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POSTWEANING PERFORMANCE AND CARCASS MERIT OF PUREBRED AND TWO-BREED CROSS PIGS[1]

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SUMMARY

The feedlot records of 2,111 purebred and crossbred pigs representing all purebred and all possible two-way crosses of Duroc, Hampshire and Yorkshire were analyzed to evaluate average daily gain on test, age at 100 kg, average backfat probe of gilts, average daily feed consumption and feed conversion. A random sample of 392 barrows was used to evaluate carcass traits. The data were analyzed to determine breed of sire and breed of dam effects, to evaluate differences between reciprocal crosses and to estimate heterosis.

Breed of sire and breed of dam effects were significant for many of the traits evaluated. Straightbred Durocs had a higher average daily gain, were fatter and produced carcasses that were firmer and had more marbling than straightbred Hampshires or Yorkshires ($P<.05$). Yorkshires were the most efficient straightbred while Hampshires had the largest *longissimus* muscle areas and leanest carcasses of the straightbreds.

Significant differences were noted between reciprocal crosses. When Yorkshires were involved in the cross, the pigs were more efficient, consumed less feed per day and produced carcasses that were leaner and had larger *longissimus* muscle areas when the Yorkshire was used as the dam rather than as the sire ($P<.05$).

Significant and favorable heterosis was found for average daily gain, age at 100 kg, feed efficiency, feed consumption and carcass length when averaged over all crosses. The general lack of heterosis for carcass traits indicates that the carcass merit of crossbred pigs can be approximated by the average of the purebreds involved in the cross.

(Key Words: Swine Crossbreeding, Feedlot, Carcass Traits.)

INTRODUCTION

There are very few crossbreeding studies involving "modern" swine breeds that evaluate postweaning performance or carcass merit of pigs raised under confinement conditions. Those that have been conducted, were primarily interested in estimating heterosis. Consequently, there is little information on specific crossing sequences or how to combine breeds to produce an overall superior market pig.

Johnson *et al.* (1973) reported the results of two replications of an experiment designed to evaluate postweaning performance and carcass merit of pigs produced by making all possible purebred and two-way cross matings of Duroc, Hampshire and Yorkshire. Since then, two additional replications were completed in this project to yield data from a total of four replications for this study. The addition of two seasons of data more than doubled the number of observations and thus greatly increased the precision of the estimates.

MATERIALS AND METHODS

The data for this paper came from four replications of Phase I of the Oklahoma swine crossbreeding project conducted at the Fort Reno Experiment Station. Distribution of pigs, litters and pens used in the analyses of the various traits are given by breed group in table 1. A total of 2,111 records of pigs from 362 litters with 70 different sires were used to evaluate average daily gain on test and age at 100 kilograms. Backfat probe was evaluated on

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TABLE 1. DISTRIBUTION OF PIGS BY BREED GROUP FOR TRAITS MEASURED

Breed group	No. of pigs for avg daily gain and age at 100 kg[a]	No. of gilts used for backfat probe	No. of pens used for feed efficiency and consumption	No. of barrows for carcass data
Total	2111 (362)	1054 (337)	142	392
D X D	183 (41)	93 (35)	17	43
H X H	172 (42)	87 (39)	16	46
Y X Y	240 (42)	126 (40)	23	44
D X H	260 (44)	136 (42)	17	45
D X Y	277 (37)	147 (35)	15	41
H X D	211 (34)	102 (30)	11	42
H X Y	198 (34)	94 (32)	12	41
Y X D	290 (43)	136 (42)	17	44
Y X H	280 (45)	133 (42)	14	46

[a]Numbers in parentheses indicate number of litters.

gilts only and 1,054 records of backfat probe on gilts from 337 litters were included in the analysis. Feed efficiency (kg gain/kg feed) and average daily feed consumption per pig were evaluated on 142 pens. A random sample of 392 barrows was used to evaluate carcass traits.

The formation and maintenance of the seedstock herds at the Stillwater Experimental Swine Farm which provided the purebred males and females for this project have previously been described by Johnson *et al.* (1973). Methods of herd management and data collection have also been described in detail by the above authors.

