GENETIC ASSOCIATIONS BETWEEN LITTER SIZE OF PRIMIPAROUS SOWS AND FEED INTAKE BEHAVIOUR OF RELATED BOARS TESTED IN STATION

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INTRODUCTION

Electronic feeding stations are increasingly implemented in performance test stations to obtain individual feed intake informations under practical conditions of group-housing. Those data were analysed in several studies in order to improve feed intake, and to optimize growth performance (Hall *et al.,* 1999; Eissen, 2000; Schulze *et al.,* 2002).

Although feed intake behaviour was found to be highly heritable, the low to moderate genetic associations with performance traits such as average daily gain, feed efficiency, etc. (Labroue *et al.,* 1997; Schulze, 2001) indicate no efficient indirect response to selection of the latter traits. Karsten *et al.,* (2000) estimated moderate genetic associations between food conversion and litter size in first parity when analysing average daily gain, backfat thickness, feed intake and food conversion of performance tested boars together with reproduction performance of their sibs and progenies. Feed intake behaviour was not analysed in their study.

The objective of the present study was to analyse the genetic associations of feed intake behaviour of performance tested boars obtained from electronic feeders and the litter size of their relatives.

MATERIAL AND METHODS

The estimation of genetic associations between growth performance and reproduction performance was based on station test data of performance tested boars and reproduction performance of their progenies, half and full sibs.

Performance test data of 3686 purebred boars of dam lines 03 (n= 2038) and 04 (n= 1648) were recorded at the central test station of PIC Germany between 1992 and 1998. The boars were penned in groups of twelve of the same line during the performance test between 100 and 170 days of age. Ad libitum feed intake was recorded using ACEMA 48 electronic feeding stations in test weeks 1, 3, 5, 7, and 9 while in the remaining test weeks food was supplied by conventional feed dispensers. Individual feed intake records were condensed to daily information of feed intake and feed intake behaviour, according to results of Schulze *et al.* (2001, 2002). Means and standard deviations of performance and feed intake traits for each line are shown in Table 1. Boars of line 03 consumed a similar amount of food in additional 0.44 visits (VD) and spend 4 min more time per day (TD) in the feeder than animals of line 04.

Reproduction traits number of total born piglets (NB) and number of piglets born alive (NBA) were available for 9710 purebred primiparous sows (5089 of line 03 and 4621 of line 04, Table 2). Sows farrowed on 10 farms and 75 % of them were artificially inseminated. In comparison to line 03, the total number of piglets born was 0.23 higher in line 04. Only those animals with known parents were considered in this investigation. A sufficient connectedness was achieved by up to five ancestor generations in the pedigree.

Table 1. Means (x) and standard deviations (s) of growth performance, feed intake and feed intake behaviour of boars of lines 03 and 04

			Line 03		Line 04	
Trait			$\bar{x}$	s	$\bar{x}$	s
Average daily gain	(ADG)	(g/day)	1029.6	127.5	1012.1	125.2
Backfat thickness	(BF)	(mm)	11.03	2.18	10.87	2.09
Daily feed intake	(DFI)	(g/day)	2510.5	363.5	2473.1	338.1
Food conversion	(FC)	(g/kg)	2455.7	341.2	2461.0	321.9
Visits per day	(VD)	(No.)	7.32	3.80	6.88	2.97
Time per day	(TD)	(min)	61.82	11.3	57.82	10.3
Time per visit	(TV)	(min)	11.36	4.01	10.55	3.26
Feed intake per visit	(FIV)	(g)	473.5	171.5	463.8	141.2
Feed intake rate	(FIR)	(g/min)	42.33	7.72	44.68	7.77

Table 2. Means (x) and standard deviations (s) of total born and born alive piglets of gilts for lines 03 and 04

		Line 03		Line 04	
Trait		$\bar{x}$	S	$\bar{x}$	s
Piglets born alive	(NBA)	9.56	2.80	9.65	2.71
Total born piglets	(NB)	10.24	2.93	10.47	2.90

Estimation of variance components was accomplished using REML program VCE4, Edition 4.2.5 (Groeneveld, 1998) within a multiple-trait animal model. The statistical model used for growth traits, feed intake, and feed intake behaviour considered the fixed effects of birth farm (4 levels) and year-quarter of beginning of performance test (16 seasons), and as covariables linear regressions on start weight, start age and end age were used. Variance components of reproduction traits were adjusted for fixed effects of mating type (2 levels), line of the mating boar (2 levels), Herd-Year-Season (75 levels) and age at farrowing as a covariable.

RESULTS AND DISCUSSION

In Table 3 heritabilities and standard errors of growth traits, feed intake and feed intake behaviour are shown for each line. Highest heritabilities of all performance traits were found for backfat thickness (h^2= 0.44 and 0.54). This is in agreement with results (h^2 = 0.38 to 0.65) from other investigations (De Haer, 1992; Von Felde *et al.,* 1996; Labroue *et al*., 1997; Hall *et al.*, 1999) dealing with feed intake recorded by electronic feeders. Moderate heritabilities for daily gain on test as in the present study were found by Hall *et al.* (1999) and Labroue *et al.* (1997) for Large White breeds (h^2 = 0.25 and 0.31), while estimates of studies analysing Landrace (Labroue *et al.* 1997) or Landrace and Large White breeds together (Von Felde *et al.* 1996) were higher (h^2 = 0.41, 0.43). Estimates of heritability for feed intake in the present study as well as by Von Felde *et al.* (1996) and Hall *et al.* (1999) were substantially lower (h^2 = 0.22, 0.19, 0.21), compared to those of Labroue *et al.* (1997) (h^2 = 0.42, 0.42) while heritabilities of food conversion were in agreement with the estimates in the above mentioned investigations (h^2 = 0.12 to 0.20).

