GENETIC EVALUATION OF NUMBER BORN ALIVE IN MONG CAI AND THEIR CROSSES IN NORTH VIETNAM

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SUMMARY

The effects of farrowing herd-year-season, service sire breed, parity as well as breed genotype group were significant for number born alive (NBA). NBA was low in the first parity (10.08 piglets), increasing up to 11.66 in parity 5, then decreasing gradually from parity 6 to 7 and dropping more dramatically from parity 8. Heritability estimates were 0.05 - 0.07 in first four parities and 0.09 pooled across the first 5 parities for pure Mong Cai (MC), and MC cross groups. Heterosis for NBA was estimated to be 3.50, 4.40, and 5.87% in F1, backcrosses and three-breed crosses. Due to low heritability, selection response in NBA can be increased by using up to 4 repeated records for selection. However, response to selection per year is remaining the same (0.18 and 0.19 piglets/year). Therefore, to improve NBA, BLUP may be the best way. However, NBA can be also increased by crossbreeding with other breeds, and this may also be useful.

Keywords: Pigs, crossbreeding, number born alive, heterosis

INTRODUCTION

To increase overall efficiency of pig production, among reproductive traits, one of the most important traits to consider is number born alive (NBA). The more NBA sows produce, the higher amount of meat per sow per unit of time will be achieved. The inheritance of this trait has been studied in many breeds, such as Large White (LW), Landrace (LR), Duroc, Hampshire (H) and Berkshire by many authors. However, the potential for production gains from use of Mong Cai (MC) and MC crosses has not received much attention until more recently. A few papers dealing with MC have been published, though MC is the most popular and important native pig breed in Vietnam and it accounts for 30% of the total sow population (Anh and Thuan 1996). The purpose of this paper is to evaluate MC and their crossbred genotypes for NBA, to estimate the heritability of this trait, and to identify heterosis in F1, backcross and three-breed cross for NBA in MC and their crosses.

MATERIALS AND METHODS

Experimental design. 21,230 litters from 12,641 pure LW and LR, 787 pure MC, 182 F1 LRxMC, LWxMC, 131 backcross LR(LRxMC), LW(LWxMC), and 131 three-breed cross LR(LWxMC), LW(LRxMC) sows over 14 years (1982 - 1995) were recorded for NBA. Each year is divided into 4 seasons: spring (Mar-May), summer (Jun-Aug.), autumn (Sep-Nov) and winter (Dec-Feb). The 7

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herds represented in this data set are Trang Bach, Dong Trieu, Thanh To, Dong Giao, Thanh Hoa and Tam Dao farms, and Thuy Phuong Pig Breeding Centre.

Statistical analysis. Fixed effects and least squares means were analysed using the SAS, PROC GLM (SAS 1993) and genetic parameters were estimated using a Restricted Maximum Likelihood (REML) procedure applied to a single trait animal model (Meyer 1993). Herd-year-season (H*Y*F), service sire breed (SSB), parity and breed were fitted as fixed effects. The levels of significance of all fixed effects for NBA of MC and their crosses are presented in Table 1.

Table 1. Fixed effects and their significant levels for NBA of Mong Cai and their crosses in different parities

Parity	Records	R^2	H*Y*F	SSB	Parity	Breed genotypes
1	787	0.28	***	**		
2	787	0.28	***	**		
3	733	0.35	***	***		
4	638	0.31	***	**		
1-4	3473	0.30	***	***	***	
1-5+	5555	0.32	***	***	***	*

+ Pooled all MC and their crosses, *** $p<0.001$, ** $p<0.01$, * $p<0.05$

RESULTS AND DISCUSSIONS

Fixed effects. Results from Table 1 indicate that the coefficients of determination (R^2) for NBA were not low, varying from 0.28 to 0.35 in first 4 separate parities of pure MC. However, they were lower in the pooled data of first 4 parities for pure MC and first 5 or 10 parities for MC and MC crosses, indicating probably interactions of model effects and parity. Farrowing H*Y*S interactions as well as SSB effects influenced NBA in both separate first four parity and pooled first 4, 5 and 10 parities. Parities and breed genotypes had an influence on NBA when data were pooled over 5 parities.

NBA performance of Mong Cai in different parities. NBA is one of the most important variables in determining profitability in the pig industry. MC is considered the most important native pig breed in Vietnam, especially in Northern areas because of its adaptability to the hard environment and high NBA. NBA in MC (10.89) is higher than the average in other breeds in Vietnam (9.1 piglets/litter), and MC is therefore considered a prolific breed in Vietnam.