Pigs were farrowed in the spring and fall of 1971 and 1973 at both the Ft. Reno Station and the Stillwater Station. Because purebred litters contained fewer pigs at weaning, purebred pigs from Stillwater were transferred to Ft. Reno at weaning and were allotted on test with Ft. Reno purebreds. Since all purebred boars and most purebred gilts used at Ft. Reno came from Stillwater, both sources of purebred pigs were of comparable breeding and the use of Stillwater pigs should not bias the purebred-crossbred comparison. Tests of significance indicated no significant difference in the performance of purebred pigs from the two stations. Purebred pigs from Stillwater were not used for average daily gain, age at 100 kg or backfat probe because sires were included in the model for anlayzing these traits. If Stillwater purebreds were in the analyses, the fact that boars that sired Stillwater pigs would be represented in only one breed group, would have resulted in an ill-conditioned matrix and difficult analyses. Stillwater purebreds were involved in the analyses of feed efficiency and average daily feed consumption because often a pen would contain purebreds from both stations and these traits were evaluated on a pen basis. Purebreds from Stillwater were also included in the analyses of carcass traits.

Litter means were used as the experimental unit in the analyses of average daily gain, age at 100 kg and backfat probe. Average daily gain and age at 100 kg were evaluated on a barrow basis and backfat probe was only on gilts. Gilt records were adjusted to a barrow equivalent based on the observed average difference between barrows and gilts. Gilt records were adjusted to a barrow equivalent by adding .0566 kg to average daily gain and subtracting 7.70 days from age at 100 kilograms. It was considered necessary to include sire in the model as a random effect and available computer programs could not do this with full sib data, therefore unadjusted litter means were used as experimental units. The experimental units for feed efficiency and average daily feed consumption per pig were pen means. Pens were composed of various combinations of barrows and gilts and no adjustments were made for this type of variation.

Data were analyzed by the least squares procedures for disproportionate subclasses described by Harvey (1960) and supplemented by Harvey (1972). The model used to analyze average daily gain, age at 100 kg and backfat probe was: $Y_{ijkm} = \mu + B_i + s_{j(i)} + D_k + BD_{ik} + e_{ijkm}$ where Y_{ijkm} = observed value of the dependent variable for the m^{th} litter in ijk^{th}

subclass, μ = fitted mean, B_i = effect of the i^{th} sire breed, $s_{j(i)}$ = effect of the j^{th} sire in the i^{th} sire breed, D_k = effect of the k^{th} dam breed, BD_{ik} = interaction of the i^{th} sire breed and the k^{th} dam breed and e_{ijkm} = random element. All effects except $s_{j(i)}$ and e_{ijkm} were considered fixed effects and $s_{j(i)}$ and e_{ijkm} were considered random effects with zero mean and variances σ_s^2 and σ^2, respectively. This model and linear contrasts among least squares means were fit within season and pooled over season giving equal weight to each season. The sire mean square was used for the error term for all comparisons except comparisons among breeds of dam and heterosis estimates. The error mean square was used as the error term for the latter two contrasts.

The model used to analyze feed efficiency, average daily feed consumption and carcass traits was: $Y_{ijkm} = \mu + R_i + B_j + D_k + RB_{ij} + RD_{ik} + BD_{jk} + e_{ijkm}$ where Y_{ijkm} = observed value of the dependent variable for the m^{th} pen or pig in the ijk^{th} subclass, μ = fitted mean, R_i = effect of the i^{th} season, B_j = effect of j^{th} sire breed, D_k = effect of k^{th} dam breed and RB_{ij}, RD_{ik} and BD_{jk} = interaction effects and e_{ijkm} = random element. In the analysis of percent lean cuts of the carcass, live weight was added as a covariable. Linear contrasts among least squares means and their standard errors were calculated. Sires could not be included in the analyses of feed efficiency and average daily feed consumption since progeny from more than one sire were included in a pen mean. Sires were not included in the analyses of carcass traits since Stillwater purebreds were included in the slaughter sample and some boars were represented in only one breed group, thus creating a dependency structure in the data and making the analyses very difficult. The deletion of sires should have its largest effect on the more highly heritable carcass traits. However, Bereskin *et al.* (1971) found sires to be a significant source of variation only for *longissimus* muscle area and percent ham and loin. In their analyses, ignoring the effect of sires would have had little effect on significance levels.

