Livestock Science 167 (2014) 33–40

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

The genetic relationships between conformation assessment of gilts and sow production and longevity

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ARTICLE INFO

Article history:
Received 4 April 2014
Received in revised form
9 May 2014
Accepted 13 May 2014

Keywords:
Conformation assessment
Sow longevity
Piglet production
Genetic parameters

ABSTRACT

The longevity of sows is important for both the production economy and animal welfare. This study suggests that a selection for several conformation traits scored on gilts by utilizing phenotypic records from nucleus herds can contribute to a better longevity in sows. The aim of our study was to investigate the heritabilities and genetic correlations between conformation traits measured on unselected gilts, piglet production and longevity of the sows in the Norwegian Landrace population in order to contribute new knowledge on the relationship between conformation and longevity traits. For this study, eight phenotypes from a total of 78,000 gilts and sows were utilized; the traits were hind and front leg quality, motorics, hind leg standing under, the sum of the individual piglet weighed at 21 days in the first two litters (LWT), the total number of piglets born in the first two litters, the ability to stay in production for two parities (STAY) and the maximum parity number before culling (MAXL). The data for STAY and MAXL was analysed with two different models, both with and without correcting for breeding value (EBV) at culling. The latter is correcting for the fact that in nucleus herds sows are culled due to low EBVs. Our study found low to moderate heritabilities ($0.05 \leq h^2 \leq 0.24$) for all traits and substantial genetic correlations between most of the conformation traits ($0.28 \leq r_2 \leq 0.66$). The heritability of STAY and MAXL became significantly greater when including a correction for EBV at culling, and the genetic correlation between STAY and front leg quality became significant ($r_g = -0.12$). This indicates that if the data from nucleus herds are used, a correction for EBV will improve the estimates. The results from our study show that there is not a strong genetic relationship between the conformation traits of the gilts and longevity. The inclusion of front and hind leg quality as traits in the breeding goal can contribute to increased longevity, although the results of such an indirect selection to longevity would be slow. Selection for improved conformation can counteract an undesired development in longevity.

1. Introduction

A reduced longevity for the sow represents both an economic loss for the producers as well as an animal welfare problem. The definition of sow longevity and its underlying traits included have been debated for decades (Ducrocq and Solkner, 1998), and is still being discussed (Tarrés et al., 2006; Nikkilä et al., 2013a). Studies suggest that traits such as parity number at removal, the total number of piglets born during a sow's lifetime and the ability to produce two or more litters (López-Serrano et al., 2000; Grindflek and Sehested, 1996; Nikkilä et al., 2013c) are ways of selecting for longevity. Several studies have shown that a sow must produce at least

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http://dx.doi.org/10.1016/j.livsci.2014.05.004
1871-1413/

three litters to be profitable (Stalder et al., 2003; Rasmussen, 2004), and that the main reasons for the culling of sows in production herds is reproduction failure, feet and leg problems and low piglet production (Engblom et al., 2007; Norsvin, 2013). In breeding nucleus and multiplier herds, an additional reason for culling is the breeding value for the sow. A conformation assessment was initially used to select both for leaner animals and for leg conformation, but after the emergence of ultrasound technology in the 1960s (Standal, 1973), the focus is now more on an assessment of structural soundness (Van Steenbergen, 1989). Steenbergen (1990) recorded conformation in many different ways on both gilts and sows, and estimated their relevance to the longevity of the sows. Among others, the findings were that the constitution of the front leg, front leg pasterns and locomotion had effects on longevity. Genetic correlations between conformation traits and longevity have been found by both Grindflek and Sehested (1996) and López-Serrano et al. (2000), thereby indicating that longevity can in fact be increased indirectly by selecting for conformation of the gilts, though their suggestions for which traits to select for varies. Grindflek and Sehested (1996) proved that poor locomotion and straight pasterns contributed to poor longevity, while López-Serrano et al. (2000) found "legs" to be related to longevity.