Table 3. Heritabilities (h²) and standard errors (s_{h^2}) of growth performance, feed intake and feed intake behaviour of boars of lines 03 and 04

Trait			Line 03		Line 04	
			h^2	s_{h^2}	h^2	s_{h^2}
Average daily gain	(ADG)	(g/day)	.35	.03	.25	.03
Backfat thickness	(BF)	(mm)	.44	.03	.54	.04
Daily feed intake	(DFI)	(g/day)	.20	.02	.29	.02
Food conversion	(FC)	(g/kg)	.11	.02	.23	.03
Visits per day	(VD)	(No.)	.31	.02	.39	.02
Time per day	(TD)	(min)	.39	.02	.47	.04
Time per visit	(TV)	(min)	.33	.02	.49	.05
Feed intake per visit	(FIV)	(g)	.36	.02	.44	.03
Feed intake rate	(FIR)	(g/min)	.37	.02	.47	.04

While moderate heritabilities were estimated for all feed intake behavioural traits in line 03 (h^2= 0.31 to 0.39), higher heritabilities (0.38 to 0.49) were found for the corresponding traits in line 04. This is in agreement with high heritabilities for feed intake behavioural traits reported by Von Felde *et al.* (1996) (h^2 = 0.43 to 0.51) and Labroue *et al.* (1997) (h^2 = 0.46 to 0.42) with little differences in estimates of equivalent traits. Lower estimates for traits describing feed intake behaviour were found by Hall *et al.* (1999) (h^2 = 0.04 to 0.34). They explained these differences as an effect of the type of feeder used.
The heritabilities for first parity reproduction traits in Table 4 were slightly lower than results reported by Roehe and Kennedy (1995) and Täubert and Brandt (2000). In contrast to these studies, the number of total born piglets showed a lower heritability than number of piglets born alive.

Table 4. Heritabilities (h²) and standard errors (s_{h^2}) of total born piglets (NB) and piglets born alive (NBA) of gilts for lines 03 and 04

		Line 03 (n= 5089)		Line 04 (n= 4621)	
Trait		h^2	s_{h^2}	h^2	s_{h^2}
Piglets born alive	(NBA)	.08	.02	.06	.01
Total born piglets	(NB)	.05	.01	.05	.01

The genetic correlations between average daily gain, backfat thickness, feed intake and food conversion with reproduction traits (Table 5) were low, with the exception of moderate associations of total piglets born with backfat thickness and feed intake in line 03 (r_a = 0.35 and 0.30) and of food conversion ratio with piglets born in total and alive in line 04 (r_a = 0.45 and 0.46). But it should be noticed that standard errors were high. The genetic associations between feed intake behaviour and reproduction performance were remarkable especially for the time related behavioural traits time per day (TD), time per visit (TV) and feed intake rate (FIR) and also more accurate as indicated by lower standard errors. A longer time in the feeder tends to improve the number of piglets born (r_a = 0.48 to 0.62).

Table 5. Genetic correlations (r_a) of growth performance, feed intake and feed intake behaviour traits with reproduction performance traits

Trait			Line 03				Line 04			
			NB		NBA		NB		NBA	
			r_a	s_{ra}	r_a	s_{ra}	r_a	s_{ra}	r_a	s_{ra}
Average daily gain	(ADG)	(g/day)	.18	.11	.02	.10	-.22	15	-.15	.14
Backfat thickness	(BF)	(mm)	.30	.09	.19	.08	-.03	.10	-.11	.09
Daily feed intake	(DFI)	(g/day)	.35	.12	.19	.12	.17	.07	.22	.07
Food conversion	(FC)	(g/kg)	.21	.09	.26	.08	.46	.14	.45	.13
Visits per day	(VD)	(No.)	-.12	.08	-.19	.06	-.20	.08	-.20	.08
Time per day	(TD)	(min)	.48	.07	.42	.06	.62	.07	.56	.07
Time per visit	(TV)	(min)	.43	.09	.47	.08	.56	.10	.54	.10
Feed intake per visit	(FIV)	(g)	.21	.08	.26	.07	.30	.09	.31	.09
Feed intake rate	(FIR)	(g/min)	-.38	.06	-.36	.05	-.54	.07	-.44	.08

NB = total number of born piglets, NBA = number of piglets born alive

CONCLUSION

In earlier studies (e.g. Schulze, 2001) low genetic associations between growing-finishing performance traits and behavioural traits were obtained. In the present study considerable associations of feed intake behavioural traits recorded on boars tested in station and reproduction performances of their female sibs and offspring were found. Considering the high heritability of behavioural traits, the use of these traits would be an early information of boars to improve the reproduction traits of their progenies. Especially the use of time per day in the feeder (TD) of boars during performance test seemed to be of interest due to the moderate genetic associations with litter size (NB, NBA) of their relatives.

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