Within each type of comparison, more comparisons are made than there are degrees of freedom. Contrasts were made to answer questions of interest without regard to the orthogonality or linear independence of the contrasts.

TABLE 2. LEAST SQUARES BREED GROUP MEANS AND LINEAR CONTRASTS AMONG MEANS AND THEIR STANDARD ERRORS FOR MEASUREMENTS OF FEEDLOT PERFORMANCE[a,b]

Item[c]	No. of pigs	No. of litters	No. of pens	Avg daily gain, kg	Age at 100 kg, days	Probe backfat thickness at 100 kg, cm	Kg of gain per kg of feed consumed	Avg daily feed consumption, kg
$\bar{X}$	2111	362	142	.720	180.7	2.97	.3149	2.212
D × D	183	41	17	.702	184.1	3.29	.3049	2.273
H × H	172	42	16	.674	191.7	2.82	.3071	2.147
Y × Y	240	42	23	.674	186.2	2.92	.3181	2.063
D × H	260	44	17	.757	174.9	2.98	.3106	2.377
D × Y	277	37	15	.750	174.9	2.92	.3298	2.142
H × D	211	34	11	.740	178.6	2.92	.3216	2.260
H × Y	198	34	12	.726	178.0	2.74	.3302	2.097
Y × D	290	43	17	.747	175.9	3.15	.3104	2.296
Y × H	280	45	14	.706	182.2	3.03	.3013	2.258

Comparisons between breeds of sire					
D – H	.023 ± .007**	-4.8 ± 1.8**	.24 ± .05**	-.0046 ± .0037	.096 ± .046*
D – Y	.028 ± .007**	-3.5 ± 1.7**	.03 ± .04	.0052 ± .0035	.058 ± .042
H – Y	.005 ± .007	1.3 ± 1.7	-.21 ± .05**	.0097 ± .0037*	-.038 ± .046
Comparisons between breeds of dam					
D – H	.017 ± .008*	-3.4 ± 1.5*	.18 ± .04**	.0059 ± .0036†	.016 ± .045
D – Y	.013 ± .008	-.2 ± 1.6	.26 ± .04**	-.0138 ± .0036**	.176 ± .045**
H – Y	-.004 ± .008	3.2 ± 1.6*	.08 ± .04*	-.0197 ± .0034**	.160 ± .044**
Comparisons between straightbreds					
D×D – H×H	.028 ± .013*	-7.6 ± 3.0*	.47 ± .09**	-.0023 ± .0060	.126 ± .074†
D×D – Y×Y	.029 ± .013*	-2.1 ± 3.0	.37 ± .08**	-.0132 ± .0055*	.210 ± .068*
H×H – Y×Y	.001 ± .013	5.5 ± 3.0†	-.10 ± .08	-.0110 ± .0056*	.084 ± .069
Heterosis estimates					
D–H crosses	.060 ± .010**	-11.1 ± 1.9**	-.11 ± .05*	.0101 ± .0044*	.108 ± .055*
D–Y crosses	.060 ± .009**	-9.7 ± 1.9**	-.07 ± .04†	.0086 ± .0040*	.051 ± .050
H–Y crosses	.042 ± .009**	-8.8 ± 1.9**	.01 ± .05	.0031 ± .0044	.073 ± .054
Overall	.054 ± .007**	-9.9 ± 1.3**	-.06 ± .03*	.0073 ± .0030*	.077 ± .037*
Comparisons between reciprocal crosses					
D×H – H×D	.017 ± .013	-3.7 ± 3.1	.06 ± .08	-.0110 ± .0066†	.117 ± .082
D×Y – Y×D	.003 ± .013	-1.0 ± 3.0	-.23 ± .08**	.0194 ± .0060**	-.155 ± .074*
H×Y – Y×H	.020 ± .013	-4.3 ± 3.1	-.29 ± .09**	.0290 ± .0068	-.161 ± .084*

[a]Means, contrasts and SE for average daily, age and probe and pooled from within season analyses.

