Boar fertility

Horst Brandt

Institute for Animal Breeding and Genetics,
University of Gottingen, Albrecht-Thaer-Weg 3, 37075 Getting en, Germany

Introduction

The male part of fertility traits in pigs has not often been analysed because of missing semen quality data in the case of natural mating. With increasing AI in pigs more data about semen quality of boars is available, so its influence on litter size can be analysed on bigger data sets. With advanced recording systems, single matings are recorded and important economic traits like mating success can be included in parameter estimation. For AI-stations, and also for breeders using their boars in natural mating, it is of great interest to get information on mating success and litter size of their boars for further selection.

From a total of 3808 boars of three lines of the German hybrid breeding scheme (Bundeshybridzuchtprogramm) growth traits were available. After selection, 1264 of these boars were used for AI in 2 company owned stations, and a total of 50749 ejaculates with semen quality traits could be analyzed. 36628 single matings and 27678 litters from 1039 of these boars were available to study the influence of boars on mating success and litter size. For the genetic analysis only 5791 purebred matings of line 1 from 8 farms and 21920 crossbred matings (boars line 1 and sows line 3) from 41 farms were included. For semen quality traits for each line, an animal model with repeated records was used including AI-station and season (3 month periods from 1990 to 1995) as fixed effects. For mating success and litter size an animal model with the sow or boar as animal and the boar or sow as additional random effect was used including parity, farm, age of semen and season (3 month periods) as fixed effects.

Boar fertility traits

For all semen quality traits, season and AI-station have a significant effect. The heritability estimates for semen quality traits are shown in Table 1. Both lines for volume, density and total number of sperms show nearly identical heritabilities and repeatabilities. Similar heritabilities are found by van der Steen et al. (1983), while Falkenberg et al. (1982) and Hillbrand (1984) found higher heritabilities. For motility the estimates for line 3 are twice as high as for line 1. The motility is a subjective score with only three classes (60%, 70% and 80%) with over 90% of all observations within the last two classes. Within line 1 less than 5% of all ejaculates show a motility of 60% which could explain some of the line differences.

Table 1: Heritabilities (h2) and repeatabilities (r) for semen quality traits

	Line 01		Line 03	
	h^2	r	h^2	r
Volume	.18	.30	.14	.27
Density	.21	.41	.26	.43
Number of Sperms	.25	.48	.22	.46
Motility	.05	.30	.13	.60

The farm, parity, season and the age of semen all show a significant effect on mating success and on litter size. For piglets born alive, the parity shows the expected increasing litter size from first to later litters. For the mating success in both lines the second litters show a slightly lower success rate than the first litters. From the second to later litters again an increasing success rate is observed. The least square means for litter size and success rate for the age of semen in days after collection are shown in Figure 1.

Two day and older semen show a significant lower litter size and a reduced success rate than semen used on the day of collection or one day later. For total piglets born and piglets born alive a small reduction can be observed already for one day old semen. Similar results are reported by Aalbergs et al. (1984); Bariteau et al. (1980) and Waberski et al.(1994).

The heritabilities and repeatabilities for litter traits and the mating success with the sow or the boar as animal are shown in Table 2. For number of piglets born alive and total number of piglets born the heritability estimates with the sow as animal in the model are in the expected range as found in several other experiments (see for example Irgang et al. 1994; Rohe et al. 1995; Hermesch et al. 1995). The heritability for success rate is below 4 %, which is close to the result of Leukkunen 1984 who found no heritability for non-return-rate.

Figure 1.: Least square means for piglets born alive and success rate for age of semen

