University of Missouri Extension

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Rotational Crossbreeding Systems for Pork Producers

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More than 90 percent of hogs marketed are of mixed breeding, an indication that crossbreeding is a well accepted management program. Yet crossbreeding alone does not guarantee efficient, profitable production. Choosing the system and breeds that fit your management and environment and operating the system correctly should result in profitable production.

Crossbreeding's benefit is heterosis, or hybrid vigor. Heterosis is the difference between the average performance of the crossbred progeny and the purebred parents. The improved performance may be more or less than the superior parental breed (Figure 1), depending on the breeds used. To achieve heterosis, the crossbred progeny must perform significantly better than the parental breed average. If the performance levels are the same, then no heterosis exists.

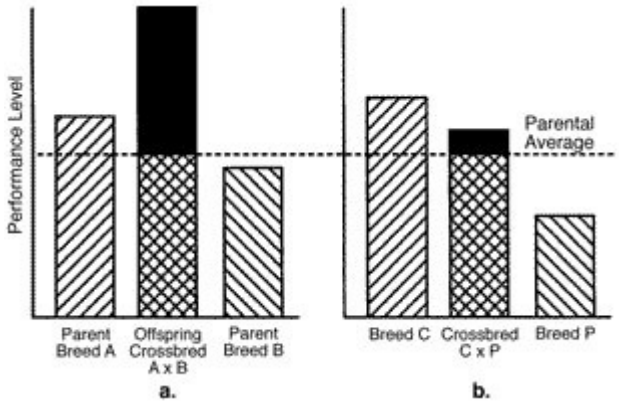


Figure 1
(a) Heterosis response in crossbred offspring superior to both parent breeds. (b) Heterosis response in crossbred offspring superior to one parent breed.

Hybrid vigor is greatest for fitness traits. Traits that involve maintenance of the species, such as reproduction, preweaning survival and growth and early pig performance, tend to be lowly heritable. Heterosis has a moderate effect on postweaning growth and very little effect on body composition and carcass traits. Body composition and carcass traits are affected more by the characteristics of the breeds used. The impact of heterosis on various traits is listed in Table 1.

Table 1
Heterosis advantage for production traits

Item	Percentage advantage over purebred	
	First cross purebred sow	Multiple cross crossbred sow
Reproduction		
Conception rate	0.0	8.0
Pigs born alive	0.5	8.0

Litter size 21 days	9.0	23.0
Litter size weaned	10.0	24.0
Production		
21-day litter weight	10.0	27.0
Days to 220 pounds	7.5	7.0
Feed/gain	2.0	1.0
Carcass composition		
Length	0.3	0.5
Backfat thickness	-2.0	-2.0
Loin muscle area	1.0	2.0
Marbling score	0.3	1.0

Characteristics of rotational programs

Rotational programs, the system most often used by pork producers, are easy to operate. They require purchasing only boars of the breeds used and give flexibility by developing replacement females. Yet rotational programs do not use all of the possible heterosis. Table 2 outlines the potential heterosis for common rotational systems. As can be seen, initial crosses for all programs express 100 percent heterosis. But as the generations advance, heterosis declines. The two-breed rotation declines to 67 percent while the four-breed rotation maintains a level above 90 percent.

Table 2
Heterosis percentage in rotational crosses

Crossbreeding system	Generation number						Equilibrium
	1	2	3	4	5	6	
Two-breed rotation	100.0	50.0	75.0	62.5	68.9	67.2	66.7
Three-breed rotation	100.0	100.0	75.0	87.5	87.5	84.4	85.7
Four-breed rotation	100.0	100.0	100.0	87.5	93.8	93.8	93.3

One problem that producers using rotational programs face is getting every sow mated to a boar of the right breed. Often, only boars of one breed are maintained at one time on the farm.

Since the sow herd often is composed of multiple parities, many females are bred to boars from the same breed as was their sire. This will lead to performance reduction and an accumulated profit loss of $30 per litter.

Simple programs can be developed to identify the breed of the sow's sire before mating. However, boars from all breeds used in a rotational program need to be maintained on the farm and used on the right sow to get maximum heterosis. Correct operation of two-breed and three-breed rotational programs is illustrated in Figure 2.