[b]Standard errors for breed group means ranged from .009 to .010 for average daily gain; 1.9 to 2.2 for age at 100 kg; .05 to .06 for backfat thickness; .0035 to .0051 for feed efficiency; .044 to .064 for feed consumption.

[c]D = Duroc, H = Hampshire, Y = Yorkshire. First letter indicates breed of sire, second letter indicates breed of dam.

[d]Number of litters for backfat are 337, 35, 39, 40, 42, 35, 30, 32, 42 and 42, respectively.

†P<.10.

*P<.05.

**P<.01.

RESULTS AND DISCUSSION

Feedlot Performance

The least squares means and linear contrasts among least squares means for feedlot performance traits are presented in table 2.

Comparisons between Breeds of Sire. Duroc sired pigs grew faster ($P<.01$) and consequently were younger at 100 kg ($P<.05$) than Hampshire or Yorkshire sired pigs with no significant difference between Hampshire and Yorkshire sired pigs for these two traits. Hampshire sired gilts had significantly less backfat than either Duroc or Yorkshire sired gilts while the difference in backfat thickness of gilts sired by the latter two breeds was neither large nor significant. Pigs sired by Hampshire boars consumed significantly less feed per day than pigs out of Duroc boars and were significantly more efficient than pigs sired by Yorkshire boars.

Comparisons between Breeds of Dam. Pigs out of Duroc dams had a higher average daily gain ($P<.05$) were younger ($P<.05$) and fatter at 100 kg ($P<.01$) and were more efficient ($P<.01$) than pigs out of Hampshire dams. Yorkshire females produced pigs that had less backfat, were more efficient and consumed less feed per day than pigs produced by Duroc or Hampshire females ($P<.05$ to $P<.01$). Pigs out of Yorkshire dams were also younger at 100 kg ($P<.05$) than pigs out of Hampshire dams.

Comparisons between Straightbreds. The straightbred Durocs grew faster ($P<.05$) than straightbred Hampshires or Yorkshires while essentially no difference was observed between the latter two straightbred groups for average daily gain. Straightbred Hampshires were older at 100 kg than either straightbred Durocs ($P<.05$) or Yorkshires ($P<.10$). Very little difference was found between Hampshires and Yorkshires for average backfat thickness; however, both groups had less backfat than Durocs ($P<.01$). Yorkshires were the most efficient straightbred group ($P<.05$) while Durocs consumed more feed per day than Hampshires ($P<.10$) or Yorkshires ($P<.05$). The differences in growth rate of these three breeds in this study are in agreement with those found by Hale and Southwell, (1967) Bruner and Swiger (1968) and Quijandria *et al.* (1970). Hale and Southwell, (1967) found that Durocs were more efficient than Hampshires while Bruner and Swiger (1968) and Quijandria *et al.* (1970) found Durocs were more efficient than Hampshires or Yorkshires. The differences in age at 100 kg found in this study are in agreement with those found by Quijandria *et al.* (1970).

Heterosis Estimates. Heterosis was estimated as the average performance of reciprocal crosses minus the average performance of the purebreds involved in the cross. All crosses exhibited heterosis ($P<.01$) for average daily gain and age at 100 kg and the amount of heterosis expressed was similar for each specific cross for both traits. Overall, crossbred pigs gained .05 ± .007 kg more per day and were 9.9 ± 1.3 days younger at 100 kg than purebreds. Crosses involving Durocs expressed favorable heterosis for backfat probe at 100 kg and feed efficiency. On an overall basis, crossbred pigs had .06 ± .03 cm less backfat and gained .0073 ± .0300 kg more per kilogram of feed consumed than purebreds. Heterosis estimates for average daily feed consumption were consistent in sign; however, only the estimate for Duroc-Hampshire crosses was significant. Overall, crossbred pigs consumed more feed per day ($P<.05$) than purebreds.

In agreement with this study, several researchers have reported that crossbreds gained faster than purebreds (Carroll and Roberts, 1942; Gregory and Dickerson, 1952; England and Winters, 1953; Gaines and Hazel, 1957; Smith *et al.*, 1960). The heterosis estimate of .054 kg per day found in this study is on the upper end of the range of values found in the literature.

