

Genetic variation of sitting frequency and duration in pigs

John J. McGlone, Chana K. Akins and Ronnie D. Green

Department of Animal Science, Texas Tech University, Lubbock, TX 79409-2141, USA

(Accepted 10 September 1990)

ABSTRACT

McGlone, J.J., Akins, C.K. and Green, R.D., 1991. Genetic variation of sitting frequency and duration in pigs. *Appl. Anim. Behav. Sci.*, 30: 319–322.

Prior to weaning, many piglets die from crushing, chilling, starvation, diarrhea and weakness. Piglets often die from crushing by the sow when she lies down after sitting. The objective of this study was to determine the amount of heritable genetic variation of sitting behavior. A total of 312 pigs from 62 litters were given ad libitum feed and water. Frequency and occurrence of sitting were summarized from 24-h video records. Heritability estimates (h^2) were calculated for these traits using a full-sib analysis. The h^2 for the occurrence of sitting was 0.41 ± 0.14 and for frequency of sitting was 0.43 ± 0.14 . Genetic correlation between frequency and occurrence of sitting was 0.84 and the phenotypic correlation was 0.68 ($P < 0.01$). Sitting behavior was moderately to highly heritable indicating possible favorable selection against occurrence of this trait. Genetic selection against sow sitting could potentially decrease mortality rates among piglets, increase production and decrease costs for pork producers.

INTRODUCTION

No doubt the causes of piglet crushing are many and complex. Many pigs die before weaning from crushing, chilling, starvation, diarrhea and weakness. While behavioral studies will probably not completely solve the problem of piglet crushing, there is a need for greater attention to be given to sow behaviors which may impact rate of piglet crushing.

Edwards et al. (1986) found that 46% of piglet deaths were due to crushing. In addition, 30% of these crushing deaths occurred when the sow lay down after sitting, 22% of the pigs were crushed when the sow lay down after standing and only 4% were crushed by the sow rolling over. McGlone and Morrow-Tesch (1990), while researching behavior of sows in farrowing environments, observed that the time sows spent in a sitting position was positively correlated with the number of piglets crushed ($r = 0.54$; $P = 0.01$). Furthermore, the rate of piglet crushing was 1.0 ± 0.36 piglets crushed per sow for

sows that showed sitting behavior and was only 0.29 ± 0.12 piglets crushed per sow for sows that showed no sitting behavior. In addition, Hansen and Curtis (1981) found that those sows which had crushed piglets spent more time sitting during the first 48-h period before the first piglet was born than sows which did not crush piglets. These studies have attributed sitting behavior to the type of environment the sows were in and no attempts have been made to determine what role genetics may play in pig-sitting behavior. Therefore, the objective of this study was to determine the level of heritable variation of sitting in the domestic pig.

ANIMALS, MATERIALS AND METHODS

Finishing pigs were housed in a mechanically ventilated building with 9 or 10 pigs per pen. Pigs were fed and watered ad libitum from a three-hole feeder and a nipple waterer. Diets were nutritionally balanced sorghum-soybean meal containing 14% crude protein. Dim lights remained on for 24 h day⁻¹ (which is normal practice in this building). The pigs were derived from a 4-breed cross of Duroc, Landrace, Yorkshire and Hampshire or terminal offspring from a commercially produced crossbred line. Pigs were weighed between 40 and 100 kg and were between 4 and 6 months of age during the period of data collection.

Pigs were videotaped (3 frames s⁻¹ recording speed) for sitting over a 24-h period. A total of 7488 pig-hours of video tape were viewed. Frequency of sitting (number of times each pig sat) and the occurrence of sitting (scored as 0 or 1) were recorded from replayed tapes.

STATISTICAL ANALYSIS

Data represented 312 pigs from 30 pens, 62 sows, 15 sires and 8 blocks (over time). The statistical model was as follows:

$$Y_{ijklm} = \mu + B_i + S/B_{ij} + D/S/B_{ijk} + \text{Sex}_l + e_{ijklm}$$

where: μ = overall mean; B_i = the fixed effect of the i th block; S/B_{ij} = the random effect of the j th sire within the i th block; $D/S/B_{ijk}$ = the random effect of the k th dam of the j th sire within the i th block; Sex_l = the fixed effect of the l th sex (male or female) of pig; e_{ijklm} = residual error. Heritability estimates (h^2) were calculated for sitting frequency and occurrence of sitting, using a full-sib analysis (Harvey's (1987) least squares analysis) as follows

$$\frac{2(\sigma_S^2 + \sigma_D^2)}{\sigma_S^2 + \sigma_D^2 + \sigma_E^2}$$

where σ_S = sire variance, σ_D = dam variance and, σ_E = error variance.

RESULTS

The heritability estimate for frequency of sitting was 0.43 ± 0.14 and for occurrence of sitting was 0.41 ± 0.14 (Table 1). The genetic correlation between the frequency of sitting and occurrence of sitting was high ($r=0.84$) as was the phenotypic correlation ($r=0.68$; $P<0.01$) between the two measures of sitting behavior. Pig gender did not influence frequency or duration of sitting.

TABLE 1

Heritability estimates¹ and phenotypic and genetic correlations for sitting frequency and presence of sitting behavior among growing pigs

Measure	Measure	
	Frequency	Presence
Frequency	0.43 ± 0.14	0.84
Presence ²	0.68**	0.41 ± 0.14

¹Heritability estimates on the diagonal, genetic correlations above the diagonal and phenotypic correlations below the diagonal.

²Presence or absence of sitting (scored 0 or 1).

** $P<0.01$; probability values are not usually attached to genetic correlations or heritability estimates.

DISCUSSION

These results indicate that sitting is a moderately to highly heritable trait. Because these data were collected in growing pigs rather than sows, we are unsure if selection against this trait would also reduce sitting among lactating sows. If, however, selection were to reduce the duration of sitting among lactating sows, piglet crushing by sows may be reduced. It could be more economical to select against this trait than to modify farrowing environments. However, some countries currently discourage selection to modify farm animals' "natural" behavior. As McGlone and Morrow-Tesch (1990) found that 30% of sows showed sitting behavior, we suggest that both sitting and absence of sitting should be considered as natural behaviors. Efforts to reduce the proportion of sows in the population that express sitting behavior may enhance producer profits and may improve the well-being of pigs which are destined to be injured or crushed. Environmental modifications, such as sloped floors, may also reduce the crushing rate.

ACKNOWLEDGMENTS

The authors were supported by a Texas line item for efficient pork production. We thank Mary Willson for typing the manuscript. Texas Tech University Agricultural Sciences manuscript No. T-5-279.

REFERENCES

- Edwards, S.A., Malkin, S.F. and Spechter, H.H., 1986. An analysis of piglet mortality with behavioral observations. *Anim. Prod.*, 42: 470 (Abstract).
- Hansen, K.E. and Curtis, S.E., 1981. Prepartal activity of sows in stall or pen. *J. Anim. Sci.*, 51: 456-460.
- Harvey, W.R., 1987. User's Guide for LSMLMW. P.C.1 version. Mixed Model Least-squares and Maximum Likelihood Computer Program, Columbus, OH.
- McGlone, J.J. and Morrow-Tesch, J., 1990. Productivity and behavior of sows in level vs. sloped farrowing pens and crates. *J. Anim. Sci.*, 68: 82-87.