Comparison Of Purebred Gilts With Purebred And Crossbred Litters From Early Embryo Development Through Weaning

R. K. Johnson, I. T. Omtvedt, R. R. Wilson and S. D. Welty

Story in Brief

This study was initiated to evaluate the performance of purebred Duroc, Hampshire and Yorkshire gilts when mated to a boar of the same breed as compared to when mated to a boar of one of the other two breeds. A total of 299 matings were made in the fall of 1970 and the spring of 1971. One month after breeding 119 gilts were slaughtered and their reproductive tracts evaluated to determine ovulation rate and early embryo development. The remaining 180 gilts were carried full term to evaluate productivity of sows with purebred and 2-breed cross litters.

Although the differences were not large, the purebred gilts with crossbred embryos consistently averaged more normal embryos and a higher percentage of ova shed represented as live embryos than did purebred gilts with purebred embryos. Differences in 30-day embryo size between purebreds and crossbreds for any breed of gilt were not significant. Purebred gilts with rossbred litters averaged more pigs per litter and heavier litter weights at birth, 21 and 42 days than did purebred gilts raising purebred litters. Pig weight differences between purebreds and crossbreds for each of these periods were not significant. The survival rate from birth to weaning was 7.4 percent higher for crossbred litters than for purebred litters. These data indicated that using a boar of a different breed was more of an advantage for purebred Duroc and Hampshire gilts than for Yorkshire gilts.

Introduction

Approximately 90 percent of the pigs marketed in the U.S. today are of crossbred origin. Research results have shown that sow productivity traits yield the greatest response to crossbreeding. However breeding programs that will yield maximum performance from crossing are un-

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available. In an effort to evaluate the response expected from crossbreeding using modern-type breeding stock, project 1444 was initiated to evaluate the combining ability of the Duroc, Hampshire and Yorkshire breeds in 2-breed and 3-breed crosses. Three purebred herds were established at the Experimental Swine Farm at Stillwater to provide the seedstock for this project. This paper reports the reproductive and litter performance through weaning of the first phase of this project where purebred females raising purebred litters are compared to purebred females raising crossbred litters.

Experimental Procedure

Data from the swine breeding research herd at Fort Reno were used in this study which included the 1971 spring and fall farrowing seasons. Six boars and 54 gilts from each breed were mated in the fall of 1970 to produce the first season's litters. Each boar was mated to 3 gilts of his own breed and to 3 gilts from each of the other two breeds. Approximately 30 days after breeding one gilt from each mating type for each boar was randomly selected to be slaughtered to evaluate ovulation rates and early embryo development. The other 2 gilts from each mating type for each boar were carried full term and permitted to farrow. During the first season this system resulted in 45 gilts slaughtered for reproductive tract studies and 89 gilts farrowed. This procedure was again repeated six months later and 74 gilts were slaughtered one month after breeding and 91 were permitted to farrow. Approximately one-half of the females which farrowed during the second season were sows and their records were adjusted over all breed groups to a gilt equivalent basis with a least squares additive correction factor. Pigs were not given access to creep feed until after the 21-day weights were obtained.

This report includes the ovulation, embryo and birth data for both seasons, but litter records covering the period from birth to weaning were available only for the 1971 spring farrowing.

Results

The data for number and size of embryos are presented in table 1. A total of 42 Duroc gilts, 40 Hampshire gilts and 37 Yorkshire gilts were slaughtered 30-days postbreeding.

The maximum litter size per sow is established by the number of eggs ovulated per sow. Ovulation rate is measured by the number of corpora lutea (CL) found on the ovaries of the gilts at slaughter. Using a boar of a different breed should not influence ovulation rate of a gilt, thus all purebred gilts of a breed can be combined to make breed com-

parisons in ovulation rate. Yorkshire and Duroc gilts both averaged 13.8 CL per gilt which was significantly greater than the 12.1 CL per gilt for Hampshires. Although the differences were not large, purebred gilts with crossbred embryos consistently averaged more normal embryos and a higher percentage of the ova shed were represented as live embryos than did purebred gilts with purebred embryos. Yorkshire gilts had smaller embryos than Duroc or Hampshire gilts but differences between purebreds and crossbreds within any breed were not significant.