In this study, crossbreds gained more efficiently and consumed more feed per day than purebreds. Lush *et al.* (1939), Tucker *et al.* (1952), Whatley *et al.* (1960) and Kuhlers *et al.* (1972) also reported that crossbreds averaged less feed per kilogram of gain than straightbreds. Tucker *et al.* (1952) reported that crossbreds consumed more feed per day than purebreds while Kuhlers *et al.* (1972) reported little difference in average daily feed consumption between purebreds and crossbreds.

Comparisons among Reciprocal Crosses. No significant differences were found between reciprocal crosses for average daily gain or age at 100 kilograms. Hampshire-Duroc pigs produced by Duroc dams gained more efficiently than when produced by Hampshire dams ($P<.10$). When Yorkshires were involved in the cross, the pigs had less backfat ($P<.01$), were more efficient ($P<.01$) and consumed less feed per day ($P<.05$) when the Yorkshire was used as the female. Since the genetic composition of reciprocally produced pigs is expected to be the

same (assuming no cytoplasmic inheritance), any difference in the performance of these pigs is probably due to a maternal effect of the dam. Assuming that the sampling of the breeds were equal for sires and dams, these data indicate that in crossbred litter production Yorkshire females provide a maternal environment prior to weaning that causes their pigs to be leaner, more efficient and consume less feed per day than the same breed combination of pigs out of Duroc or Hampshire dams.

Carcass Traits

The least squares breed group means and linear contrasts among means for carcass traits are presented in table 3.

Comparisons between Breeds of Sire. A large number of differences were found between breeds of sire. Duroc sired pigs produced carcasses that were shorter than carcasses of pigs sired by Hampshires or Yorkshires ($P<.01$). Hampshire boars sired pigs with the least carcass backfat and largest *longissimus* muscle areas while Yorkshire boars sired pigs with the most carcass backfat and smallest *longissimus* muscle areas ($P<.05$). Total lean cut yield as a percent of carcass weight ranked the three sire breeds from highest to lowest in the order; Hampshire, Duroc and Yorkshire, with all differences significant. Duroc boars sired pigs that produced *longissimus* muscles that were more marbled, firmer and less pale in color than carcasses produced by pigs sired by either Hampshire or Yorkshire boars ($P<.01$). The differences between the latter two sire breeds for these traits were essentially zero.

Comparisons between Breeds of Dam. The comparison of Duroc and Hampshire dams produced results similar to the comparison of Duroc and Hampshire sires. Comparisons involving Yorkshire dams produced results somewhat different than the same comparisons involving Yorkshire sires. The longest carcasses were from pigs produced by Yorkshire females followed by those produced by Hampshire females ($P<.05$). Duroc dams produced pigs whose carcasses had significantly more backfat, smaller *longissimus* muscle areas and a smaller percent lean of the carcass than pigs from Yorkshire or Hampshire dams. The difference between the latter two breeds for these traits was significant only for percent lean of the carcass. Duroc dams produced pigs that had *longissimus* muscles that were more marbled and firmer than those of pigs from dams of the other two breeds ($P<.01$). Hampshire females produced pigs whose *longissimus* muscles were significantly lighter and softer than those of pigs from Duroc or Yorkshire females.

Comparisons between Straightbreds. Straightbred Hampshires produced carcasses that had less backfat, larger *longissimus* muscle areas and a higher percent lean of the carcass than carcasses from straightbred Durocs or Yorkshires ($P<.01$). Hampshire carcasses were longer than Duroc carcasses ($P<.01$) but shorter than Yorkshire carcasses ($P<.10$). Straightbred Duroc carcasses had a smaller percent lean of the carcass ($P<.01$) than straigh*bred Yorkshires. The differences found between the three pure breeds in this study agree with differences reported by Hale and Southwell (1967), Jensen *et al.* (1967), Bruner and Swiger (1968) and Quijandria *et al.* (1970).

