Sire Ranking Based Upon Purebred vs Crossbred Progeny Performance in Swine

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Story in Brief

Genetic correlation between purebred and crossbred progeny of the same sire and the correlation between sire ranks based upon breeding value for purebred and crossbred progeny were estimated. Expected responses in crossbred populations from selection within purebreds and selection based upon crossbred progeny performance were evaluated.

Data from two experiments were analyzed separately. In total, these data represented records on 2,258 purebred and 4,815 crossbred progeny of 32 Duroc, 22 Hampshire, 9 Landrace, 8 Spotted and 31 Yorkshire boars. Pig weight at birth, 21-, and 42-days-of-age, postweaning average daily gain, and probed backfat thickness were investigated.

Weighted average correlations of sire breeding values (genetic correlations) and sire ranks were, respectively, .39 and .36 for birth weight, .45 and .53 for 21-day weight, .47 and .43 for 42-day weight, .48 and .49 for postweaning average daily gain, and .85 and .85 for probed backfat thickness. Comparison of the expected responses in crossbred populations, based upon genetic parameter estimates obtained in this study, suggested no clear practical advantage of selection based upon crossbred progeny performance over selection within the pure breeds themselves for the traits studied.

Introduction

It has been estimated that 90 percent or more of hogs marketed in the United States are crossbred. Given the importance of crossbreeding to the swine industry, it seems reasonable that the primary criterion of genetic value in breeds of swine should be the performance of the crossbred offspring rather than performance of the purebreds themselves.

This poses the question as to whether, in order to achieve continued genetic improvement in the market hog population, selection of purebred parents should be based upon their own performance, or upon the performance of their crossbred progeny. Selection based upon crossbred progeny performance, however, necessitates progeny testing. It is unlikely to increase, and may indeed decrease progress unless selection based upon individual performance is relatively inaccurate as compared to using progeny records.

If selection based upon purebred performance is to be effective in improving performance of the crossbred population, the genetic correlation between performance in the purebreds and crossbreds must be relatively high. In addition, the correlation between sire ranking based upon purebred and crossbred

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progeny should be high. Low or negative genetic and rank correlations might suggest that some system of selection based upon crossbred progeny performance should be considered in order to obtain maximum genetic progress.

The objectives of this study were: 1) to estimate genetic and rank correlations for pig birth weight, 21-day weight, 42-day weight, postweaning average daily gain, and probed backfat thickness at 220 pounds; and 2) to evaluate the expected response in crossbred populations from selection within purebreds vs selection based upon crossbred progeny performance for the above traits.

Materials and Methods

The data used in this study were from two projects carried out by the Oklahoma State University Agricultural Experiment Station in cooperation with the USDA. The two data sets, designated 1444 and 1620, were analyzed separately.

The first data set (1444) consisted of 1184 purebred and 2275 crossbred progeny sired by 22 Duroc, 22 Hampshire and 23 Yorkshire boars at the Fort Reno Experiment Station during the spring and fall farrowing seasons of 1971 and 1973. Each of approximately six boars of each breed were mated to two females of each breed each season to produce purebred and two-breed cross litters. A different group of boars was used each breeding season.

The second data set (1620) consisted of 1074 purebred and 2540 crossbred litters sired by 10 Duroc, 9 Landrace, 8 Spotted and 8 Yorkshire boars at the Stillwater Experiment Swine Farm during the fall of 1976 and the spring and fall of 1977 and 1978. Approximately four boars of each breed were mated at random to females of each breed to produce a total of approximately six purebred litters and four of each of the possible two-breed cross litters each season. Boars were used between one and four breeding seasons.

In both experiments, the breeding season extended over an eight-week period starting in mid-May and mid-November each year. Females were hand mated and maintained throughout gestation in pasture lots. Litters were farrowed in confinement and weights of all fully-formed piglets were recorded within 12 hours of birth. Piglets were allowed access to creep feed from 21 days of age and were weaned at approximately 42 days of age. Individual pig weights were recorded at approximately 21 and 42 days of age in experiment 1444, and at 42 days of age only in experiment 1620.