A total of 89 litters (30 purebred and 59 crossbred) were farrowed in the spring of 1971 and 91 litters (34 purebred and 57 crossbred were farrowed in the fall of 1971. Birth records for these pigs are shown in the bottom portion of Table 1. In all cases the gilts with crossbred litters averaged more pigs per litter and heavier litter weights than did gilts with purebred litters. Although the overall advantage of 0.5 more pigs at birth for crossbreds was not significant, the advantage of 2 lbs. heavier litter weight for crossbred litters was significant.

The litters records through weaning of the gilts farrowed in the spring of 1971 are presented in Table 2. Although litter birth records for this season were not analyzed separately but were analyzed together with the fall 1971 season, the number of pigs born per litter in spring 1971 are included in this table so that meaningful breed comparisons of litter records from birth to weaning can be made. Significant differences favoring crossbred litters were obtained for number of pigs at 21 and 42 days as well as for litter weight at 21 and 42 days. However, it should be noted that although litter size and weights at birth and weaning favored the

Table 1. Thirty-Day Postbreeding Embryo Development and Birth Litter Records of Purebred Gilts with Purebred Litters Compared To Purebred Gilts with Crossbred Litters[1]

	Duroc Gilts[2]		Hamp Gilts[2]		York Gilts[2]		Overall[2,3]	
	Pure	Cross	Pure	Cross	Pure	Cross	Pure	Cross
No. slaughtered	13	29	14	26	12	25	39	80
No. CL/gilt	14.3[a]	13.5[a]	11.6[a]	12.3[a]	13.8[a]	13.8[a]	13.2[a]	13.2[a]
Embryos/gilt	10.6[a]	11.0[a]	8.6[a]	9.9[a]	11.4[a]	11.6[a]	10.2[a]	10.8[a]
Survival, %	74.2[a]	81.4[a]	74.5[a]	82.4[a]	83.9[a]	84.4[a]	77.6[a]	82.7[a]
Embryos size, mm.	24.6[a]	25.4[a]	26.2[a]	25.3[a]	23.4[a]	24.0[a]	24.6[a]	24.8[a]
No. farrowed	24	38	22	45	18	33	64	116
No. pigs born	9.0[a]	10.3[b]	8.8[a]	9.0[a]	9.4[a]	9.6[a]	9.1[a]	9.6[a]
Litter birth wt.	23.6[a]	26.3[b]	21.0[a]	23.4[b]	20.3[a]	21.0[a]	21.6[a]	23.6[b]
Pig birth wt.	2.70[a]	2.59[a]	2.41[a]	2.63[a]	2.24[a]	2.22[a]	2.45[a]	2.48[a]

[1]Includes winter 1970 and summer 1971 embryo data and spring 1971 and fall 1971 farrowing data.
[2]Each breed group weighted equally.
[3]Means with different superscripts for a trait within any breed of gilt are significantly different from each other ($P < .05$).

Table 2. Productivity of Purebred Gilts with Purebred Litters Compared to Purebred Gilts with Crossbred Litters from Birth to Weaning[1]

	Duroc Gilts[2]		Hamp Gilts[2]		York Gilts[2]		Overall[2,3]	
	Pure	Cross	Pure	Cross	Pure	Cross	Pure	Cross
No. litters	10	20	7	22	9	17	26	59
No. pigs born	9.1	10.3	8.2	8.9	9.8	10.4		
No. at 21-days	5.9[a]	7.6[b]	4.9[a]	6.5[a]	8.0[a]	8.3[a]	6.3[a]	7.5[b]
Lit. 21-day wt.	55.4[a]	79.6[b]	49.5[a]	68.1[a]	86.5[a]	84.2[a]	63.8[a]	77.3[b]
Pig 21-day wt.	9.16[a]	10.5[a]	10.0[a]	10.2[a]	10.9[a]	10.3[a]	10.0[a]	10.3[a]
No. 42-days	5.6[a]	7.5[b]	4.7[a]	6.4[a]	7.9[a]	8.2[a]	6.1[a]	7.4[b]
Lit. 42-day wt.	132.7[a]	183.7[b]	107.1[a]	151.9[a]	192.3[a]	195.6[a]	144.0[a]	177.1[b]
Pig 42-day wt.	23.6[a]	24.4[a]	21.9[a]	23.3[a]	24.7[a]	24.0[a]	23.4[a]	23.9[a]
% Survival	58.0[a]	74.0[a]	67.3[a]	75.1[a]	82.3[a]	80.8[a]	69.2[a]	76.6[a]

[1]Spring 1971 farrowing only.
[2]Each breed group weighted equally.
[3]Means with different superscripts for a trait within any breed of gilt are significantly different from each other ($P < .05$).