Longissimus muscles from Duroc carcasses were firmer and had more marbling than those from either Hampshire or Yorkshire carcasses ($P<.01$). Hampshire *longissimus* muscles had a significantly lower color score than those from Durocs or Yorkshires and were significantly softer than those from Yorkshires. Jensen *et al.* (1967) also found that Duroc carcasses were firmer and had more marbling than Hampshire or Yorkshire carcasses with no difference between the latter two for these traits. In contrast, to this study, Jensen *et al.* found Yorkshires had the highest color score and Hampshires the lowest color score. Judge *et al.* (1959) and Otto (1962) also reported significant breed differences for meat color.

Heterosis Estimates. There were few significant heterosis estimates for carcass traits. The only overall heterosis estimate that was significant was for carcass length and it was the result of significant positive heterosis exhibited by crosses involving Duroc, the shortest straightbred. No significant heterosis was found for carcass backfat or *longissimus* muscle area. Duroc-Yorkshire crosses did exhibit positive heterosis for percent lean cuts of the carcass ($P<.10$). Hetzer *et al.* (1951), Tucker *et al.* (1952), Whatley *et al.* (1960), Kuhlers *et al.* (1972) and Gregory and Dickerson (1952) also found little difference in the carcass traits of crossbreds and purebreds. However, in agreement with this study, the first three authors did indicate that crossbred carcasses were longer than purebred carcasses. Bereskin *et al.* (1971) reported that crossbreds averaged .23 cm less

TABLE 3. LEAST SQUARES BREED GROUP MEANS AND LINEAR CONTRASTS AMONG MEANS AND THEIR STANDARD ERRORS FOR MEASUREMENTS OF CARCASS MERIT[a]

Item[b]	No. obs.	Carcass length, cm	Carcass backfat, cm	*Longissimus* muscle area, cm^2	Lean cuts of carcass wt, %	Marbling score[c]	Firmness score[d]	Color score[e]
$\overline{X}$	392	77.61	3.08	30.52	56.72	4.26	4.79	4.83
D X D	43	75.90	3.21	28.90	54.77	5.83	6.16	5.24
H X H	46	77.76	2.78	32.33	58.56	3.25	3.78	4.52
Y X Y	44	78.40	3.20	30.00	56.51	3.40	4.28	5.08
D X H	45	77.47	3.02	30.71	56.70	5.27	5.56	4.98
D X Y	41	77.66	3.10	31.34	57.44	5.15	5.50	5.15
H X D	42	77.55	2.96	30.80	57.06	4.79	5.02	4.83
H X Y	41	78.23	2.86	32.39	58.68	3.16	3.93	4.46
Y X D	44	77.84	3.31	29.11	55.18	4.66	5.27	5.12
Y X H	46	77.65	3.26	29.10	55.58	2.83	3.57	4.07
				Comparisons between breeds of sire				
D − H		-.84 ± .21**	.24 ± .04**	-1.53 ± .40**	-1.80 ± .29**	1.68 ± .16*	1.50 ± .16**	.52 ± .12**
D − Y		-.96 ± .21**	-.15 ± .04**	.92 ± .40*	.55 ± .28*	1.79 ± .16**	1.36 ± .16**	.37 ± .12**
H − Y		-.12 ± .21	-.39 ± .04**	2.44 ± .40**	2.34 ± .28**	.11 ± .16	-.13 ± .16	.15 ± .12
				Comparisons between breeds of dam				
D − H		-.53 ± .21*	.14 ± .04**	-1.11 ± .40*	-1.28 ± .28**	1.31 ± .16**	1.18 ± .16**	.54 ± .12**
D − Y		-1.00 ± .21**	.11 ± .04*	-1.64 ± .41**	-1.87 ± .29**	1.19 ± .16**	.91 ± .16**	.16 ± .12
H − Y		-.47 ± .21*	-.04 ± .04	-.53 ± .40	-.60 ± .28*	-.12 ± .16	-.27 ± .16†	-.37 ± .12**
				Comparisons between straightbreds				
D X D − H X H		-1.86 ± .36**	.44 ± .07**	-3.43 ± .69**	-3.78 ± .49**	2.58 ± .28**	2.38 ± .27**	.72 ± .20**
D X D − Y X Y		-2.50 ± .36**	.01 ± .07	-1.10 ± .69	-1.73 ± .48**	2.43 ± .28**	1.87 ± .27**	.16 ± .21
H X H − Y X Y		-.64 ± .36†	-.43 ± .07**	2.33 ± .68**	2.05 ± .48**	-.15 ± .27	-.50 ± .27†	-.56 ± .20*
				Heterosis estimates				
D−H crosses		.68 ± .26*	-.01 ± .05	.14 ± .49	.21 ± .35	.49 ± .20*	.32 ± .19†	.03 ± .15
D−Y crosses		.60 ± .26*	-.00 ± .05	.77 ± .49	.67 ± .35	.29 ± .20	.17 ± .19	-.02 ± .15
H−Y crosses		-.14 ± .26	.07 ± .05	-.42 ± .49	-.40 ± .34	-.33 ± .20†	-.28 ± .19	-.53 ± .14**
Overall		.38 ± .18*	.02 ± .04	.16 ± .35	.16 ± .24	.15 ± .14	.07 ± .14	-.18 ± .10

