Effect of environmental factors and crossbreeding on litter size and litter weights of Estonian Large White sows

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Introduction

Efficient production is essential for a pork producer to survive in uncertain economic times. The use of crossbreeding in commercial swine production is a well-accepted tool to enhance productivity through the exploitation of heterosis and combining advantages of different breeds. Heterosis tends to be largest for traits with low heritability such as litter size, litter weaning weight and piglet survival rate. Full benefits from crossbreeding can be gained only by careful combination of available breeds and take into consideration influence of different environmental factors (Pond and Maner, 1984, Buchanan, et al., 1990).

The objectives of this study were to evaluate litter size, litter weights and piglet liveability in litters from specific pure-bred and two-way crossbred sows, mated with pure-bred boar of same breed, or another breed and to estimate influence of some environmental factors on litter traits.

Material and methods

Breed designations used were: ELW = Estonian Large White, EL = Estonian Landrace and ELW/EL = Estonian Large White sow and Estonian Landrace boar mated.

The study was based on data from 149 ELW sows with 391 litters and 20 two-way crossbred sows (ELW x EL) with 20 litters, 54 ELW boars and 12 EL boars. Pure-bred and two-breed cross litters involving the ELW sows, ELW boars and EL boars were produced at the two herds of Tartu Swine Testing Station (STS) and Ao Producers Union in the period 1991 to 1996. Sows were kept indoors and during the lactation period in individual pens. Feeding level was largely depending on economical situation and no diet specification was recorded. Piglet weaning age was 8 weeks in order to better use of mothers ability to produce milk. All sows were mated by using AI. Semen of EL boars were bought from Kehtna AI station and the semen of ELW boars were collected at the same farm where the experiment was carried out.

Traits measured. Litter size and litter weights were recorded at birth, at 3 and at 8 weeks. Due to different management system, litter traits at 8 weeks were not recorded at the Tartu STS. Based on the recordings made, piglet liveability and piglet average daily gain from birth to 8 weeks were calculated by using SAS software (SAS Inst. Inc., 1991).

For all litters farrowing date, boar and sow identification number were recorded. Parity numbers above 2 are in the statistical analyses described as parity group two and first parity as parity group one.

Statistical analyses. The GLM procedure (SAS Inst. Inc., 1991) was used for analysing the dataset by analyses of variance. The statistical model for analysing data included the effects of breed of litter (3 classes), parity group (2 classes) and herd-year combination (5 classes).

The farrowing year was divided in four seasons. Effect of farrowing season was tested and found not to be significant and was therefore omitted from the analyses. Analysing litter weight, the regression on number of piglets born was included in statistical model.

Level of significances' is expressed conventionally: # : $P<0.10$, * : $p<0.05$, ** : $p<0.01$, *** : $p<0.001$ and a, b, c - least square, within each effect with one letter in common do not differ significantly.

Results and discussion

Year effect. Litter weight at 3 weeks was lower (52.12 kg) in 1996 and higher (62.04 kg) in 1994 (Table 1). However, litter weight at 8 weeks was 14.13 kg higher in 1996 than in 1995. Poorer results in litter weight at 3 weeks in 1996 and at 8 weeks in 1995 were influenced by difficult situation in feeding grain market in 1995. Due to this reason sow and piglet feeding was worse at that time and piglet average daily gain from birth to 8 weeks was poorer.

Table 1. Least-square means for effect of herd-year combinations

Traits	Tartu STS	Ao Producers Union			
	1995-96	1991-93	1994	1995	1996
Number of litters	56	67	121	142	25
Number of piglets					
Born alive	11.31^{a}	11.29^{a}	11.15^{a}	11.61^{a}	9.89^{a}
At 3 weeks	10.82^{a}	10.44^{ab}	10.21^{ab}	10.59^{ab}	8.31^{b}
At 8 weeks	-	9.27^{a}	9.06^{a}	9.17^{a}	7.45^{a}
Litter weight (kg)					
At birth	11.79^{a}	13.83^{b}	13.74^{b}	13.64^{b}	13.49^{b}
At 3 weeks	51.94^{a}	59.54^{bc}	62.04^{b}	56.86^{c}	52.12^{ac}
At 8 weeks	-	162.32^{ab}	169.77^{a}	158.86^{b}	172.81^{ab}
Piglet average daily gain (g/day)	-	303^{ab}	321^{a}	293^{b}	353^{ab}
Piglet liveability (%)	-	85.00^{a}	84.01^{a}	82.06^{a}	78.61^{a}

Herd effect. Herd had significant influence on litter weight at birth and at 3 weeks, being lower in Tartu STS (Table 1).

