

Testes Size as Predictor for Semen Production of Boars and Relation to Female Reproductive Traits

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ABSTRACT: Semen production is an important parameter to A.I. studs in the pig industry. This parameter can only be evaluated once the boar has entered quarantine and semen has been collected. Therefore, a protocol to score the testes size of the boars subjectively was developed. We evaluated these subjective scores of testes size as a predictor of semen production and its correlations to female reproduction traits in one of the Hypor populations. Results are showing that boars with bigger testes produce semen with a higher concentration of spermatozoa than boars with smaller testes and thus more doses although the volume produced is reduced. Moreover, positive correlations to female reproductive traits (total born and percentage born alive) were found.

Keywords: pig production; testes size; semen production; female reproductive traits.

INTRODUCTION

Semen production is a crucial part in the pig industry. However, semen characteristics like concentration or volume produced can only be evaluated after semen has been collected from the boars, which mainly happens once they are in quarantine. Poor production and/or quality of semen can lead to slaughter of the boars and undesired costs. Previous studies show that testes size can be used as a predictor of semen production (Rathje et al (1995); Huang and Johnson (1996)). Studies on the testes size in boars show heritabilities ranging from 0.12 to 0.80 (Bidanel (2011)). The size of the testes, evaluated with the width, length or weight, seems to be negatively correlated with volume but positively with concentration. However, on a big scale such quantitative measurements are hardly doable. We thus used a scoring protocol and looked at the correlation of the given scores with the semen production of the boars in their 8 first jumps. The interest is to have a predictor for semen production at an early stage of the life cycle of boars. Inconsistent trends can be found in the literature between female reproductive traits and testes size (Bidanel (2011)). Therefore we also investigated the genetic relation between this trait and female reproductive traits.

MATERIALS AND METHODS

Data. Boars of one line produced in Hypor's selection nucleuses have been scored for testes size on a scale from 1 (very small) to 5 (very big). The animals weighed on average 120kg when they were scored. There were 2,510 testes scores (T_S) available. We also looked for correlations between female reproductive traits and the testes size. The following female reproductive traits were considered: litter size (NBP), percentage of piglets born alive (PBA) and percentage of piglets weaned (PW) coming out of 4'866 farrowings from 1'244 sows. Twenty-two of

the boars that had a score for testes size were from the same farm. The following traits were assessed according to the standard procedure of the A.I. stud on entering production: volume (ml) (VOL), concentration (10^6 spermatozoa / ml) (CC), number of doses produced (N_DOS), percentage alive (P_AL) and motility (scored from 1 to 5) (MOT). Data were filtered to keep only the results of the first eight jumps of each boar.

Semen production traits. Due to the low number of boars used in production the relationships between testes size and semen traits were only investigated from a phenotypic point of view using the glm (R Core Team (2013)) and allEffects (Fox (2003)) functions in R. The model included the testes score treated as a fixed effect and the age at 1st jump as covariate to explain the production traits. The influence of testes score on the uniformity of the production over boars has been evaluated with an F-test.

Genetic parameters of testes size with female reproductive traits. We used DMU software v6 (Madsen and Jensen (2012)) to estimate the genetic parameters of the four traits (T_S, NBP, PBA and PW) in a multi-trait model using. For all traits, a herd-year-season effect was included, as well as a permanent environment and an animal effect. For the farrowing traits, a fixed effect for the cycle of the sow was added.

RESULTS AND DISCUSSION

Semen production traits. Among the 22 boars where the relation between testes score and semen production could be analyzed, 1 had a score 2, 13 a score 3 and 8 a score 4. The animal scoring a 2 has been discarded from the analysis. The average interval between two jumps was 6 days, 86% of the intervals between two jumps being maximum 1 week. The boars were aged between 218 and 297 days, with an average of 249 days at 1st jump. The jump number and the interval between two jumps showed no significant effect for any of the traits and were thus discarded from the analysis. Averages for the different traits and the effect of the testes score are presented in Table 1. These results are in agreement with previous studies showing that boars having bigger testes are producing significantly less semen but more doses as the concentration increases with the testes size (Rathje et al (1995); Huang and Johnson (1996)) indicating that the scoring method reflects the quantitative measurements. Testes size had no significant influence on the percentage of spermatozoa alive or the motility, i.e. on the semen quality. The variances differed significantly between the two classes of testes sizes for the concentration, motility and the percentage of spermatozoa alive (Table 2). A larger variability in the concentration, motility and percentage of spermatozoa alive was observed in boars having bigger testes. Nevertheless, the number of doses produced, which is the relevant

