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INFLUENCE OF PERFORMANCE TEST TRAITS OF GILTS ON VARIABILITY OF THEIR REPRODUCTIVE PERFORMANCE AS PRIMIPAROUS SOWS

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Abstract: Objective of this paper was to establish genetic and environmental factors which influence the variation of reproductive parameters in primiparous sows with special focus on how selection on growth traits and lean meat content can influence the fertility in gilts as primiparous sows. Investigation included 1092 primiparous sows of Swedish Landrace breed. Production traits of gilts in direct test were previously adjusted to body weight of 100 kg, and subsequently they were grouped in 4 classes based on standard deviations for each of adjusted production trait. For analysis of data several models of the Least Squares Method were used *(Harvey, 1990)*. Sires influenced the variation of age at first conception, litter size at birth and weaning and period weaning-conception of their daughters ($P<0.001$ to $P<0.05$). Age at first conception, number of live born piglets and total born piglets varied statistically significantly ($P<0.001$ to $P<0.05$) by the influence of adjusted lifetime average daily gain, but not under the influence of adjusted back fat thickness and lean meat content.

Key words: gilts, primiparous sows, lifetime daily gain, lean meat content, reproductive traits.

Introduction

According to assessment of numerous authors, sow productivity, especially trait of litter size, represents on of the most important, if not key factors, which influence the efficiency and economical value of the production. Special attention must be directed to gilts and primiparous sows since they make the highest percentage of female breeding animals in one herd. Reproductive problems are more frequent in such animals and therefore the number of non productive days before first farrowing or within the period from first to second farrowing increases, which considerably influences the fertility of herd, and in this way also the economical efficiency of the production.

Animals, also, should have intensive and efficient gain and have high lean meat ratio. Optimal selection strategy should be simultaneous (balanced) improvement of growth traits and carcass quality traits in gilts and reproductive traits in sows. Numerous researchers have studied the genetic correlation between productive and reproductive traits in different pig populations and different breeds *(Rydhmer et al., 1995; Kerr and Cameron, 1996; Peškovičová et al., 2002; Holm et al., 2004; Stalder et al., 2005)* and obtained results are contradictory.

Objective of this paper was to establish genetic and environmental factors which influence the variation of reproductive parameters in primiparous sows with special focus on how selection on growth traits and lean meat content can influence the fertility in gilts as primiparous sows.

Materials and Methods

According to set objective, research included productive and reproductive indicators of the Swedish Landrace pigs (SL) from the nucleus and multiplying part of the herd on the pig farm »Vizelj«, PKB »Imes« A.D., in Padinska Skela. Only pigs that finished performance testing and had reproductive results prior to second gestation were included in the analysis.

Analysis did not include animals with: incomplete origin data, less progeny (less than 4 daughters per sire), higher body weight at the end of the test (>130 kg), higher age at first conception (>300 days), and longer interval from first litter weaning to conception (>70 days). Final size of the sample was 1092 gilts as offspring of 39 sires and 621 mothers/dams.

Productive traits included: lifetime average daily gain (LADG; g/day), average back fat thickness (ABF; mm) and lean meat content (LM; %). Average daily gain was calculated from birth to the end of the test based on body weight and age, taking into consideration body weight at birth of 1.4 kg. Ultrasonic measurements was done using PIGLOG 105. Average back fat thickness was defined as average of measurements in the back and loin section.

Reproductive traits of primiparous sows included: age at first conception (AFC; days), number of live born piglets (NBA), number of still born piglets (NSB), number of total born piglets (NTB), number of weaned piglets including transferred piglets (NW), weight of litter at weaning including transferred piglets (LWW; kg), interval from first litter weaning to conception (WCI; days) and functional ability of maintaining og animals in the herd from weaning to second gestation (STAY; %, defined as remaining in the herd=100 or did not remain=0).

Productive traits of gilts were adjusted to average body weight of 100 kg. Age of gilts at the end of the test and lifetime average daily gain were adjusted using formula/equation presented by *Tummaruk et al. (2000)*. Adjustment of average back fat thickness and lean meat content was done by applying linear regression equations where regression coefficients for ABF (b_1=0.12172 mm/kg) and LM (b_2=0.10702 %/kg) were evaluated based on data for animals included in the analysis. Gilts were grouped in four classes (Table 1) depending on the average value of adjusted productive traits and their absolute variation expressed in standard deviations.