Comparisons between reciprocal crosses							
DXH – HXD	-.09 ± .37	.06 ± .08	-.09 ± .70	-.36 ± .49	.48 ± .28	.54 ± .27*	.15 ± .21
DXY – YXD	-.18 ± .37	-.22 ± .08*	2.23 ± .70**	2.26 ± .50**	.50 ± .28†	.23 ± .27	.03 ± .21
HXY – YXH	.58 ± .37	-.40 ± .08**	3.29 ± .70**	3.10 ± .49**	.33 ± .28	.36 ± .27	.40 ± .21†

[a]Standard errors of breed group means ranged from .25 to .27 for length; .052 to .055 for backfat; .477 to .508 for loin eye area; .34 to .36 for percent lean cuts of carcass; .19 to .20 for marbling score; .19 to .20 for firmness score; .14 to .15 for color score.

[b]D = Duroc, H = Hampshire, Y = Yorkshire. First letter indicates breed of sire, second letter indicates breed of dam.

[c]1 = devoid; 4 = average; 7 = abundant.

[d]1 = very soft; 4 = average; 7 = very firm.

[e]1 = pale; 4 = dark pink; 7 = very dark.

†P<.10.

*P<.05.

**P<.01.

backfat, .4% more ham and .28% more ham and loin than the average of the parental purebred Durocs and Yorkshires.

Duroc-Hampshire crosses exhibited positive heterosis for marbling score (P<.05) and firmness score (P<.10). However, crosses among Hampshires and Yorkshires expressed negative heterosis for marbling score (P<.10) andcolor score (P<.01).

The lack of consistent and significant heterosis estimates for the carcass traits evaluated indicate that the carcass merit of crossbred pigs can be approximated by the average of the purebreds involved in the cross.

Comparisons among Reciprocal Crosses. Duroc-Hampshire crossbred pigs produced by Hampshire dams produced firmer *longissimus* muscles than the same breed combination out of Duroc dams (P<.05). When Yorkshires were used as the female, the pigs had less carcass backfat, larger *longissimus* muscle area and a higher percent of lean cuts in the carcass (P<.05). As in the feedlot data, this indicates a difference in the maternal effects of the Yorkshire dams *vs* the Hampshire and Duroc dams. The Yorkshire female provides a maternal environment prior to weaning which causes her pigs to produce a leaner more heavily muscled carcass than the same breed combination out of Duroc or Hampshire dams. The differences between reciprocal crosses of Durocs and Yorkshires in this study are in agreement with those reported by Bereskin *et al.* (1971) and support their conclusion of the presence of a large maternal effect on carcass traits.

These data indicate that significant and favorable heterosis can be expected for average daily gain, age at 100 kg, feed efficiency, average daily feed consumption and carcass length. Little heterosis is expected for other carcass traits.

The differences in reciprocal crosses indicate that if Yorkshires are to be involved in the cross, they should be used as the dam breed. Crosses involving the Yorkshire are more efficient in the feedlot and produce carcasses that are leaner and more heavily muscled when the Yorkshire is used as the dam rather than as the sire.

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