Genetic selection on number of teats

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Introduction

Genetic selection on litter size in swine over the last 10 to 15 years resulted in an important increase in litter size. In Canada, litter size increased by 1.8 to 2.3 pigs per litter in maternal lines between 1995 and 2007 (CCSI, Annual Report 2007-2008). With this increase in litter size, sows have been found to be sometimes limited by the number of functional teats they have. Indeed, the incidence of a sow weaning more pigs than the number of their functional teats is rare (Skjervold, 1963). When selecting pigs, breeders should take into account the number of functional teats the pig has because it is known that the number of functional teats influences sow productivity.

Description of the different kind of teats

There are three possible kinds of teats; functional (good) teats, the inverted teats, and the supernumeraries (extra) teats, as illustrated in Figure 1. A good teat is a teat with a predominant sphincter. A good teat has the sphincter and the body of the teat clearly distinct. An inverted teat is turned inwards with various degrees of inversion (partial to complete). It looks like a crater with an invisible sphincter or a sphincter hidden in the teat's body. A supernumerary (extra) teat is usually shorter in size than normal teats. The total number of teats can be determined at birth but it is not possible at that time to differentiate good teats from inverted or extra teats. Teats are better counted during selection when pigs are weighed and measured for other production traits.

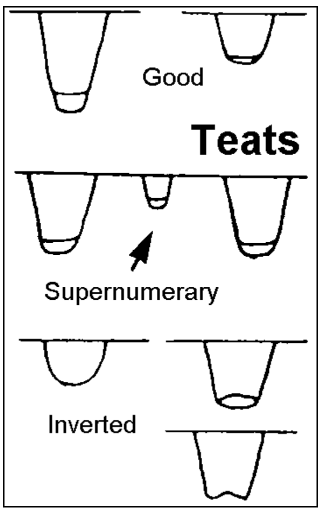

Figure 1. Different kinds of teats (adapted from Muirhead and Alexander, 1997)

Analyses of Landrace data

Analyses were performed using 173,466 Landrace born between 1991 and 2006. 168, 954 pigs were evaluated for teats on 65 farms. Table 1 gives descriptive statistics on the different teat traits, while Figure 2 shows the distribution of the traits. Inverted teats and extra teats were not normally distributed. Approximately 90% of all pigs had no inverted or extra teats.

Table 1. Mean, standard deviations (SD) and coefficients of variation (CV%) for teats numbers in Landrace

Trait	Abbreviation	Mean	SD	CV%
No of total teats	TTEAT	14.9	1.03	7
No of functional teats	GTEAT	14.5	1.32	9
No of inverted teats	ITEAT	0.21	0.87	
No of extra (supernumeraries) teats	ETEAT	0.16	0.44	

