performance Parameters And 95 kg. Measurements - Overall Data

	Front Leg Length	Tail C.	Chest Width	Chest Depth	Stifle Width	Jaw Width
S-95 kg. ADG	-.28	-.05	-.04	-.04	.16	.06
S-113 kg. ADG	-.39**	-.09	.04	-.17	.02	.13
S-136 kg. ADG	-.33*	-.24	-.06	-.07	-.11	.11
95-113 kg. ADG	-.29	-.07	.20	-.18	-.09	.11
113-136 kg. ADG	-.17	-.38	-.10	.17	-.14	.05
95-136 kg. ADG	-.25	-.23	.04	.00	-.15	.10
95 kg. Backfat	-.01	-.28	.35*	.21	-.18	-.02
113 kg. Backfat	-.09	-.29	.42*	.06	-.16	.02
136 kg. Backfat	-.14	-.33*	.40**	.14	-.12	.19
Carcass Length	.11	-.11	-.04	.10	-.20	-.06
Loin Eye Area	.11	-.09	.00	-.16	.07	-.07
Lean Cuts Percent	.01	.19	-.07	-.34*	.22	-.07
Ham-Loin Percent	.05	.24	-.11	-.27	.15	-.15

* $P < .05$

** $P < .01$

Table 10. Correlation Coefficients For Selected Performance Parameters And 95 kg. Measurements - Large Scale Data

	Eye	Ear	Length	Forearm	Front Cannon	Back Cannon	Heart-girth
S-95 kg. ADG	.16	.07	-.10	-.22	.02	.21	-.08
S-113 kg. ADG	.30	.23	-.10	-.13	.09	.32	.12
S-136 kg. ADG	.21	.11	-.02	.09	-.03	.22	.33
95-113 kg. ADG	.23	.22	-.07	-.18	.12	.34	.13
113-136 kg. ADG	-.07	-.14	.10	.23	-.18	.06	.42*
95-136 kg. ADG	.12	.09	.02	.07	.00	.25	.30
95 kg. Backfat	-.30	.04	.09	-.12	-.36	-.27	.08
113 kg. Backfat	-.14	-.05	.10	-.12	-.35	-.19	.23
136 kg. Backfat	.06	.21	-.17	-.13	-.24	-.13	.06
Carcass Length	-.35	.01	-.15	.29	.18	.17	-.48*
Loin Eye Area	-.23	-.28	.22	.14	.24	.09	-.10
Lean Cuts Percent	-.06	.40	-.17	.09	.18	.02	-.43*
Ham-Loin Percent	-.19	-.22	-.05	.05	.16	.06	-.56**

* $P < .05$

** $P < .01$

Table 11. Correlation Coefficients For Selected Performance Parameters And 95 kg. Measurements - Large Scale Data

	Front Leg Length	Tail C.	Chest Width	Chest Depth	Stifle Width	Jaw Width
S-95 kg. ADG	-.38	.23	-.24	.10	.24	-.22
S-113 kg. ADG	-.39	.10	-.26	-.17	-.01	.05
S-136 kg. ADG	-.35	-.19	-.41*	-.18	-.19	-.01
95-113 kg. ADG	-.28	.01	-.08	-.11	-.07	.17
113-136 kg. ADG	-.19	-.47*	-.42*	-.08	-.26	-.19
95-136 kg. ADG	-.26	-.25	-.28	-.02	-.24	.01
95 kg. Backfat	-.06	-.33	.20	.16	-.39	-.20
113 kg. Backfat	-.12	-.35	.24	-.07	-.38	-.17
136 kg. Backfat	-.11	-.30	.28	.05	-.40	.13
Carcass Length	-.02	-.07	-.05	.16	.01	.08
Loin Eye Area	.11	.21	.07	-.17	.13	.00
Lean Cuts Percent	.05	.20	.03	-.27	.35	.16
Ham-Loin Percent	.05	.19	-.03	-.15	.28	.00

* P <.05

** P<.01

Table 12. Correlation Coefficients For Selected Performance Parameters And 95 kg. Measurements - Small Scale Data

