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FERTILITY AND LACTATION YIELD OF ESTONIAN LARGE WHITE SOWS

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Summary
The experiment was carried out in the Tartu STS and Kõpsta PU during the period 1991...1997. The aim of the study was find out possibilities to increase fertility by using crossbreeding and by changing some environmental factors. The first group consisted of 434 litters of 188 purebred Large White (ELW) sows mated with 42 purebred boars of ELW breed. The second group included 28 litters of 28 purebred ELW crossed with 4 boars of Landrace (EL) and the third consisted of 22 litters of 22 crossbred sows mated with 7 purebred ELW boars.
Litters of gilts are significantly smaller (by 10…14%) and of lower liveability rate (by 4.5…6.0%) than the litters of sows farrowed two or more times. However, daily gain is up to 6% higher in piglets of gilts. Heavier piglets and litters are born in spring and winter. Farrowing season has no significant influence on piglet and litter weaning weight. Although winter born piglet survival rate is a little better, there are no differences between farrowing seasons. Lighter piglets are usually born in larger litters (r_p=-0.313). Simple crossbreeding of Large White and Estonian Landrace breeds increases fertility only by 0.44…0.67 piglets. Using crossbred sows increases sow fertility by 1.22…1.68 piglets. To realise heterosis arising in crossbreeding, feeding conditions must be improved to get higher daily gain, litter and piglet weight.

1. Introduction

Efficient production is essential for pork producer to survive in uncertain economic times. Sow fertility has a large influence on economical profitability of pig production. Litter size, piglet liveability and daily gain depends on genetic factors and environmental conditions. Fertility traits of the sows are generally lowly heritable, but good results can be got with crossbreeding (Johansson, 1985). 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).

First large-scale experiments with pigs in Estonia were carried out in Kuremaa Swine Testing Station in 1931…1939 by L. Voltri and E. Sauer (Šmigelskite, 1995).

As recent years have shown an extensive import of pig breeds to improve performance of the local breeds, it was necessary to investigate the effect of the relative breeds on fertility traits of local breeds, the possibilities of increasing fertility by using crossbreeding and by changing some environmental factors. For that purpose the fertility of the Large White breed as well as the possibilities of fertility improvement by using crossbreeding and the effect of some environmental factors (parity, farm, year, season) on fertility were investigated.

2. Material and methods

To study the influence of effectiveness of crossing of the Large White (ELW) breed sows and the Estonian Landrace (EL) boars as well as the effect of environmental factors on fertility of

sows the fertility traits of the sows of the Tartu Swine Testing Station (STS) in 1995...1996 and the Kõpsta Farm of the Ao Producers Union (PU) in 1991...1997 were used.

The study was based on data from 216 Large White sows with 434 purebred litters and with 28 crossbred litters (ELW/EL), 22 single cross sows (ELW/EL) with 22 crossbred litters (75%ELW/25%EL) (Table 1). Large White sows were mated with Large White and Estonian Landrace boars. Selected sows from crossbred litters were mated with Large White boars. Piglet weaning age was 8 weeks in order to use better the mothers ability to produce milk. Large White sows previously improved by the Finnish Yorkshire boars and some Finnish Yorkshire sows were mated with Large White boars.

Table 1. Distribution of the research material by breed combinations and farms

Material	Breed combination (♂ x ♀)					Total
	ELW x ELW		EL x ELW		ELW x ELW/EL	
	Tartu STS	Ao PU	Tartu STS	Ao PU	Ao PU	
Sows	34	154	13	15	22	238
Families	12	4	7	3	-	26
Boars	6	36	1	3	7	53
Lines	4	20	1	2	6	33
Litters	45	389	13	15	22	484

Semen of Estonian Landrace boars was bought from Kehtna AI Station and the semen of Large White boars was collected on the same farm where the experiment was carried out.

Traits measured. For all litters the farrowing date, boar, sow identification number and parity were recorded. Litter size and litter weight were recorded at birth, at three and at eight weeks. Litter weight at three weeks is also described as lactation yield as the growth rate of the piglets up to this time depends almost entirely on the milk they receive (Reiner et al., 1995). Due to different management system; litter traits at eight weeks were not recorded at the Tartu Swine Testing Station. Estimation of feeding situation based on influence of year and season.

Based on the recordings made, piglet average weight at birth, at three and at eight weeks, piglet liveability, piglet average daily gain from birth to third and from birth to eight weeks were calculated by using SAS software (SAS Inst. Inc., 1988). The same program was used to calculate correlations between fertility traits.