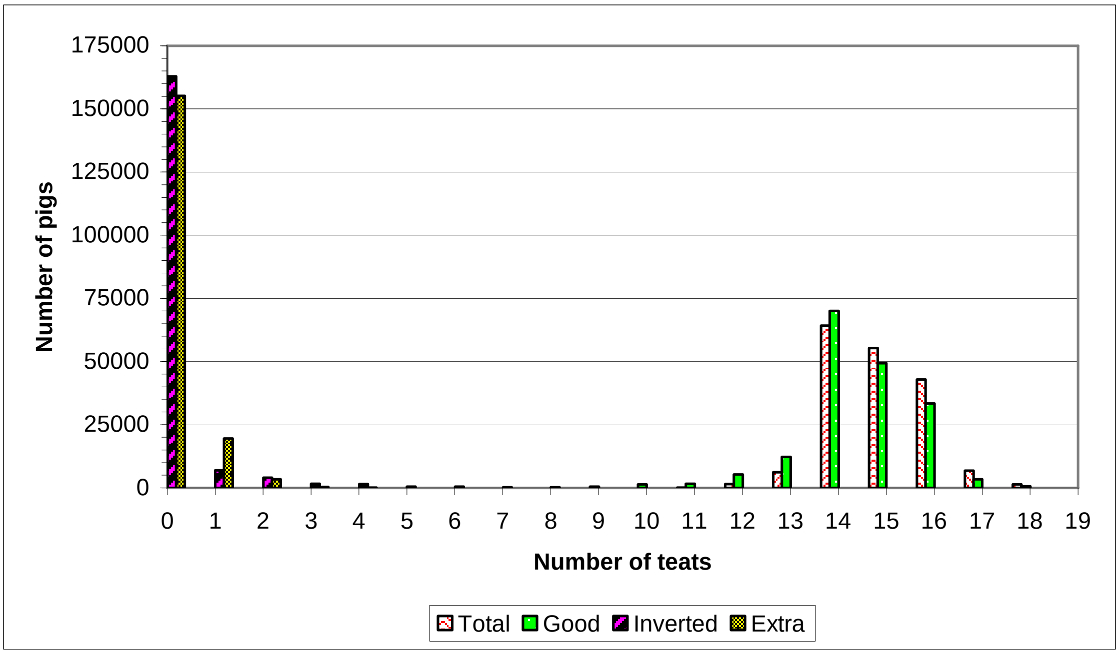

Figure 2. Distribution of different teat characteristics

Estimation of variance components was performed using ASReml (Gilmour *et al*., 2002) implementing an animal model with litter as an additional random effect. The contemporary group was defined separately for both sexes within each farm and month of recording, which is very similar to the standard definition of contemporary groups over time in PIGBLUP. Genetic parameters are shown in Table 2. Total (TTEAT) and functional (GTEAT) teats had moderate heritabilities (0.38 and 0.30 respectively). These heritabilities are similar to those found in the literature (Molenat and Thibault, 1977; Lignonesche *et al*., 1995) and similar to estimates found in three other Genetiporc populations (Hermesch and Marois, 2008). Number of inverted teats (ITEAT) also had moderate heritability. However, heritability estimates for this trait should be viewed with caution given that parameters did not converge. The non-normal distribution caused numerical problems. The number of extra teats (ETEAT) had a low heritability of 0.06. Total teat number and functional teat number had a high genetic correlation of 0.83 and moderate to high genetic correlations with extra-teats (0.57 and 0.40 respectively). Similar genetic correlations were found in three other breeds at Génétiporc (Hermesch and Marois, 2008), but estimates were higher than the correlation found in the French population (Lignonesche *et al*., 1995). It was not possible to estimate the genetic correlation between functional teats and inverted teats because parameters did not converge.

Table 2. Heritabilities (bold, on diagonal) and genetic correlations (above diagonal) for number of teat traits for Landrace. Standard errors of estimate are given within brackets

Trait	TTEAT	GTEAT	ITEAT	ETEAT
TTEAT	**.38 (.007)**	.83 (.01)	.04 (.02)	.57 (.02)
GTEAT		**.30 (.008)**	ne*	.40 (.03)
ITEAT			**.20 (.007)**	.04 (.04)
ETEAT				**.06 (.003)**

* could not be estimated

Selection on teats at Génétiporc

Génétiporc began performing genetic evaluations on total number of teats and number of functional teats at the beginning of 2008. Before that, only phenotypic selection was used. Selection target in the Génétiporc breeding program for teat number are 14 good teats for pure line animals (males and females). No inverted teats are tolerated. Selection is done at around 100 to 120 kg.

Table 3 gives the mean number and the distribution of good teats for pigs born in 2002 and for pigs born in 2006. An improvement has been made on the number of good teats during this five year interval. Indeed, the mean number of good teats increased by 0.4 teats during this period, and the percentage of pigs having at least 14, 15 and 16 teats increased by 4.4, 11.9 and 4.7% respectively. Good improvements have also been achieved on the number of inverted teats (Table 4) with 5% fewer pigs born in 2006 having inverted teats compared to pigs born in 2002. In addition, the mean number of inverted teats improved by 0.21 teats over the 5 year period. No real improvement was achieved for extra teats (Table 4) as no restrictions were imposed on this criterion. Figure 3 shows mean estimated breeding values (EBV) for the number of good teats plotted against year of birth, for pigs born between 2002 and 2006. An improvement of +0.26 good teats was achieved over the 5 years, for a mean genetic improvement of +0.05 good teats per year.

Table 3. Mean number of good teats, and percentage of pigs having different number of good teats for pigs born in 2002 and 2006

Year of birth	Mean number good teats	% of pigs having good teats < 12	≥12	≥13	≥14	≥15	≥16
2002	14.2	4.2	95.8	91.4	83.9	40.9	18.5
2006	14.6	2.0	98.0	95.2	88.3	52.8	23.2
2006-2002	+0.4	-2.2	+2.2	+3.8	+4.4	+11.9	+4.7

Table 4. Mean number of inverted and extra teats, and percentage of pigs having different number of good inverted or extra teats for pigs born in 2002 and 2006

Year of birth	Mean number inverted teats	% of pigs having inverted teats			Mean number extra teats	% of pigs having extra teats		
		0	1	≥1		0	1	≥1
2002	0.45	85.5	4.6	9.9	0.12	89.8	8.7	1.5
2006	0.24	90.3	4.5	5.2	0.13	88.1	10.6	1.3
2006-2002	-0.21	+4.8	-0.1	-4.7	+0.01	-1.7	+1.9	-0.2