	Eye	Ear	Length	Forearm	Front Cannon	Back Cannon	Heart-girth
S-95 kg. ADG	.00	-.29	-.14	-.09	.09	.31	-.17
S-113 kg. ADG	-.03	-.25	-.15	-.03	.13	.32	-.23
S-136 kg. ADG	-.01	-.22	-.07	-.03	.07	.21	-.11
95-113 kg. ADG	-.11	-.15	-.07	.08	.10	.15	-.21
113-136 kg. ADG	-.02	-.14	-.01	.07	-.01	.06	.07
95-136 kg. ADG	-.05	-.13	-.05	.06	.02	.09	-.07
95 kg. Backfat	-.24	.08	-.11	-.16	-.22	-.19	.59**
113 kg. Backfat	-.16	-.02	-.18	-.27	-.24	-.10	.55**
136 kg. Backfat	-.19	-.24	-.36	.06	-.02	.08	.49*
Carcass Length	-.29	-.30	.34	.29	.22	.08	-.45*
Loin Eye Area	-.05	-.02	-.02	-.05	-.09	-.09	-.03
Lean Cuts Percent	.13	.03	-.01	.18	.20	.23	-.52*
Ham-Loin Percent	.01	.01	.14	.22	.17	.15	-.60**

* $P < .05$

** $P < .01$

Table 13. Correlation Coefficients For Selected Performance Parameters And 95 kg. Measurements - Small Scale Data

	Front Leg Length	Tail C.	Chest Width	Chest Depth	Stifle Width	Jaw Width
S-95 kg. ADG	-.42*	-.34	.17	-.17	.18	.17
S-113 kg. ADG	-.44*	-.39	.31	-.21	.07	.20
S-136 kg. ADG	-.31	-.36	.20	.00	-.03	.24
95-113 kg. ADG	-.21	-.27	.34	-.14	-.16	.15
113-136 kg. ADG	-.12	-.31	.08	.32	-.05	.25
95-136 kg. ADG	-.18	-.31	.20	.13	-.11	.23
95 kg. Backfat	.15	-.35	.44*	.46*	-.06	.18
113 kg. Backfat	.04	-.32	.53**	.34	-.01	.22
136 kg. Backfat	-.06	-.54**	.53**	.48*	.17	.37
Carcass Length	.15	-.12	.00	-.08	-.39	-.24
Loin Eye Area	.11	-.07	-.05	-.18	.03	-.12
Lean Cuts Percent	-.04	.20	-.14	-.46*	.09	-.26
Ham-Loin Percent	.08	.34	-.21	-.46*	-.01	-.32

* $P < .05$

** $P < .01$

Small scale. (Table 12 and 13) The small scale group had a negative (undesirable) correlation ($P < .05$) between front leg length and average daily gain from S-95 and S-113 kg. (-.42 and -.44, respectively).

b. 136 kg. Measurements.

Overall data. (Table 14 and 15) Heartgirth circumference was positively correlated ($P < .05$ and $P < .01$) with average daily gain from S-113, S-136, 95-113, 113-136, and 95-136 kg. (.45, .52, .35, .36, and .45, respectively). Chest width was positively (desirably) correlated with S-95, S-113, and S-136 kg. average daily gains (.35, .47, and .46 respectively). These results agree with the studies of Irlam et al. (1975) and Conley (1976). Back cannon circumference was positively correlated ($P < .05$) with 95-136 kg. average daily gain (.30) and tail circumference was negatively (undesirably) correlated with 113-136 kg. average daily gain (-.33).

Large scale. (Table 16 and 17) The large scale data correlations (showing statistical significance) agreed with the overall data correlations with one additional measurement, body length, being negatively (undesirably) correlated ($P < .05$) with S-136, 113-136, and 95-136 kg. average daily gains (-.45, -.44, and -.45 respectively).

Small scale. (Table 18 and 19) The small scale group did not show as many statistically significant correlations of the 136 kg. measurements to average daily gains. Heartgirth was positively correlated ($P < .05$) with S-95 and S-113 kg. average daily gain (.48 and .45 respectively). Chest width also had a positive correlation with the same two parameters (.64 and .56, respectively).