Table 1. LSMMeans for the volume (VOL), concentration (CC), number of doses produced (N_DOS), motility (MOT) and percentage of spermatozoa alive (P_AL) depending on the testes size and the age at 1st jump.

Trait	Testes score			Change per day of age
	3	4	p-value [‡]	
VOL (ml)	158.4	132.3	*	+0.8
CC (10 ⁶ /ml)	388.2	525.5	***	-0.3
N_DOS	21.3	24.2	*	NS
MOT	3.98	3.91	NS	NS
P_AL (%)	94.7	92.9	NS	NS

[‡] *: p-value <0.05, **: p-value <0.01, ***: p-value <0.001, NS: not significant.

economic trait, showed a similar variance between the two classes. This result indicates that the variance in the number of doses produced will stay similar, however with a higher average number of doses produced. Selecting on testes size would be profitable from a production point of view, without being at the expense of increasing the risk of having some less productive boars.

Genetic correlations of testes size with female reproductive traits. The distribution of the testes scores in the different classes showed a very small percentage (less than 1%) of boars classified in the two extreme groups (Figure 1). The estimated heritability of testes size was 0.20. This estimate is in the range found in literature (Bidanel (2011)). Genetic correlations between testes size and the female reproductive traits were estimated to be 0.39 (0.14) for NBP, 0.30 (0.14) for PBA and -0.10 (0.15) for PW. There are very few articles on the genetic relation between the testes size and the reproductive results of the females. Nevertheless, the positive correlation between NBP and testes size is in accordance with the results of Smital et al. (2005). The standard errors in our study are quite high due to the size of the data set and the fact that the boars scored for testicle size had no descendant with record.

Figure 1. Distribution of the testes scores.

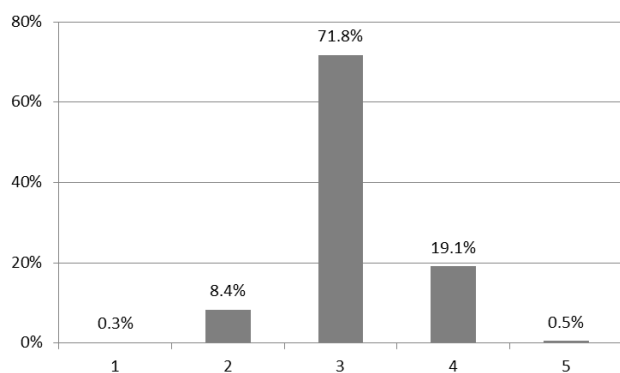


Table 2. Standard deviations for the volume (VOL), concentration (CC), number of doses produced (N_DOS), motility (MOT) and percentage of spermatozoa alive (P_AL) depending on the testes size.

Trait	Testes score		p-value [‡]
	3	4	
VOL (ml)	46.0	47.8	NS
CC (10 ⁶ /ml)	108.0	152.8	**
N_DOS	6.9	6.6	NS
MOT	0.23	0.59	***
P_AL (%)	2.8	14.0	***

[‡] *: p-value <0.05, **: p-value <0.01, ***: p-value <0.001, NS: not significant.

CONCLUSION

This study confirms that the size of testes in boars is related to the semen production. A visual evaluation of the size appears to be a good predictor to select boars that have the capacity to produce more doses of semen. Positive genetic correlations were found with the total number of piglets born and the percentage of piglets born alive, providing a first insight into a possibility of indirect early selection for female traits on the boar side. Nevertheless, these results need to be confirmed in further analyses with an extended data set.

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