Yorkshire gilts with crossbred litters over the Yorkshire gilts with purebred litters, these differences were relatively small and that most of the advantage contributing to crossbred superiority came from using a boar of another breed on Duroc and Hampshire gilts.

Although crossbreeding involving Yorkshire gilts did not increase survival rate and the overall increase of 7.4 percent for crossbreds over purebreds was not significant, Duroc and Hampshire gilts raised a considerably higher proportion of the pigs farrowed when raising crossbred litters than when raising purebred litters (16 percent for Duroc gilts and 7.7 percent for Hampshire gilts). There were no consistent trends in average pig weights at 21 and 42 days. More data are needed before definite conclusions involving the relative differences in crossbred productivity for the 3 breeds can be made.

Two basic reasons for crossbreeding are to obtain heterosis and to combine the strong points of different breeds. Heterosis is defined as the difference in the average performance of crossbreeds compared to the purebreds which made up the cross. Considerable heterosis was observed for the productivity traits measured in this study. The results also revealed that the breed of sire effect was generally small indicating that the sire breed used was of minor importance. However the breed of dam effect was generally large for all traits evaluated. This would indicate that the dam breed used in a crossbreeding program is of considerable importance for productivity traits. Thus, in order to develop a breeding program that will yield maximum performance from crossing, information on the productivity for specific crosses is needed.

Table 3 shows the average performance for each cross for embryo and birth records. The numbers are too limited to draw any definite conclusions at this point, but quite large differences between certain reciprocal crosses were observed for embryo numbers. For example, Duroc gilts mated to Hampshire boars had 1.3 more normal embryos at 30 days postbreeding than Hampshire gilts mated to Duroc boars.

Virtually no difference in early embryo percent survival existed among the crosses, thus the differences between the reciprocal crosses in number of embryos appears to be primarily a function of differences in ovulation rates of the breeds. Although no significant differences between reciprocal crosses were obtained at this point, there was a tendency for Yorkshire gilts to be superior to the gilts of the other 2 breeds in reciprocal crosses and for Duroc gilts to out-perform Hampshire gilts. When reciprocal crosses were combined (DxH and HxD; DxY and YxD; HxY and YxH) and comparisons among crosses made, pig birth weight was the only trait for which crosses were different. Duroc-Hampshire crossbred pigs were heavier at birth than crosses involving the Duroc-Yorkshire or Hampshire-Yorkshire breeds.

Results of this study indicate that the relative advantage of crossbreeding is highly dependent on the breed of dam involved. Using a boar of a different breed increased litter size and litter weight at farrowing, 21-days and weaning. Crossbreeding increased the productivity of Duroc and Hampshire gilts more than it did Yorkshire gilts.

Table 3. Comparison of all Possible Crosses for Early Embryo[1] Development and Gilt Productivity at Birth[2]

	DxH	HxD	DxY	YxD	HxY	YxH
No. gilts slaughtered	12	11	13	18	12	14
No. embryos/gilt	9.8	11.1	11.3	10.9	11.8	9.9
% Survival	83.8	80.5	83.3	80.9	85.6	81.0
Embryo size, mm.	25.7	26.2	24.5	24.7	23.4	25.0
No. gilts farrowed	23	18	18	20	15	22
Pigs born/litter	8.6	10.3	9.9	10.3	9.3	9.4
Litter birth wt., lb.	22.8	27.5	20.4	25.1	21.7	24.1
Pig birth wt., lb.	2.73	2.68	2.12	2.50	2.33	2.53

[1]Includes winter 1970 and summer 1971 embryo data.
[2]Includes spring 1971 and fall 1971 farrowing data.