Parity numbers above 2 are in the statistical analyses described as parity group two and first parity as parity group one. The farrowing year was divided into four parts: spring = March, April, May; summer = June, July, August; fall = September, October, November and winter = December, January, February.

Statistical analyses. The General Linear Model (GLM) procedure (SAS Inst. Inc., 1988) was used for analysing the dataset by analyses of variance. Analysing litter weight, the regression on number of piglets born was included in statistical model:

$$Y_{ijklm}=\mu+H_i+S_j+B_k+P_l+bX_{ijklm}+e_{ijklm},$$

where

Y_{ijklm} = dependent variable
μ = general mean
H_i = effect of farm x year combination (1-5)
S_j = effect of season (1-4)
B_k = effect of combination of breeds (1-3)
P_l = effect of parity (1-2)
e_{ijklm} = random residual effect
bX_{ijklm} = regression on number of piglets born

Level of significances is expressed conventionally: a, b, c, d, e - least square, within each effect with one letter in common do not differ significantly.

3. Results and discussion

Farm x year combination. Farm influence was high for all traits, except for litter size. Tartu STS traits were lower than in Ao PU, except piglet liveability up to the third week (Table 2).

Litter size did not differ significantly between farrowing years. Significantly heavier piglets at three and eight weeks were born in 1994, compared with those born in 1995 and 1996…1997. Compared with other years, lighter litters at birth and at three weeks were born in 1994. The pigs born in 1994 were also with higher daily gain.

Table 2. Least-square means for the effect of farm x year combination on sow fertility

Traits	Tartu STS	Ao Producers Union			
	1995-96	1991-93	1994	1995	1996-97
No. litters	57	67	121	142	97
No. piglets					
born alive	10.95^{a}	10.99^{a}	10.88^{a}	11.34^{a}	10.55^{a}
at 3 weeks	10.29^{a}	9.97^{a}	9.82^{a}	10.28^{a}	9.49^{a}
at 8 weeks	-	9.78^{a}	9.55^{a}	9.60^{a}	9.18^{a}
Piglet mean weight, *kg*					
at birth	1.12^{a}	1.28^{b}	1.29^{b}	1.29^{b}	1.28^{b}
at 3 weeks	5.67^{a}	6.77^{b}	6.90^{b}	6.22^{c}	5.78^{a}
at 8 weeks	-	19.85^{ab}	20.72^{a}	19.13^{b}	18.80^{b}
Litter weight, *kg*					
at birth	11.63^{a}	13.78^{b}	13.77^{b}	13.71^{b}	13.18^{c}
at 3 weeks	51.85^{a}	60.60^{b}	62.80^{b}	56.99^{c}	52.61^{a}
at 8 weeks	-	172.60^{ab}	180.69^{a}	169.80^{b}	165.79^{b}
Piglet mean daily gain, *g/ day*					
from birth to 3rd week	202^{a}	253^{b}	261^{b}	222^{a}	214^{a}
from birth to 8th week	-	322^{ab}	340^{a}	311^{b}	311^{b}
Piglet liveability, *%*					
from birth to 3rd week	95.05^{a}	90.74^{a}	91.08^{a}	91.85^{a}	90.73^{a}
from birth to 8th week	-	88.38^{a}	87.28^{a}	84.97^{a}	85.84^{a}

Litter and piglet weight and daily gain may significantly differ between farms and years in similar economic conditions. Investigation of the effect of keeping as well as environmental conditions has given different results (Meisner, 1985; 1990). Reasons for this are obviously the differences in climatic and keeping conditions (Fahmy et al., 1978).

An extensive using of imported pig breeds has not significantly affected the fertility of the local breeds.

Combination of breeds. Crossbreeding is not widely used method to produce slaughter pigs in Estonia. Experiment data showed that simple crossbreeding increased sow fertility at birth only by 6.5%, at three weeks by 4.7% and at weaning by 6.0% (by 0.44…0.67 piglets) (Table 3). However, using crossbred sows fertility increased significantly - 11.8%, 17.3%, 19.1% respectively (by 1.22…1.68 piglets).

Crossing of two swine breeds, bred in Estonia, was investigated also by V. Laanmäe, E. Meisner and A. Timmi. According to the results obtained by E. Meisner (1985; 1990) it was more effective to use crossbred sows whose fertility was by 7…15% higher than that of purebred sows. Simple crossbreeding increased fertility only by 1.5…3.3%. The results obtained by A. Timmi (1988) showed that simple crossbreeding also increased swine fertility.