The NBA of first 10 parities of Mong Cai were estimated and presented in Table 2. NBA of MC is high, varying from 10.08 to 11.66 piglets/litter across 10 parities. This finding is similar to the results of Thien and Luan (1994) and Binh (1996). However, our estimates were lower than estimates of 11.85 (Luan and Quang 1983) and 12.44 piglets/litter (Diep 1985). NBA increased from first to 5th parity, then decreases gradually from 6th to 7th parity, after which it decreased dramatically to 10th parity. It was highest in 4th and 5th parities. This finding agrees with Binh

(1996). NBA from parity 3 to 7 are significantly higher than the first two and after 8 parities. However, least squares means of SSB show that MC-sired litters have higher NBA (11.09 piglets/litter) compared with LW-sired and LR-sired litters (10.12 piglets/litter). Part of the higher reproductive performance in MC for NBA is therefore due to the service sire effect.

Table 2. Estimated least squares means and standard errors of NBA of MC across parities

Parity	Records	Number of Service Sires	X ± SE
1	787	114	10.08±0.05
2	787	121	10.92±0.06
3	733	120	11.39±0.06
4	638	119	11.58±0.06
5	528	106	11.66±0.08
6	454	100	11.56±0.08
7	387	96	11.37±0.09
8	316	84	10.81±0.09
9	230	68	10.61±0.10
10	184	58	10.50±0.11

Heritability studies. The estimate of heritability of NBA of MC varied from 0.05 to 0.09. The genetic, environmental and phenotypic variance components are presented in Table 3. The heritability estimates were low and their standard errors were high, which reflects the size of the data set. The heritability estimate was a little higher when the analysis was pooled across the first 4 parities (0.09). The heritability estimates were not higher even when the data were pooled in first 5 parities and used not only the Mong Cai breed, but their crosses (0.09), but their standard error was smaller (0.03). This result explains that the heritability of MC for NBA is low and for estimating NBA heritability, record data up to 4 parities can be used. However, care should be taken to use heritability estimates which are appropriate for the use which is to be made of them. Our findings agreed with Haley *et al.* (1988), who found h^2 of 0.09.

Table 3. Genetic, environmental and phenotypic variance components of NBA of Mong Cai

Parity	σ^2_A	σ^2_{Et}	σ^2_{Ep}	σ^2_E	σ^2_P	$h^2+SE_{(h^2)}$
1	0.10			1.94	2.04	0.05±0.07
2	0.15			2.26	2.41	0.06±0.07
3	0.16			2.23	2.39	0.07±0.08
4	0.10			1.72	1.82	0.06±0.08
1-4	0.18	0.17	1.60	1.77	1.95	0.09±0.04
1-5+	0.17	0.07	1.67	1.74	1.91	0.09±0.03

+ Pooled all Mong Cai and their crosses

Selection response for NBA in MC pigs will undoubtedly be slow due to this low heritability. The repeatability estimate for NBA in this study was 0.16 for the first 4 parities and the standard deviation was 1.44 for parity 1. Thus, using the first four parity data for selection, response to selection for NBA can increase up to 0.30 from 0.185 piglets/generation. However, response to selection per year were not different from them (R = 0.18 and 0.19 piglets/year). Therefore, for improving NBA in pigs by selection, BLUP may be a good solution. Otherwise, crossbreeding might be a good way to increase the NBA.

Heterosis study. Crossbreeding may be the best way of improving sow fertility, especially NBA. Due to the effects of crossbreeding, NBA of MC crosses may be higher than the average of the purebreds, especially when the sows themselves are crossbreds. In this study, NBA of MC crosses was higher than their parents. The average of NBA and heterosis of MC and their crosses are presented in Table 4. Heterosis has been calculated as % of (crossbred average - parent average) / parent average.

Table 4. Predicted least squares mean and heterosis for NBA for Mong Cai and their crosses

Breed genotypes	Records	X±SE	Heterosis (%)
LW and LR	12,641	9.08±0.03	0.00
MC	5,044	10.91±0.02	0.00
F1	1,609	10.35±0.03	3.50
Backcrosses	891	9.96±0.06	4.40
Three-breed crosses	1,045	10.10±0.05	5.87

In F1 the average of NBA of (LWxMC) and F1 (LRxMC) was 10.35 piglets/litter. This finding was lower than those of 10.86 (Thien *et al.* 1990). However, NBA of MC cross dams in our study was higher than the value of 9.50 piglets/litter (Mai 1990). Heterosis can be achieved in any crossbred but better results can be achieved when breeds used for crossing are less related. Heterosis is generally about 2-8% for litter size at birth. In this study, in F1 groups, the estimated heterosis for NBA was about 3.50%. It was higher in backcrosses, at 4.40%. Particularly, in three-breed crosses, the heterosis was higher than backcrosses or F1 of Mong Cai, at 5.87%. This finding was lower than that of 0.97 piglets/litter found by (Bass et al. 1992) in the crossbred progeny H x LR. Therefore, to increase NBA, a further benefit of maternal heterosis from use of MC crossbred dams may be the best policy to be used in north Vietnam.

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