Table 14. Correlation Coefficients For Selected Performance Parameters And 136 kg. Measurements - Overall Data

	Eye	Ear	Length	Forearm	Front Cannon	Back Cannon	Heart-girth
S-95 kg. ADG	.18	.03	.26	-.03	.12	.11	.17
S-113 kg. ADG	.21	.02	-.06	-.02	.21	.26	.45**
S-136 kg. ADG	.14	-.10	-.20	-.14	.13	.27	.52**
95-113 kg. ADG	.11	-.04	-.14	.10	.25	.28	.35*
113-136 kg. ADG	.00	-.24	-.16	-.18	.01	.21	.36*
95-136 kg. ADG	.08	-.15	-.19	-.08	.16	.30*	.45**
95 kg. Backfat	-.24	.15	-.16	-.24	-.38**	-.22	.23
113 kg. Backfat	-.18	.00	-.30*	-.10	-.23	-.08	.38**
136 kg. Backfat	-.06	.20	-.37*	-.03	-.14	-.04	.36**
Carcass Length	-.20	-.16	.31*	.31*	.25	.22	-.13
Loin Eye Area	-.31*	-.19	.09	-.04	.03	-.01	-.07
Lean Cuts Percent	-.06	.04	.13	.37**	.17	.01	-.42**
Ham-Loin Percent	-.19	-.04	.28	.31*	.14	-.03	-.42**

* $P < .05$

** $P < .01$

Table 15. Correlation Coefficients For Selected Performance Parameters And 136 kg. Measurements - Overall Data

	Front Leg Length	Tail C.	Chest Width	Chest Depth	Stifle Width	Jaw Width
S-95 kg. ADG	.06	.12	.35*	-.01	.02	.04
S-113 kg. ADG	-.08	.01	.47**	-.03	.12	.04
S-136 kg. ADG	-.12	-.17	.46**	-.03	.17	-.03
95-113 kg. ADG	-.16	-.05	.23	.03	.09	-.05
113-136 kg. ADG	-.16	-.33*	.22	-.01	.14	-.15
95-136 kg. ADG	-.20	-.19	.27	.04	.14	-.09
95 kg. Backfat	-.36*	-.26	-.17	.08	-.07	-.14
113 kg. Backfat	-.38**	-.31*	.04	-.02	-.08	-.03
136 kg. Backfat	-.26	-.38**	.06	.10	.16	-.02
Carcass Length	.42**	.02	-.18	.26	-.01	-.34*
Loin Eye Area	.03	.10	-.23	-.08	.09	.00
Lean Cuts Percent	.19	.31*	-.23	-.21	.09	-.05
Ham-Loin Percent	.21	.39**	-.41**	-.06	.09	-.14

* $P < .05$

** $P < .01$

Table 16. Correlation Coefficients For Selected Performance Parameters And 136 kg. Measurements - Large Scale Data

	Eye	Ear	Length	Forearm	Front Cannon	Back Cannon	Heart-girth
S-95 kg. ADG	.20	.07	.30	.14	.11	.11	.04
S-113 kg. ADG	.28	.03	-.19	.05	.23	.32	.46*
S-136 kg. ADG	.18	-.13	-.45*	-.09	.18	.41*	.60**
95-113 kg. ADG	.25	-.05	-.31	.08	.31	.39	.53**
113-136 kg. ADG	.00	-.30	-.44*	-.18	.07	.36	.46*
95-136 kg. ADG	.15	-.20	-.45*	-.07	.26	.48*	.62**
95 kg. Backfat	-.29	.19	-.19	-.28	-.45*	-.21	.14
113 kg. Backfat	-.16	-.01	-.33	-.09	-.19	.05	.40
136 kg. Backfat	-.06	.20	-.50*	.00	-.20	-.02	.40
Carcass Length	-.25	-.04	.16	.32	.27	.18	.04
Loin Eye Area	-.32	-.18	.18	.10	.12	-.10	-.15
Lean Cuts Percent	-.16	-.03	.20	.35	.35	-.20	-.42*
Ham-Loin Percent	-.25	-.09	.36	.27	.16	-.24	-.43*

* $P < .05$

** $P < .01$

Table 17. Correlation Coefficients For Selected Performance Parameters And 136 kg. Measurements - Large Scale Data