Purebred and crossbred piglets and litters were about of the same weight at birth and also at three weeks. The piglets and litters were heavier at weaning than purebred and backcrossed piglets

and litters when using simple crossbreeding. Realisation of arisen heterosis in lactation yield and piglet weaning weight by using crossbreeding obviously depend more on feeding-keeping conditions. Significant differences were found between breed combinations in daily gain at the age of eight weeks ($P<0.05$). Whereas the daily gain of the simple crossbred piglets was higher than that of the purebred ones, and the daily gain of purebred piglets was higher than that of crossbred piglets from backcross litters. Piglet liveability did not differ significantly between breed combinations.

Table 3. Least-square means for the effect of breed combination on sow fertility

Traits	Breed combination (♂ x ♀)		
	ELW x ELW	EL x ELW	ELW x ELW/EL
No. litters	434	28	22
No. piglets			
born alive	10.31[a]	10.98[a]	11.53[a]
at 3 weeks	9.29[a]	9.73[ab]	10.90[b]
at 8 weeks	8.79[a]	9.32[ab]	10.47[b]
Piglet mean weight, *kg*			
at birth	1.26[a]	1.26[a]	1.23[a]
at 3 weeks	6.17[a]	6.53[a]	6.11[a]
at 8 weeks	18.99[a]	21.67[b]	18.21[a]
Litter weight, *kg*			
at birth	13.39[a]	13.05[a]	13.19[a]
at 3 weeks	56.08[a]	58.47[a]	56.37[a]
at 8 weeks	166.91[a]	190.27[b]	159.48[a]
Piglet mean daily gain, *g/ day*			
from birth to 3rd week	236[a]	247[a]	208[a]
from birth to 8th week	318[a]	361[b]	284[c]
Piglet liveability, *%*			
from birth to 3rd week	90.78[a]	89.76[a]	95.13[a]
from birth to 8th week	85.65[a]	82.39[a]	91.83[a]

Swine crossbreeding studies carried out abroad since 1930, with both inbred and noninbred animals, showed that heterosis for reproductive traits, litter size, piglet liveability, piglet weight and litter weight ranged from 5 to 25%, having been highly dependent upon breeds used in the cross (Drewry, 1980).

Crossbreeding can increase litter size, whereas litter and piglet weight by changing environmental factors. To increase pig production profitability, the crossbred sows giving larger litters must be used for producing slaughter pigs. To realise heterosis arising in crossbreeding, feeding conditions must be improved to get higher daily gain, litter and piglet weight.

Parity. The first and later parities differed significantly concerning litter size at birth, at three and eight weeks, whereas smaller litters were got in the first parity. Piglets from the first parity, however, grew more quickly. Significantly higher piglet liveability was observed in the second and higher parities during the third week of life and at weaning ($P<0.01$). Weak positive phenotypic correlation was found ($r_p=0.093$) between the first and second litter size. In selection of young sows it must be considered that the first parity litter size does not give statistically significant information about the next parities.

Farrowing season. Analysing the farrowing season it was found that lighter piglets were born in summer and heavier piglets and litters in winter ($P<0.05$). Litter weight at three weeks was significantly higher in spring born piglets ($P<0.05$), compared with those born in summer and fall. Lactation yield of the spring-farrowed sows was higher than that of the sows farrowed in fall ($P<0.01$). Farrowing season had no significant effect on piglet and litter weight. Higher daily gain up to the third week increased the spring born litter weight at the age of three weeks, compared with that of the summer and fall born ones ($P<0.05$). Significantly higher piglet liveability up to the third

week was observed in winter born piglets (94%) compared with spring (90%) born ones ($P<0.05$), which may be conditioned by the conditions in piggeries.

Correlations. In addition to the preceding aspects, the relations between reproductive traits were investigated. Negative correlation between piglet weight and litter size at birth ($r_p=-0.313$; $P<0.001$) and positive correlation between piglet birth weight and piglet liveability at the age of three ($r_p=0.158$; $P<0.001$) and eight weeks ($r_p=0.168$; $P<0.01$) were found. Litter weight decreased if piglet mean birth weight exceeded 1.49 kg. Strong positive correlation ($r_p=0.885$) was found between the number of piglets and litter birth weight ($P<0.01$). Positive relation was also found between number of piglets born and lactation yield ($r_p=0.521$) and litter weight ($r_p=0.550$) at eight weeks ($P<0.001$).

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