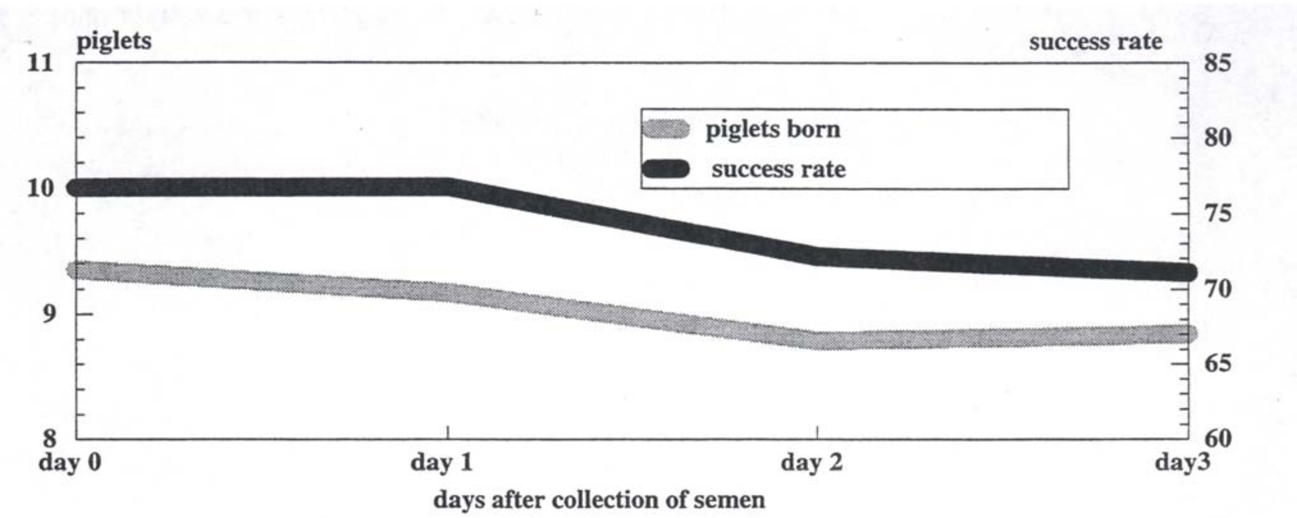


Table 2. Heritabilities (h2) and repeatabilities (r) for litter traits

	Sow line 01		Boar line 03	
	h^2	r	h^2	r
Piglets born alive	0.65	.137	.014	.020
total born piglets	.084	.171	.010	.030
Mating success	.033	.039	.003	.007

The heritability estimates with the boar as animal in the model are with 1 to 1.4 % for litter size and 0.3 % for success rate very low. For Pietrain boars in Bavaria and Germany, Götz (1997) found only 0.22 % additive genetic variance for number of piglets born alive. Although lowly heritable, the application of these parameters in a genetic evaluation for the Pietrain boars resulted in an average accuracy of the estimated breeding values of 37.5 % with a difference of 0.9 piglets between the two extreme boars. To get reasonable accuracies for boars, a total of at least 50 matings or litters are necessary.

Correlations of boar fertility to growth traits

Before young boars are selected for use in AI within breeding programs they are selected mainly based on gain and backfat measurements so the genetic correlations between growth traits and semen quality traits is important for any correlated response on the paternal impact on litter size. The estimates of the genetic correlations between the semen quality traits and between growth and semen quality traits for the two lines are shown in Table 3. Between volume and density an expected high negative correlation is found. There is also a high negative correlation between density and motility and could be a result of the above mentioned method of accessing motility. The density shows from a breeding point of view positive genetic correlation to daily gain and backfat in both lines although the relationship is lower in line 03 than in line 01. Motility shows an unfavourable genetic relationship to gain and backfat, which is also reported by Falkenberg et al. (1991). In tendency all correlations within line 03 are lower than in line 01. All standard errors are as expected very high because only 192 boars of line 01 and 174 boars of line 03 have growth traits and semen quality traits observed.

Between the daily gain of boars of line 01 and line 03 and number of piglets born alive a positive genetic correlation of .21 (±.15) was found. Between backfat and number of piglets born alive this correlation is unfavourable with .27 (±.20). Both correlations are because of their high standard errors not significantly different from zero, so the commonly used selection of young boars should not reduce their litter performances.

Table 3. Genetic correlations with standard errors (in brackets) between semen quality and growth traits

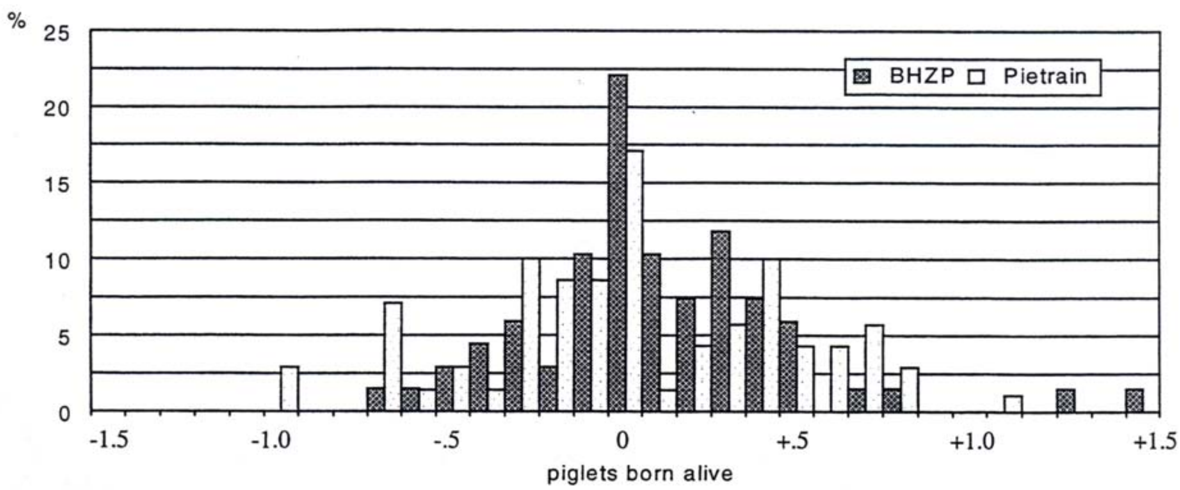
			Line 01	Line 03
Volume	:	Density	-.54 (.08)	-.44 (.09)
Volume	:	Motility	.09 (.18)	.26 (.09)
Volume	:	Daily Gain	-.21 (.12)	-.17 (.13)
Volume	:	Backfat	-.19 (.13)	-.03 (.12)
Density	:	Motility	-.49 (.13)	-.38 (.13)
Density	:	Daily Gain	.30 (.11)	-.02(.11)
Density	:	Backfat	-.21 (.10)	-.15 (.09)
Motility	:	Daily Gain	-.62 (.17)	-.32 (.18)
Motility	:	Backfat	.34 (.17)	.14 (.17)