	Front Leg Length	Tail C.	Chest Width	Chest Depth	Stifle Width	Jaw Width
S-95 kg. ADG	-.20	.28	.12	-.10	.05	-.02
S-113 kg. ADG	-.22	.02	.41*	-.12	.22	.11
S-136 kg. ADG	-.15	-.25	.51*	-.13	.29	.04
95-113 kg. ADG	-.21	-.13	.38	-.07	.26	.13
113-136 kg. ADG	-.07	-.49*	.40	-.08	.22	-.17
95-136 kg. ADG	-.16	-.33	.46*	-.04	.26	.00
95 kg. Backfat	-.24	-.40	-.18	.14	.04	-.30
113 kg. Backfat	-.24	-.53**	.19	.03	.05	-.12
136 kg. Backfat	-.17	-.51*	.08	.04	.24	.03
Carcass Length	.42*	.08	-.38	.27	.13	-.35
Loin Eye Area	-.02	.30	-.25	.04	.03	-.22
Lean Cuts Percent	.19	.35	-.39	.16	.05	.24
Ham-Loin Percent	.24	.44*	-.50*	-.29	.15	-.11

* $P < .05$

** $P < .01$

Table 18. Correlation Coefficients For Selected Performance Parameters And 136 kg. Measurements - Small Scale Data

	Eye	Ear	Length	Forearm	Front Cannon	Back Cannon	Heart-girth
S-95 kg. ADG	.06	.03	.09	-.29	.05	.01	.48*
S-113 kg. ADG	.11	.03	.14	-.12	.19	.12	.45*
S-136 kg. ADG	.10	-.07	.22	-.22	.06	.04	.39
95-113 kg. ADG	.04	-.05	.15	.16	.28	.25	.12
113-136 kg. ADG	.02	-.18	.25	-.18	-.04	.01	.22
95-136 kg. ADG	.05	-.11	.22	-.08	.09	.12	.23
95 kg. Backfat	-.12	.07	-.05	-.20	-.26	-.20	.36
113 kg. Backfat	-.16	-.02	-.20	-.12	-.24	-.22	.36
136 kg. Backfat	.01	.17	-.04	-.05	.04	.00	.27
Carcass Length	-.21	-.28	.49*	.31	.18	.25	-.41
Loin Eye Area	-.31	-.20	-.03	-.19	-.08	.11	.03
Lean Cuts Percent	.07	.14	.03	.40	.36	.35	-.43*
Ham-Loin Percent	-.09	.04	.14	.39	.44*	.46*	-.41

* $P < .05$

** $P < .01$

Table 19. Correlation Coefficients For Selected Performance Parameters And 136 kg. Measurements - Small Scale Data

	Front Leg Length	Tail C.	Chest Width	Chest Depth	Stifle Width	Jaw Width
S-95 kg. ADG	-.10	-.05	.64**	.01	.18	.02
S-113 kg. ADG	-.03	.00	.56**	.08	.02	-.09
S-136 kg. ADG	-.09	-.06	.40	.10	.02	-.12
95-113 kg. ADG	.08	.02	.11	.19	-.17	-.20
113-136 kg. ADG	-.20	-.16	.04	.10	.03	-.11
95-136 kg. ADG	-.09	-.06	.10	.16	-.07	-.16
95 kg. Backfat	-.31	-.14	-.16	.08	-.31	-.13
113 kg. Backfat	-.37	-.10	-.10	-.02	-.34	.15
136 kg. Backfat	-.17	-.23	.07	.27	-.08	-.03
Carcass Length	.36	-.06	.03	.22	-.07	-.41
Loin Eye Area	.05	-.09	-.21	-.20	.16	.27
Lean Cuts Percent	.21	.27	-.04	-.12	.03	.03
Ham-Loin Percent	.30	.35	-.27	.13	-.06	.13

* $P < .05$

** $P < .01$

2. Backfat

a. 95 kg. Measurements.

Overall data. (Table 8 and 9) Chest width at 95 kg. was positively (undesirably) correlated ($P<.01$) with 95, 113, and 136 kg. backfat measurements (.35, .42, and .40, respectively) as was heartgirth circumference with 95 and 113 kg. backfat probes (.38 and .43). This agrees with the results of the study of Irlam et al. (1975). Front cannon circumference was negatively (desirably) correlated with 95 and 113 kg. backfat probes (-.33 for both) and tail circumference at 95 kg. had a similar relationship with 136 kg. backfat measurements (-.33).

Large scale. (Table 10 and 11) The large scale group measurements tended to be related to backfat in the same manner as overall data but not statistically significant.

Small scale. (Table 12 and 13) The small scale group 95 kg. measurements were correlated significantly ($P<.05$ and $P<.01$) with heartgirth, chest width, and tail circumference just as the overall data. One more body measurement, chest depth, was positively (undesirably) correlated to 95 kg. and 136 kg. backfat measurements (.46 and .48 respectively, $P<.05$).

b. 136 kg. Measurements.