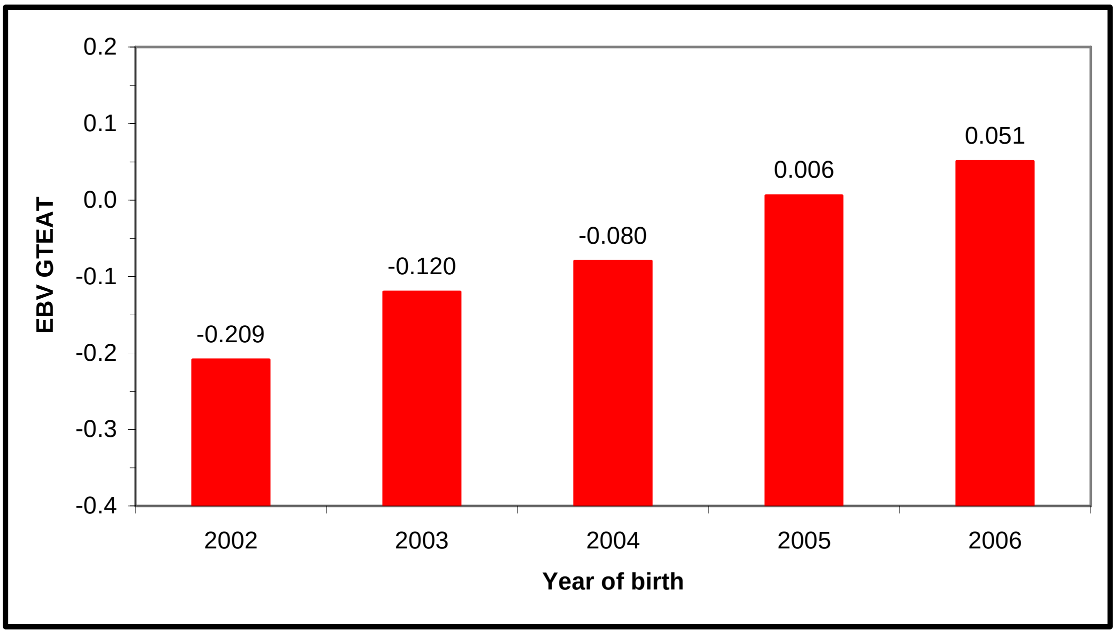

Figure 3. Mean genetic values of number of good teats per year of birth for pigs born between 2002 and 2006

The genetic correlation between inverted teats and good teats could not be estimated and mixed results in teat EBVs are observed between families with a high number of good teats or at least one inverted teat. Table 5 gives an example of two families with a common sire evaluated on the same day. Both families are similar according to number of good teats but two inverted teats were found on one of the four pigs in family A. Family A does not have a worse EBV for inverted teats than family B, and pigs of family A have generally better EBV's for good teats. Due to these mixed results, it was decided to implement selection on number of good teats only. Additionally, we explored the possibility of removing the use of genetic correlations between inverted and extra teats with number of good teats, in order to improve the evaluation on number of good teats.

Table 5. Example of estimated genetic values (EBV) for good, inverted and extra teats for two families with common sire evaluated the same day

Family	Pig	GTEAT	ITEAT	ETEAT	EBV GTEAT	EBV ITEAT	EBV ETEAT
A	A1	14	0	0	0.06	0.08	0.00
	A2	14	0	0	0.06	0.08	0.00
	A3	14	2	0	0.14	0.11	0.01
	A4	15	0	0	0.25	0.07	0.01
B	B1	14	0	0	-0.24	0.10	-0.02
	B2	14	0	0	-0.24	0.10	-0.02
	B3	13	0	0	-0.48	0.12	-0.03
	B4	16	0	0	0.11	0.08	0.00
	B5	14	0	0	-0.28	0.10	-0.02

The economic value of one extra functional teat is not obvious. We estimate that one extra functional teat is equivalent to one extra piglet born alive assuming that the extra functional teat would allow the sow to wean one extra pig. This is a non-linear rule because the value of the extra functional teat depends on the level of number born alive in the population. It is thought that average number of good teats should be at least two teats above the number of piglets born alive in the population, as the last pair of teats is usually less productive than other teats. With a prolificacy of 12 born alive, 14 functional teats should be targeted.

Conclusion

It is generally believed that sows must have a high number of functional teats to rear pigs. Because the number of functional teats may have a direct influence on production, they should be considered as part of objective selection. Genetic gains are possible for total number of teats and number of functional teats since sufficient genetic variation exists for these traits. In contrast, the number of inverted and extra (supernumerary) teats for genetic improvement has not been found to be useful. One approach to improve the general quality of teats is selection based on the number of good teats and to avoid the selection of sows or boars which have inverted or extra teats. Both sires and dams used in breeding herds should be selected based on their number of good teats.

References

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