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A GENETIC STUDY OF REPRODUCTIVE PERFORMANCE OF SOWS IN A LARGE COMMERCIAL PIG HERD

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Summary

The heritability estimates of litter size at birth, at weaning at 5 weeks and preweaning mortality were 0.05, 0.25 and 0.12 respectively. The corresponding repeatability estimates were 0.14, 0.26 and 0.16 respectively. The heritability estimates of litter weight at birth and at weaning were 0.26 and 0.18 respectively, while the corresponding repeatability estimates were 0.26 and 0.17 respectively.

A breed comparison of the reproductive performance of sows indicated that there was little difference between the purebred and crossbred litters of purebred sows. However, crossbred sows farrowed litters which averaged 17 per cent more piglets, were 31 per cent heavier at birth, contained 19 per cent more pigs, and were 46 per cent heavier at 5 week weaning than purebred litters.

I. INTRODUCTION

No estimates of the genetic parameters of litter productivity traits in sows have been reported in this country. The purpose of this study was to determine the heritabilities and repeatabilities of several of these traits and their response to heterosis in a large commercial pig herd.

II. MATERIALS AND METHODS

The data were extracted from records of 2,010 litters born between October 1967 and October 1969. These records included information on the birthdate, size and weight of the litter alive at birth and at weaning. The birthdate and breed of the sire and dam were also available. There were no accurate records of fosterings available although the transfer of young between sows was known to be practised.

The litter productivity traits under consideration were :-

(i) Litter size alive at birth
(*ii*) litter size at weaning (at 5 weeks)
(*iii*) preweaning litter mortality
(iv) litter weight at birth
(v) litter weight at weaning

Because litter parity had not been recorded, arbitrary age categories were set for sows to determine this parameter for each litter record. Sows were coded according to the range in parities of their recorded litters. The process of coding sows enabled a comparison of litter characters between parities, but only within those sows that had survived culling to that stage. The relationships between

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parity and litter productivity were thus established for each character on a within code basis, thereby accounting for any effect of culling sows on these characteristics. Correction factors computed from these relationships were applied to the data to adjust all parameters to a standard first-parity equivalent.

The heritabilities of the five litter traits were calculated from daughter-dam regressions (Falconer 1960). Dams' records were repeated where more than one daughter had a litter in the recorded data. The mean performance of the dam was used in the regression when more than one of her own litters appeared in the data.

Repeatabilities for the five characters were estimated by an analysis of variance (Sokal and Rohlf 1969), the intraclass correlation coefficients being computed separately for the parities represented within each of several code groups.

Comparisons of litter sizes and weights at birth and at weaning were made between two breeds and their crosses, back-crosses and crosses incorporating other breeds. The means and standard deviations were computed for each character within each breed category.

III. RESULTS

The heritability (h^2) estimates for each of the five litter productivity traits are presented in Table 1.

TABLE 1

***Heritability estimates and the number** of daughter-dam **pairs** for **each** of **five** litter characters*

Character	Heritability	S.E.	No. of pairs
Litter size at birth	0.05	0.42	283
Litter size at weaning	0.25	0 13	104
Preweaning litter mortality	0.12*	0.04	103
Litter weight at birth	0.26	0.34	289
Litter weight at weaning	0.18	0.39	104

*Heritability is significantly different from zero ($P < 0.05$).

The results indicate a range in heritability from the very low estimate for the number of pigs born alive per litter to the moderate values for litter size weaned and litter weight at birth. The only estimate to achieve significant difference from zero was for the trait of preweaning litter mortality.

The repeatability estimates of the five litter productivity characters are given in Table 2. Estimates are presented for only three of the code groups, the number of sows in each of the remaining groups being too small for consideration.

Of the three groups included in Table 2 several of the repeatabilities were derived from small sow numbers. A negative estimate occurred in three of these cases which, presumably, was a consequence of the small samples.

The repeatabilities from the larger sample sizes were generally of a low order. For litter size and litter weight at birth, there was a rise in repeatability from code 02 to 03, then a drop to code 04. Repeatabilities for litter size and weight at weaning and preweaning litter mortality all showed a consistent decline from

TABLE 2

Repeatability estimates (R) of five litter traits for each of three code groups including the number of sows (n) within each code group

Character	Code Parities	02 1-2	03 1-3	04 1-4
Litter size	R	0.14	0.36	0.03
at birth	n	133	71	52
Litter size	R	0.26	0.13	—0.02
at weaning	n	74	15	15
Preweaning	R	0.16	0.04	—0.01
Litter				
mortality	n	66	15	11
Litter weight	R	0.26	0.38	0.27
at birth	n	136	71	52
Litter weight	R	0.17	0.12	—0.02
at weaning	n	72	15	15