Overall data. (Table 14 and 15) Heartgirth at 136 kg. was positively (undesirably) correlated ($P<.01$) with 113 and 136 kg. backfat measurements (.38 and .36). Body length was negatively (desirably) correlated ($P<.05$) with 113 and 136 kg. backfat measurements (-.30 and -.37, respectively) as was tail circumference (-.31 and -.38). These results agree with Conley's study in 1976. In addition, front leg length at 136 kg. was desirably correlated with backfat probes at 95 and 113 kg.

(-.36 and -.38, respectively) and front cannon circumference was similarly related to 95 kg. backfat probes (-.38).

Large scale data. (Table 16 and 17) The large scale group measurements had similar correlations to the overall data with body length at 136 kg. having a negative (desirable) relationship ($P < .05$) to 136 kg. backfat (-.50). Tail circumference was also negatively (desirably) correlated with 113 and 136 kg. backfat (-.53 and -.51, respectively).

Small scale data. (Table 18 and 19) The small scale body measurements were not as significantly related to backfat measurements as was the large scale group since no correlation was statistically significant ($P < .05$).

3. Carcass Measurements.

a. 95 kg. Measurements.

Overall data. (Table 8 and 9) Eye width at 95 kg. was negatively (undesirably) correlated ($P < .05$) with carcass length (-.33). Heartgirth was negatively correlated with carcass length ($P < .01$), lean cuts and ham-loin percent (-.49, -.46, and -.54, respectively). Chest depth at 95 kg. had an undesirable correlation ($P < .05$) to lean cuts percent (-.34).

Large scale data. (Table 10 and 11) Heartgirth measurement at 95 kg. was undesirably correlated ($P < .05$) with carcass length, lean cuts percent, and ham-loin percent (-.48, -.43, and -.56).

Small scale data. (Table 12 and 13) Heartgirth was negatively (undesirably) correlated ($P < .05$) with carcass length (-.45), lean cuts percent (-.52), and ham-loin percent (-.60; $P < .01$). Chest depth for the small scale group was negatively (undesirably) correlated ($P < .05$) with lean cuts and ham-loin percent (-.46 for both).

b. 136 kg. Measurements.

Overall data. (Table 14 and 15) Eye width at 136 kg. was negatively (undesirably) correlated ($P < .05$) with loin eye area. Body length, front leg length and forearm circumference were positively (desirably) correlated with carcass length (.31, .42, and .31, respectively) but jaw width was negatively correlated (-.34). Tail circumference was positively (desirably) correlated with lean cuts and ham-loin percent (.31 and .39) as was forearm circumference (.37 and .31, respectively). Heartgirth was negatively (undesirably) correlated ($P < .01$) with lean cuts and ham-loin percent (-.42 for both) and chest width was negatively correlated to ham-loin percent (-.41).

Large scale data. (Table 16 and 17) Front leg length was desirably correlated ($P < .05$) with carcass length (.42) and tail circumference was desirably correlated with ham-loin percent (.44). Heartgirth at 136 kg. was undesirably correlated ($P < .05$) with lean cuts and ham-loin percent (-.42 and -.43) and chest width had an undesirable correlation with ham-loin percent (-.50).

Small scale data. (Table 18 and 19) For the small scale group, body length was positively (desirably) correlated ($P < .05$) with carcass length (.49). Front cannon and back cannon circumference measurements were desirably correlated ($P < .05$) with ham-loin percent (.44 and .46, respectively). Heartgirth was undesirably correlated with lean cuts percent (-.43).

4. Performance With Performance. (Table 20) Average daily gains were fairly highly correlated, except S-95 kg. average daily gain to the interval average daily gains because most were component parts of each other. Most of the post-95 kg. average daily gains were positively

