Teat Number, Fattening Performance And Litter Traits in Pigs, - Estimates Of Genetic Correlations

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Introduction

In most pig breeding programs, dam lines are selected for both production and reproduction traits. Estimates on annual genetic improvement of litter size give figures in the range 0.2 to 0.3 piglets increase per year. This indicates the need for a parallel increase in the number of functional teats on the sow. This is very important, since the nursing and suckling behaviour of pigs follow a complex scheme, and the milk ejection lasts for only 10-20 seconds, approx. once per hour. Not all teats on the sow are regarded to be functional, and thus to be of less value for the piglets. Examples on these non-functional teats are: inverted teats, small teats, extra teats (inserted between two normal ones). The aim of this study was to analyse the genetic correlation between teat number and performance traits in the Swedish Yorkshire breed, recorded at performance testing (at 100 kg live weight), and litter size and litter weight at 3 weeks of age.

Material and methods

The study is based on data from the Swedish-Finnish breeding organization Nordic Genetics. In the nucleus herds, performance testing (including information on functional and non-functional teats on both sexes; interval 80-130 kg live weight) is performed by technicians from the breeding organization. Recording of litter traits (including litter weight in nucleus herds) if performed by herd staff.

The study is based on information on:

1. Performance tested purebred Yorkshire pigs born in years 2007 and 2008 in nucleus herds.
2. Information on litter traits for purebred Yorkshire sows (1st and 2nd parity, both purebred and crossbred litters) farrowing in nucleus and multiplier herds, in the interval Jan. 2006 to Nov. 2009.

Information from herds with less than 1000 performance tested pigs in the 2-year-period, as well as data from herd-sire breed combinations with less than 200 litters in the period studied were excluded from analysis.

The handling and editing of data was performed using the SAS software (Ver. 9; SAS Inst. Inc., Cary, NC) and the genetic analyses were performed using the DMU-package (Madsen & Jensen, 2007). The analysed traits are presented in table 1. Two traits (D100; S100) were pre-corrected to 100 kg live weight). Three traits (NF100; SB1; SB2) with severe non-normal distribution were transformed using normal score.

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The statistical model included for the four traits recorded at 100 kg live weight, the fixed effects of: herd-year at testing and sex, and the random effects of animal, fattening pen (i.e. batch-pen-combination) and birth litter.
The model applied to the litter traits included the fixed effect of herd-sire breed combination, and the random effects of animal and herd-year-2-month-period of farrowing. The model for the litter weight traits also included the regression on age at weighing (18-24 days) and number of piglets at weighing. Since cross fostering is to some degree applied in these herds, all the piglets weighed and included in the litter weight, were in some cases not biologic offspring of that very sow.

The genetic analyses were performed six combinations of traits: 1) all four performance testing traits; 2) all six litter traits; 3) D100+S100 and litter traits for parity 1; 4) D100+S100 and litter traits for parity 2; 5) T100+NF100 and litter traits for parity 1; 6) T100+NF100 and litter traits for parity 2. In addition, T100+NF100 were analysed together with litter size at weighing (approx. at 3 weeks of age), for both parity 1 and parity 2.

Table 1. General information on the analysed data

Trait	No. of records	Mean	SD
Days at 100 kg [D100]	32828	158.9	16.6
Sidefat thickness at 100 kg, mm [S100]	32828	10.5	1.9
Total teat number, at 100 kg [T100]	32858	14.5	0.9
No. non-functional teats at 100 kg [NF100]	32858	0.25	0.8
No. liveborn piglets, 1st parity [LB1]	8822	11.0	3.2
No. stillborn piglets, 1st parity [SB1]	8822	1.05	1.5
Litter weight (3wk), 1st parity, kg [LW1]	4814	56.7	13.0
No. liveborn piglets, 2nd parity [LB2]	5617	11.9	3.4
No. stillborn piglets, 2nd parity [SB2]	5617	0.95	1.4
Litter weight (3wk), 2nd parity, kg [LW2]	2498	63.5	13.1

Results and discussion

The estimated level of heritability for T100 (Table 2) is somewhat higher than presented by Ligonesche, Bazin and Bidanel (1995), but NF100 has obviously a lower additive genetic background than T100. In present study, no significant correlations between teat number and production traits (D100; S100) are found. This is in contrast with Ligonesche, Bazin and Bidanel (1995) who found, for both total number of teats and number of good teats, that fast growth was correlated with high number of teats. The positive correlation between T100 and NF100 might be the cause of 'auto correlation', since NF100 is included in T100, and/or that 'extra teats' biologically are inserted between the standard set up of normal teats. In present data, no information is available on the type of non-functional teats that was observed.