Pigs were moved to a confinement finishing home for gain test at approximately two weeks postweaning in experiment 1444 and penned in groups of approximately 15 pigs per pen by breeding group. A 16 percent crude protein milo-soybean meal ration was self-fed until average pig weight per pen was approximately 120 pounds. A 14 percent crude protein ration was self-fed for the duration of the test period. Pigs were weighed off test weekly at 220 pounds, at which time gilts were probed for backfat thickness. The average of three ultra-sonic probes taken at the first rib, last rib, and last lumbar vertebrae were used. Backfat thickness records on barrows were obtained by averaging carcass measurements taken at these three points. Approximately 10 purebred and 46 crossbred barrows representing all possible breed groups were slaughtered each season.

In experiment 1620, pigs were moved to either an open front confinement building with either 10 gilts or 10 boars to a pen, or to pasture lots with ap-

proximately 50 gilts and barrows per lot. Pigs were weighed on gain test when moved at approximately two weeks postweaning (eight weeks of age). A 14 percent crude protein corn or milo based ration was self-fed for the duration of the test period. Gilts were weighed off test at 200 pounds and boars and barrows at 220 pounds. All pigs were probed for backfat thickness as described for the gilts in experiment 1444.

Postweaning performance traits investigated in this study were average daily gain from the first day on test to 220 pounds, and probed backfat thickness at 220 pounds. Actual off test live weight, age, and backfat thickness were adjusted to a 200-pound basis.

Predictions of sire breeding values for purebred and crossbred progeny were obtained for the above pre- and postweaning traits. The genetic correlation between purebred and crossbred progeny of the same sire was estimated as the correlation between sire breeding values for purebred and crossbred progeny. Sires were also ranked based upon their breeding values for purebred and crossbred progeny, and rank correlations calculated.

Results and Discussion

Weighted average genetic and rank correlations were, respectively, .39 and .36 for birth weight, .45 and .53 for 21-day weight, .47 and .43 for 42-day weight, .48 and .49 for postweaning average daily gain, and .85 and .85 for probed backfat thickness (Table 1.)

A correlation coefficient of 1.0 would indicate complete agreement between sire breeding values or ranking based upon purebred vs crossbred progeny. While the correlations obtained in this study are in general considerably lower than 1.0, the question is whether they are low enough to warrant changing existing selection practices.

If, for any particular trait, we consider crossbred progeny performance as the criterion of selection, then selection based upon crossbred progeny performance may be regarded as direct selection, and selection based upon

Table 1. Genetic and Rank Correlations.

Trait[a]	Data Set	Genetic Correlation	Rank Correlation
BW	1444	.53	.55
BW	1620	.27	.17
W21	1444	.45	.53
W42	1444	.46	.43
W42	1620	.48	.42
ADG	1444	.54	.51
ADG	1620	.40	.46
BF	1444	.80	.85
BF	1620	.90	.86

[a]BW = Birth Weight; W21 = 21-day Weight; W42 = 42-day Weight; ADG = Postweaning Average Daily Gain; BF = Probed Backfat Thickness at 220 lb.

purebred performance as indirect selection. Using genetic correlation and heritability estimates obtained in this study, it was possible to estimate the relative expected genetic change in the crossbred population from each of these two selection procedures. Allowing for the decrease in selection intensity and increase in generation interval associated with progeny testing, indirect selection based upon purebred performance was indicated to be superior to selection based upon crossbred progeny performance for all traits with the possible exception of birth weight in one data set.

Therefore, provided heritability within purebred populations is high, and the genetic correlation between purebred and crossbred performance is at least moderately high, it would seem unlikely that selection based upon crossbred progeny performance has very much to offer to practical swine breeding.