Between semen quality traits and litter size, all phenotypic and genetic correlations are below 0.04 which could be explained by the standardization concerning density and total number of sperms of the semen used in AI.

Monitoring of boar fertility in AI-stations

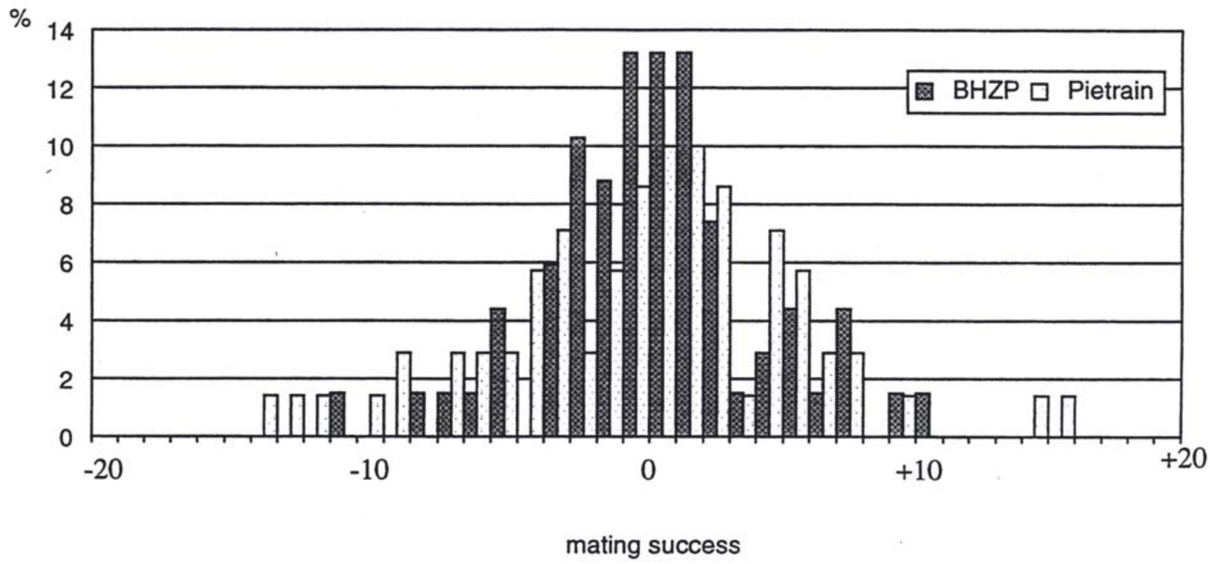
One of the biggest AI-stations in Germany in Ascheberg, Westfalen, has implemented a so called fertility monitoring for their AI-boars. They have access to more than 100 farms with sow management programmes and calculate an average phenotypic value for their boars for mating success and for number of piglets born alive. The average values are adjusted for fixed effects like litter number, farm, season and breed of sow. Figures 2 and 3 show the distribution of these values for boars with more than 50 observations for two breeds.

Figure 2. Distribution for average number of piglets born alive for boars with more than 50 litters as deviation from mean



Between the two extreme boars there are differences of more than 20 % in mating success and around 2 piglets born alive for both breeds. The correlation between the average values for boars for success rate and number of piglets born alive is 0 for both breeds. The major goal of this fertility monitoring is the early detection of boars with low success rates and small number of piglets born alive for culling. This selection does not accumulate any genetic progress because all boars are terminal sires which are not used to maintain the purebred lines within the breeding programmes.

Figure 3. Distribution for average mating success for boars with more than 50 matings as deviation from mean



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