Table 2. Estimated heritabilities for, and genetic correlations between traits recorded at 100 kg live weight. Correlations in bold are significant (p<0.05)

Trait	h^2	S100	T100	NF100
Days at 100 kg [D100]	0.23	**-0.12**	0.00	0.08
Sidefat thickness, mm [S100]	0.43		0.04	-0.11
Total teat number [T100]	0.42			**0.22**
Non-functional teats [NF100]	0.09			

The estimated heritabilities for LB and SB (Table 3) are in the range of earlier estimates presented by Serenius *et al*. (2008), and so is the heritability level for LW (Ehlers *et al*. (2005)). High number of liveborn piglets has a strong genetic correlation to many stillborn piglets in parity 2, but not in parity 1. Surprisingly however, LB1 has a strong genetic correlation with SB2, but not with SB1. The unfavourable correlation between LW1 and LB2 indicate that first parity sows that give priority on milk production, are less well prepared for next litter.

Table 3. Estimated heritabilities for, and genetic correlations between litter traits. Correlations in bold are significant (p<0.05)

Trait	h^2	SB1	LW1	LB2	SB2	LW2
No. liveborn piglets, 1st par. [LB1]	0.07	0.11	-0.01	**0.51**	**0.43**	0.02
No. stillborn piglets, 1st par.[SB1]	0.05		-0.07	0.13	**0.56**	-0.06
Litter weight , 1st par. [LW1]	0.19			**-0.30**	0.09	**0.84**
No. liveborn piglets, 2nd par. [LB2]	0.09				**0.39**	-0.22
No. stillborn piglets, 2nd par. [SB2]	0.06					0.11
Litter weight, 2nd par. [LW2]	0.17					

Slow growth to 100 kg is correlated with large litters (Table 4), which is in agreement with findings of Holm *et al.* (2004), and with slow piglet growth during their first 3 weeks of life. Thick fat layer at 100 kg live weight is correlated with slow piglet growth (parity 1). Total teat number is positively correlated with litter weight at 3 weeks in parity 2, but not in parity 1. This difference between parities might be caused by the, on average, higher litter size in parity 2 compared with parity 1. Higher litter size stresses the need for enough number of (functional) teats. The genetic correlation between number of non-functional teats and litter size at 3 weeks of lactation was negative for both par. 1 (-0.20; non-significant) and par. 2 (-0.32; p<0.05). The correlations between T100 and litter size were not significant.

Table 4. Estimated genetic correlations between traits recorded at 100 kg live weight and litter traits. Correlations in bold are significant (p<0.05)

Trait	LB1	SB1	LW1	LB2	SB2	LW2
Days at 100 kg [D100]	**0.26**	0.14	**-0.60**	**0.40**	-0.05	**-0.62**
Sidefat thickness [S100]	0.16	-0.04	**-0.16**	0.12	-0.14	-0.13
Total teat number [T100]	-0.02	-0.09	-0.08	0.05	-0.09	**0.19**
Non-functional teats [NF100]	0.17	0.09	-0.15	-0.12	0.22	-0.13

The recording of teat number on the 100 kg pig, often when it is placed in a scale with iron bars on the side, is not an easy task. Especially, the differentiation between functional and what is regarded to become non-functional teats is a hard task. Also, the knowledge on the association between teat appearance at 100 kg live weight, and during lactation, is today incomplete. This leads to ideas on how to improve the accuracy in selection for increased number of functional teats.

Conclusion

This study indicates that selection for increased teat number would be fruitful, and that teat number is positively genetically correlated with piglet growth during lactation. However, no significant genetic correlations between teat number and other traits under selection are found. Further, growth rate until 100 kg live weight is unfavourably correlated to litter size, but favourably correlated to piglet growth rate during nursing period.

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