Table 20. Correlations of Selected Performance Parameters

	95 kg. ADG 1	113 kg. ADG 2	136 kg. ADG 3	95-113 kg. ADG 4	113-136 kg. ADG 5	95-136 kg. ADG 6	95 kg. B.F. 7	113 kg. B.F. 8	136 kg. B.F. 9	Carcass Length 10	LEA 11	LC% 12	H-L% 13
1	1.00												
2	.73**	1.00											
3	.44**	.86**	1.00										
4	.18	.75**	.78**	1.00									
5	.08	.42**	.79**	.52**	1.00								
6	.15	.69**	.91**	.86**	.87**	1.00							
7	-.26	-.04	.10	.12	.21	.20	1.00						
8	-.21	.04	.18	.21	.29*	.29*	.86**	1.00					
9	-.14	.18	.28	.32*	.28	.36*	.71**	.73**	1.00				
10	.17	.11	.01	.09	-.05	.03	-.21	-.30*	-.05	1.00			
11	.05	-.20	-.26	-.41**	-.25	-.35*	-.20	-.25	-.37*	-.01	1.00		
12	.07	-.13	-.33*	-.25	-.46**	-.43**	-.56**	-.62**	-.51**	.13	.50**	1.00	
13	.07	-.14	-.32*	-.23	-.42**	-.39**	-.48**	-.61**	-.52**	.23	.56**	.93**	1.00

* $P < .05$

** $P < .01$

Numbered parameters on the left hand side coincide with the same numbered parameter across the top of the table.

correlated with backfat measurements and negatively (undesirably) correlated with loin eye area, lean cuts percent and ham-loin percent. Backfat probes were highly correlated with the actual carcass backfat measurements (95 kg. probe: .71; and 113 kg. probe: .73; $P<.01$). In addition, backfat measurements were negatively (desirably) correlated with lean cuts and ham-loin percent in all cases ($P<.01$). Carcasses with larger loin eyes tended to have a higher lean cut and ham-loin percent (.50 and .56). Lean cuts percent was correlated very positively to ham-loin percent (.93, $P<.01$).

5. 95 kg. Measurements With 113 kg. Measurements.

Correlations of 95 kg. measurements with the same measurements at 136 kg. were generally high except chest width (-.07). A list of the significant correlations ($P<.01$) include: width between the eyes, .65; width between the ears, .52; jaw width, .52; tail circumference, .59; front cannon circumference, .62; back cannon circumference, .55; front leg length, .42; and length, .52. Other significant correlations ($P<.05$) include: forearm circumference, .34; heartgirth, .36; chest depth, .33; and stifle width, .34.

E. Regression Analyses.

Regression models were set up using 95 kg. measurements at independent variables to predict S-136 kg. average daily gain, 136 kg. backfat, carcass length, loin eye area, lean cuts percent, and ham-loin percent. In all cases (Table 21), R-square values were fairly low. The same models were used with 136 kg. measurements as independent variables and in all cases, R-square values were low (Table 22). Models were constructed using the 95 kg. measurements as independent variables to predict the 136 kg. measurements. Again, R-square values were low in all cases (Table 24a, 24b).

REGRESSION ANALYSIS

Table 21. Regression Analysis - 95 kg. Measurements as Independent Variables

1. 136 kg. ADG.

   Model: Y = 1.560 + (-.026) front leg length

   R^2: 0.11

2. 136 kg. Backfat.

   Model: Y = -4.491 + (.072) heartgirth + (-.153) tail circumference + (.132) chest width

   R^2: 0.28

3. Carcass Length.

   Model: Y = 125.244 + (.320) forearm circumference + (-.490) heartgirth

   R^2: 0.31

4. Loin Eye Area.

   No individual variable qualified to enter at the specified significance. ($P < .10$)

5. Lean Cuts Percent.

   Model: Y = 126.595 + (-.607) heartgirth + (-.769) chest depth + (.661) stifle width

   R^2: 0.33

6. Ham-Loin Percent.

   Model: Y = 108.112 + (-.642) heartgirth

   R^2: 0.30

Table 22. Regression Analysis - 136 kg. Measurements as Independent Variables

1. <u>136 kg. Average Daily Gain.</u>

   Model: Y = -2.089 + (-.073) front cannon circumference + (.111) back cannon circumference + (.018) heartgirth + (.020) chest width + (-.022) jaw width

   R^2: 0.48

2. <u>136 kg. Backfat.</u>

   Model: Y = -5.230 + (-.203) eye width + (.322) ear + (.093) heartgirth + (-.270) tail circumference

   R^2: 0.38

3. <u>Carcass Length.</u>

   Model: Y = 61.115 + (.997) front cannon circumference + (.524) front leg length + (-.677) jaw width