The aim of our study was to investigate the heritabilities and genetic correlations between the conformation traits measured on unselected gilts, piglet production and longevity of the sow in the Norwegian Landrace population in order to contribute with new knowledge about the relationship between conformation and longevity traits. The topics for discussion were which conformation traits to record, where to record the traits and how to use the phenotypes in a breeding system.

2. Material and methods

The animals in this study were purebred Landrace and originated from the Norsvin breeding nucleus and multiplier herds. The traits to be analysed were grouped into three: the conformation traits of the gilts, the piglet production traits and the longevity traits of the sows. The phenotypes for conformation traits were recorded by trained Norsvin technicians in the breeding nucleus—(86%) and multiplier (14%) herds, while the traits for sow piglet production and longevity were recorded by the herdsmen through the national litter recording scheme "InGris" in breeding nucleus, multiplier and commercial herds. "InGris" is a web based management and registration tool for pig producers where the data is collected in a central database.

2.1. Conformation traits of gilts

All gilts born in a litter in a nucleus herd should be subjectively assessed for conformation by a trained technician between the age 100 to 200 days, with a preferred age of 150 days (average age = 144.6 days, std. dev. = 13.5, average live weight = 97 kg, std. dev 14.9 kg). Among the many traits required to be assessed based on an established scoring system, the following conformation traits were included in this study: conformation of the hind leg (HLEG), motorics (MOT), hind leg standing under (HSTU) and the conformation of the front leg (FLEG). The traits were chosen based on a preliminary analysis of heritabilities and their presence in the Norsvin Landrace breeding goal, and the guidelines for the scoring systems were as follows:

HLEG: The hind leg was scored on a 7-point linear scale (Supplementary Fig. 1) with a combination of stance, hock and pasterns. Gilts with severely steep hocks, knocked legs, upright pasterns or twisted pasterns received a score of 7, while crooked hocks, bowed legs, too soft pasterns and normal stance received a score of 1. Gilts with a preferred hind leg conformation received a score of 4.
FLEG: The front leg was assessed on a 7-point linear scale (Supplementary Fig. 2) based on the appearance of knees and pasterns. Gilts with severely upright pasterns and bucked knees received a score of 7, while gilts with severely soft pasterns and sickled knees received a score of 1. Gilts with a preferred FLEG conformation received a score of 4.
MOT: Locomotion was assessed using a 4 point linear scale (4 to 7), in which 4 is the optimal locomotion. Gilts with severely stiff, peg like movements and waddling hindquarters received a score of 7.
HSTU: As illustrated in Supplementary Fig. 3, a gilt with preferred stance (a score of 4) can have a line drawn from the hip bone vertically through the middle of the hoof and down in the ground. For a gilt expressing a severe standing under condition (a score of 7), the vertical line drawn will fall behind the dewclaws and hoofs to the ground.

Data from the presented conformation assessment system was only available for females born from 2009, and to help avoid an overrepresentation of those gilts that were too young to have several litters produced, gilts born after 2012 were discarded from the analysis. A total of 48,210 gilts had phenotypes for all four conformation traits.

2.2. Piglet production and longevity of the sows

Individual weights at 3 weeks were recorded by the herdsmen for all piglets born in a purebred litter between 17 and 25 days of age, and adjusted for the deviation from 21 days. The trait LWT is the sum of the adjusted individual piglet weights for the first two litters of a sow. In case of cross fostering, the foster sow was credited for the weight of the cross fostered piglet. The trait TBOR is the sum of live born and stillborn piglets from the first two litters of a sow. MAXL was defined as the number of parities at culling, whereas stayability (STAY) was defined as a binary trait indicating whether a sow was culled after the first parity or a second or greater parity. Reasons for including only the first two parities was that the genetic correlation between the ability to sustain two litters and the ability to sustain three litters is great (Engblom et al., 2009). In addition, the risk of culling is greater between