Table 2. Least-square means for effect of parity group

Traits	Parity group		Difference
	1	≥2	
Number of litters	168	243	-
Number of piglets			
Born alive	10.45	11.66	-1.21***
At 3 weeks	9.30	10.85	-1.55***
At 8 weeks	7.99	9.49	-1.50***
Litter weight (kg)			
At birth	13.14	13.46	-0.32
At 3 weeks	55.42	57.58	-2.16$^{\#}$
At 8 weeks	165.45	166.43	-0.98
Piglet average daily gain (g/day)	327	308	19*
Piglet liveability (%)	79.27	85.57	-6.3**

Parity effect. Parity group had significant influence for number of piglets at birth, at 3 weeks and at 8 weeks, being higher in 2nd group (Table 2). Higher results were calculated also for piglet liveability in 2nd group (5.57 %). Significant difference was found for piglet average daily gain ($P<0.05$), being 19 g/day higher in first group.

Table 3. Least-square means for effect of sow and boar breed group

Traits	Breed		
	ELW x ELW	ELW x EL	ELW/EL x ELW
Number of litters	363	28	20
Number of piglets			
Born alive	10.17[a]	10.72[a]	12.27[a]
At 3 weeks	8.94[a]	9.39[ab]	11.89[b]
At 8 weeks	8.44[a]	8.62[a]	9.16[a]
Litter weight (kg)			
At birth	13.50[a]	13.22[a]	13.18[a]
At 3 weeks	56.52[a]	57.27[a]	55.72[a]
At 8 weeks	172.63[a]	196.79[b]	128.41[c]
Piglet average daily gain (g/day)	337[a]	384[b]	232[c]
Piglet liveability (%)	84.30[a]	79.62[a]	83.35[a]

Breed effect. Effect of breed for litter traits are given in Table 3. It is noticeable, that number of piglets are better for crossbred litters. Reason for poorer piglet average daily gain in ELW/EL x ELW group was lower litter weight at 8 weeks. Higher piglet average daily gain was calculated in ELW x EL litters.

The analyses in the present work showed superiority in most of litter traits of ELW x EL cross over pure-bred ELW litters. This crossbreeding effect was for number of piglets born 5%, for number of piglets at weaning 2% and total litter weight at weaning 24.16 kg. Results of the same magnitude are presented by many scientists, cited by Bitchard et. al. (1971). These data have all referred to gains arising from the extra vigour possessed by crossbred piglets born to pure-bred dams. Future gains would be expected from the use of crossbred dams through heterosis in the component traits of reproductive process.

References

Bichard, M. and Smith, C. 1971. Crossbreeding and genetic improvement. In: Pig production. London. Butterworths. pg. 37-52. Editor Cole, D.J.A.

Buchanan, D.S., Luce, W.G. and Clutter, A.C. 1990. Swine crossbreeding systems. OSU Ext. Coop. Ext. Serv. Okla. State Univ. Stillwater, Okla.: The Service. 3 pg.

Pond, W.G. and Maner, J.H. 1984. Purebreeding, crossbreeding and outbreeding. In: Swine production and nutrion. AVI Publishing Co., Inc. pg. 68 -79.

SAS. 1991. SAS User's Guide: Statistics. SAS Inst. Inc., Gary , NC.

Summary

The study was based on litters from 149 Estonian Large White sows and 20 two-way crossbred sows, 54 Estonian Large White boars and 12 Estonian Landrace boars. Sows were produced at the two herds in the period 1991-1996.

Significant differences were found between herds and years. Parity group had large influence on number of piglets and piglet liveability. Crossbreeding exerted substantial effect upon the number of piglets in the litter.