   R^2: 0.34

4. <u>Loin Eye Area.</u>

   Model: Y = 61.057 + (-.1595) eye width

   R^2: 0.09

5. <u>Lean Cuts Percent.</u>

   Model: Y = 59.050 + (.698) forearm circumference + (-.421) heartgirth + (1.387) tail circumference + (-.466) chest depth + (.601) stifle width

   R^2: 0.51

6. <u>Ham-Loin Percent.</u>

   Model: Y = 31.871 + (.499) forearm circumference + (-.393) heartgirth + (1.212) tail circumference + (.569) stifle width

   R^2: 0.48

Table 23. Regression Analysis - 95 kg. Measurements as Independent Variables

1. S-113 kg. Average Daily Gain.

   Model: Y = 0.438 + (.734) back cannon circumference + (-.028) front leg length

   R^2: 0.25

2. S-95 kg. Average Daily Gain.

   Model: Y = 1.395 + (-.012) forearm + (.062) back cannon circumference + (-.032) front leg length + (-.075) scale

   R^2: 0.36

3. 113-136 kg. Average Daily Gain.

   Model: Y = -.461 + (.016) heartgirth + (-.054) tail circumference

   R^2: 0.20

4. 95-113 kg. Average Daily Gain.

   Model: Y = 1.748 + (-.033) front leg length

   R^2: 0.08

5. 95-136 kg. Average Daily Gain.

   Model: Y = 1.472 + (-.026) front leg length

   R^2: 0.06

6. 113 kg. Backfat.

   Model: Y = -7.377 + (-.572) front cannon circumference + (.460) back cannon circumference + (.098) heartgirth + (.116) chest width

   R^2: 0.45

7. 95 kg. Backfat.

   Model: Y = -0.943 + (-.167) eye width + (.134) ear + (-.196) front cannon circumference + (.059) heartgirth + (.084) chest width

   R^2: 0.49

Table 24a. Regression Analysis - 95 kg. Measurements as Independent Variables Used To Predict 136 kg. Measurements

1. 136 kg. Width Between the Eyes.

   Model: Y = -3.032 + (.564) eye width + (.566) back cannon circ.

   R^2: 0.49

2. 136 kg. Width Between the Ears.

   Model: Y = 12.366 + (.402) ear + (-.107) forearm circumference

   R^2: 0.35

3. 136 kg. Length.

   Model: Y = 141.145 + (.386) length + (-.684) heartgirth + (1.004) chest depth + (-1.045) jaw width

   R^2: 0.47

4. 136 kg. Forearm Circumference.

   Model: Y = 46.881 + (.420) forearm circumference + (-.247) heartgirth + (.281) chest width

   R^2: 0.24

5. 136 kg. Front Cannon Circumference.

   Model: Y = 4.739 + (.080) forearm circumference + (.614) front cannon circumference

   R^2: 0.45

6. 136 kg. Back Cannon Circumference.

   Model: Y = 11.762 + (.733) front cannon circumference + (-.172) tail circumference

   R^2: 0.41

7. 136 kg. Heartgirth.

   Model: Y = 97.450 + (.397) heartgirth + (-.588) front leg length

   R^2: 0.21

8. 136 kg. Front Leg Length.

   Model: Y = 33.600 + (.216) forearm circumference + (.481) front leg length + (-.570) chest depth + (-1.43) scale

   R^2: 0.50

Table 24b. Regression Analysis - 95 kg. Measurements as Independent Variables Used To Predict 136 kg. Measurements

9. 136 kg. Tail Circumference.

Model: Y = 16.692 + (-.057) length + (.663) tail circumference + (.145) chest width + (-.409) jaw width + (-.449) scale

R^2: 0.55

10. 136 kg. Chest Width.

Model: Y = 21.766 + (.440) eye width + (.783) back cannon circ. + (.173) heartgirth

R^2: 0.28

11. 136 kg. Chest Depth.

Model: Y = 21.766 + (-.505) eye width + (.588) tail circumference + (.483) chest depth

R^2: 0.30

12. 136 kg. Stifle Width.

Model: Y = 36.164 + (-.376) front leg length + (.325) stifle width

R^2: 0.25

13. 136 kg. Jaw Width.