TABLE 3

The litter productivity of sows of different breed crosses

Breed Dam	Sire	Litter size Birth	(No.)	Weaning	Litter weight (kg) Birth	(No.)	Weaning
LW[a]	LW	7.80	314	6.17	10.48	314	46.64
		S.D.2.52		2.63	3.49		24.86
LR[b]	LR	7.19	74	5.45	11.33	75	42.30
		S.D.3.62		2.23	3.80		20.84
LR	LW	7.49	7	6.69	11.67	7	62.80
		S D.1.58		11.29	1.41		14.43
LW	LR	7.06	33	5.74	9.78	33	48 18
		S.D.2.61		2.46	3 56		24.32
LW/LR							
or	LW	8.94	43	7.69	12.91	44	66.67
LR/LW		S.D.2.69		2 28	3.72		16.18
LW/LR							
or	LR	8.72	23	7.58	12.93	24	63.61
LR/LW		S.D.2.87		2.73	4.30		25.95
Others[c]	LW	8.15	302	6.72	11.72	300	57.10
		S.D.2.03		2.60	3.57		24.24
Others	LR	7 97	101	6.64	11.90	99	56.21
		S.D.2.49		2.69	3.75		27.05
Any	Cross						
Breed[d]	Bred[e]	7.51	163	6.29	10.97	162	49.21
		S.D.2.47		2.41	4.01		21.61

a, Large White.
b, Landrace.
c, Berkshire, Wessex Saddleback, Tamworth and Large Black or any other crossbred sow not categorised.
d, Any purebred or crossbred sow mated to a crossbred boar.
e, Boars derived from two or more different breeds.

code 02 to 04. Such a decline is expected if culling of sows was based on litter performance.

A comparison of the litter productivity of sows of different breed crosses is presented in Table 3.

The results indicated that heterosis was only evident in the crossbred litters of purebred sows for those traits measured at weaning. However, heterosis was apparently present for the parameters measured both at birth and at weaning in the case of litters of crossbred Large White—Landrace sows. The litters of the so-called "other" sows were superior to the litters of the purebred Large White and Landrace sows in each of the four characters. Sows of unspecified breed mated to crossbred boars produced litters showing no superiority over any of the other breed categories.

IV. DISCUSSION

The low h^2 for litter size at birth is in general agreement with other similar studies (Urban *et al.* 1966; Strang and King 1970). In view of this, the moderate h^2 found for litter weight at birth was unexpected as there is a reasonably strong genetic correlation between the two traits (Strang and King 1970). Whilst the estimate was not significant it was in general agreement with the high estimate of 0.35 reported by Cummings *et al.* (1947).

The h^2 of litter size at five week weaning was greater than the 0.19 and 0.09 reported, respectively, by Louca and Robison (1965) and Strang and King (1970) for eight week weaning. The h^2 of litter weaning weight agreed with the 0.21 and 0.19 found by Blunn and Baker (1947) and Urban *et al.* (1966) for litters at 8 weeks of age. The estimate for mortality was greater than the 0.04 reported by Strang and King (1970).

It was to be expected that estimates of repeatability would decline as more parities were included. Culling, if practised, eliminates the lower producing sows and thus reduces the between sow variance component. For this reason the repeatabilities pertaining to code 02 sows are considered to be the best estimates. The repeatabilities for litter size at birth, litter weight at weaning and preweaning mortality were in general agreement with the low estimates found in similar studies (Stewart 1945; King and Gajic 1969; and Strang and King 1970). The implication is that early litter performance is a poor predictor of a sow's later productivity.

The repeatability of litter size at weaning was higher than the 0.16 reported by Lush and Molln (1942) and by Shelby (1967). Litter weight at birth had a moderate repeatability, in agreement with the 0.25 reported by King and Gajic (1969). Few other estimates have been reported for this character.

The breed comparison revealed that crossbred pigs from purebred sows had a better survival rate and growth rate than the purebred pigs. The crossbred litters at weaning contained on average 6 per cent more pigs and were 25 per cent heavier than the purebred litters. In similar investigations Skarman (196 1) and Smith and King (1964) found that crossbred litters contained 6 per cent and 5 per cent more pigs respectively at 8 week weaning and were 14 per cent and 10 per cent heavier at that age than purebred litters.

The greatest improvement in litter productivity came from crossbred Large White—Landrace sows backcrossed to one of the parental breeds. There were benefits at birth, as well as at weaning which were to be expected if heterosis in the dam had an effect on the prenatal life of the litter. The litter of these crossbred dams averaged 17 per cent more pigs at birth, 19 per cent more pigs at weaning, and were 31 per cent heavier at birth and 46 per cent heavier at weaning than the purebred litters. These advantages were more marked than those reported by Smith and King (1964) who found that by comparison with purebreds, litters from crossbred sows had 5 per cent more pigs at birth and at weaning contained 8 per cent more pigs and were 11 per cent-heavier.

Fredeen (1957) suggested that three-breed crosses may exhibit further hybrid vigour in comparison with two-breed backcrosses. Whilst some of the litters of the so-called "other" sows were three-breed crosses, others were of two breeds only. Insufficient data prevented further subdivision according to the breed of the sow. Similarly, litters sired by crossbred boars could not be further categorised according to the breed of the dam. More information is needed concerning the relative reproductive performance of crossbred sows backcrossed to one of the original breeds or mated to boars of a third breed.

This study revealed that Large White boars, on average, sired larger litters than Landrace boars whether mated to purebred or crossbred sows. However, this difference, because of the relatively small number of data, was not significant.

This study has highlighted some of the difficulties which may be encountered in deriving estimates of genetic parameters from farm records. A high proportion of data had to be discarded due to incomplete information as witnessed by the fact that from 2,010 litter records, only 104 daughter-dam pairs were available for h^2 estimates of litter size and weight at weaning. Unrecorded fosterings of piglets between litters tended to reduce the accuracy of statements made relative to traits measured at weaning.

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