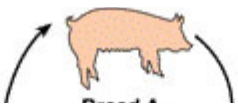
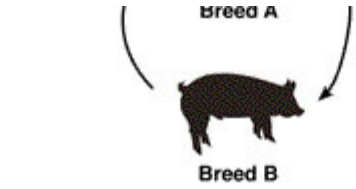
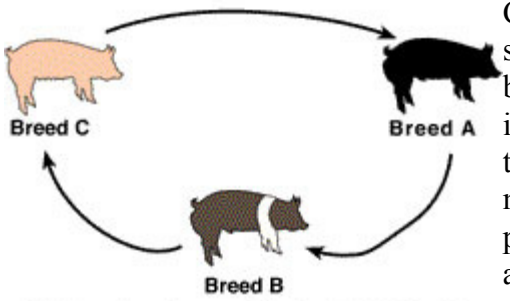


Figure 2
Two- and three-breed rotational programs



In the two-breed program, females sired by Breed A are bred to boars from Breed B. Females sired by Breed B are bred to boars from Breed A.



In the three-breed program, females sired by Breed A are bred to boars from Breed B. Females sired by Breed B are bred to boars from Breed C, and females sired by Breed C are bred to boars from Breed A.

In a two-breed rotational program, females sired by Breed A are bred to boars from Breed B. Females sired by Breed B are bred to boars from Breed A. In the three-breed rotational program, females sired by Breed A are bred to boars from Breed B. Females sired by Breed B are bred to boars from Breed C and females sired by Breed C are bred to boars from Breed A.

Choosing breeds that work well together is essential in developing a successful rotational crossbreeding program. The programs should use breeds that are similar yet complementary. Crossing breeds that excel in postweaning performance but are poor in litter traits with breeds that are good mothers but inferior in feedlot traits will not result in maximum efficiency. Heterosis will be expressed, but absolute performance will be less than that of breeds used that were near average or better for maternal, growth and carcass traits. Table 3 outlines differences among breeds.

Table 3

Relative performance of breeds

Breed	Conception rate	Litter size weaned	21-day weight	Age at 220 pounds	Backfat
Berkshire	+	-	-		
Chester White	+	++	-		A
Duroc	A	A	-	+	-
Hampshire	A	-	A	-	++
Landrace		++	++	A	
Poland				A	+
Spotted				+	-
Yorkshire	-	++	+	+	-

Based on NC-103 review.
Blank cell indicates data unavailable.
A indicates performance near average of breeds studied.
+ indicates performance superior to average.
++ indicates performance substantially superior to average.
- indicates performance inferior to average.
- - indicates performance substantially inferior to average.

Selecting boars of breeds used in the program is critical. Progeny from boars used will be sold as market animals while some gilts will be kept for replacement females. Boars purchased from seedstock suppliers should be above average for maternal and postweaning traits. Practice careful scrutiny when evaluating the performance records on potential herd boars. Boars should be from sows that are better than average on a Sow Productivity Index (SPI) used by the major breed association or recommended by the National Swine Improvement Federation (NSIF).

Boars should exhibit average performance or better for growth (average daily gain or days to 230 pounds) and average backfat thickness (adjusted to 230 pounds) compared to the group in which he was tested. Boars of this description may not excel in any one area, but their progeny will improve your herd in several performance categories that influence profit. However, boars that excel in one trait and are weak in several

others should be avoided. For example, if a boar has very low days to 230 pounds but is poorer than average for backfat thickness and is from a poor indexing sow, his pigs may grow faster but they probably will be fatter than average and his daughters may be poor mothers.

Health

When bringing outside animals into the herd, always buy from reputable breeders with an overall health program including a validated brucellosis-free and qualified negative pseudorabies herd. Always quarantine new animals for 30 to 60 days and re-test for brucellosis and pseudorabies.

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Related MU Extension publications

- G2311, Terminal and Rotaterminal Crossbreeding Systems for Pork Producers
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G2311
- G2502, Purchasing a Herd Boar for Commercial Swine Production
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G2502
- G2509, Swine Management Check Sheet
  http://extension.missouri.edu/publications/DisplayPub.aspx?P=G2509
- G2911, Inbreeding: Its Meaning, Uses and Effects on Farm Animals
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