Model: Y = 3.413 + (.338) eye width + (.328) tail circumference + (.481) jaw width

R^2: 0.49

SUMMARY

This study was conducted to initially differentiate (at 35 to 60 kg.) between large and small scale (frame) barrows by using a body measurement selection index. The subsequent performance parameters, average daily gain, feed efficiency, and carcass characteristics, were recorded as the pigs were grown to 136 kg. and slaughtered. An initial difference was shown in the height times length index between large and small scale pigs. However, in all cases, the indexes at 95 kg. and 136 kg. were nearly the same for both scale groups. Large scale barrows gained faster from start to 95 kg. but all subsquent performance parameters were nearly the same. There were no significant differences in feed efficiencies, backfat measurements, or carcass parmeters between scales.

Thirteen body measurements were taken at 95 kg. and again at 136 kg. to determine the relationship between body measurements and certain growth parameters. Correlations between the body measurements and growth tended to be low for most parameters and were in agreement with Irlam _et al._ (1975) and Conley (1976). Regression analysis, first using the 95 kg., and then the 136 kg. measurements as the independent variables failed to produce models that would account for the variation in average daily gain, backfat, or carcass measurements.

This study suggests that even with initial selection of pigs to be as extreme as possible in their weight class, their subsequent performance and measurements for the scale index tended to become equalized across both scale groups. The performance definitely was negative from a producer's standpoint (decreasing average daily gain and worsening feed-gain ratio) when the barrows were carried to a heavy market weight. In addition, this study failed to support the value of the body measure-

ments as visual indicators of growth. The study suggests, as did Conley's (1976), that performance testing is still the best method of predicting a particular animal's genetic potential.

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THE RELATIONSHIP BETWEEN BODY MEASUREMENTS AND PERFORMANCE PARAMETERS OF SELECTED BARROWS CARRIED TO HEAVY WEIGHTS

A SCALE (OR FRAME) STUDY LARGE SCALE VS. SMALL SCALE

by

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Fourty-seven Yorkshire barrows were selected for large or small scale test groups by using a selection index constructed by multiplying a body height and length measurement. Pigs used were compared in a two to three kilogram weight range and used if their index was at least one standard deviation from the mean for their group. Growth parameters studied included all interval average daily gains and feed per gains from start to 95 kg., 113 kg., and 136 kg. Backfat probes were taken at 95 kg. and 113 kg. and carcass data were collected at 136 kg. (carcass backfat, carcass length, loin eye area, lean cut percent, and ham-loin percent). Thirteen body measurements were taken at 95 kg. and at 136 kg. to determine the relationship of body size and certain performance parameters. Measurements taken included three about the head, nine on the body and legs, and one on the tail.

An initial difference was shown in the indexes between large and small scale groups, especially in the extreme pigs ($P < .05$), but at 95 kg. and 136 kg. the same index measurements gave indexes that were nearly equal for both scale groups. Large scale barrows gained faster per day from start to 95 kg. (0.89 kg., large scale; 0.83 kg., small scale; $P < .05$). There were no other significant differences in average daily gains, feed efficiencies, backfat probes or carcass measurements. Interval average daily gains and feed per gains from 95 kg. to 136 kg. became definitely undesirable as the pigs were carried to the heavy market weight. Only two measurements showed a significant difference ($P < .05$) between large and small scale pigs- chest depth at 95 kg. was greater for large scale pigs (33.2 cm. to 32.7 cm.) and at 136 kg. the large scale pigs had a longer front leg (37.0 cm. to 35.7 cm.).

The head and tail measurements were poorly correlated with performance parameters except tail circumference which was negatively (desirably) correlated ($P < .05$) with backfat thickness (-.51, large scale; -.38, overall data) and positively correlated (desirable) with lean cuts and ham-loin percent. Most leg measurements were lowly related to performance except that shorter-legged pigs and heavier boned pigs had a higher average daily gain, but taller, heavier boned pigs were trimmer. Body volume measurements that had significant correlations were heartgirth, chest width, and length. Pigs with larger heartgirths and wider chests had positive correlations with average daily gain (heartgirth to S-113 and S-136 kg. ADG - large scale pigs: .46 and .60; chest width to S-95, S-113, and S-136 kg. ADG - small scale pigs: .64, .56, and .40). The larger heartgirth, wider chested pigs were fatter and had a lower lean cut and ham-loin percent. The pigs with a greater body length measurement tended to be trimmer (-.33 and -.50, large scale, at 113 and 136 kg.). Regression analysis using the 95 kg. measurements and 136 kg. measurements to predict 136 kg. performance resulted in models with low R-square values.