Table 1. Grouping of gilts according to adjusted performance traits to 100 kg body weight

Trait [a]	Group							
	n	1	n	2	n	3	n	4
ALADG	168	≤ 468.7	381	468.8 – 501.5	372	501.6 – 534.3	171	≥ 534.4
AABF	179	≤ 11.0	412	11.1 – 14.3	331	14.4 – 17.6	170	≥ 17.7
ALM	184	≤ 53.0	318	53.1 – 56.2	422	56.3 – 59.5	168	≥ 59.6

[a] ALADG = adjusted lifetime average daily gain; AABF = adjusted average back fat thickness; ALM = adjusted lean meat content

Prior to analysis, a logarythmic transformation was applied for IWI and WCI presented by *Ten Napela et al. (1995)*, and used by numerous researchers *(Hannenberga et al., 2001; Holma et al., 2004, 2005; Imboonte et al., 2007)*.

For the purpose of analysis of the effect of sire, combined effect of year and season (birth or conception or farrowing), adjusted lifetime average daily gain, adjusted back fat thickness and adjusted lean meat content, as fixed effects, several models of Least Squares Method were used *(Harvey, 1990)*.

Results and Discussion

Average age of gilts at the end of the test was 206±11.2 days, and average body weight 107.0±9.1 kg, indicating that performance test ends earlier based on age than body weight (CV=5.4 *v.* 8.5). Average values of adjusted traits of age at the end of the test, lifetime daily gain, back fat thickness and lean meat content were as follows: 197.5 days, 502±32.81 g/day, 14.3±3.30 mm and 56.2±3.27 %. Also, phenotypic trends for ALADG, AABF and ALM were desired/favourable (b = 1.28 g/day/year; – 0.67 mm/year and 0.69 %/year), but not statistically significant ($P>0.05$) for ALADG, indicating that considerable progress was achieved only in carcass quality traits.

Sires have influenced varying of the age at first conception, litter size at birth and weaning and period from weaning to conception in their daughters (Table 2, $P<0.001$ to $P<0.05$). Class ALADG was statistically very highly significant ($P<0.001$) source of variability for AFC. Beside that, NBA and NTB differed statistically significantly (P<0.05) and highly significantly (P<0.01) between classes ALADG, but not NSB.

Table 2. Fixed effects and co-variables included in the different models for investigated reproductive traits and their statistical significance (P)

Trait [a]	Random effect [b]	Fixed effects [c]				Co-variables [d]		
	SIRE	YS	ALADG	AABF	ALM	AFF	LL	NW
AFC (day)	0.000	0.000 [1]	0.000	0.84	0.20	…	…	…
NBA	0.000	0.88 [2]	0.011	0.51	0.37	0.000	…	…
NSB	0.026	0.77 [2]	0.98	0.53	0.69	0.74	…	…
NTB	0.000	0.85 [2]	0.008	0.54	0.46	0.000	…	…
NW	0.000	0.82 [3]	0.12	0.64	0.48	0.000	0.015	…
LWW (kg)	0.068	0.29 [3]	0.71	0.45	0.77	0.98	0.001	…
TIWI (day)	0.39	0.48 [3]	0.055	0.21	0.12	0.029	0.93	0.048
TWCI (day)	0.022	0.37 [3]	0.065	0.67	0.92	0.14	0.15	0.56
STAY (%)	0.25	0.94 [3]	0.51	0.13	0.48	0.38	…	…

[a, c, d] AFC = age at first conception; NBA = number of piglets born alive; NSB = number of piglets stillborn; NBT = total number of piglets born; NW = number of pigs weaned; LWW = weaning weight of litter; IWI = interval from weaning to first insemination after first litter; WCI = interval from weaning to first conception; IWC = interval from weaning to culling from the herd; STAY = sow stayability from the first to second parity; ALADG = adjusted lifetime average daily gain; AABF = adjusted average back fat thickness; ALM = adjusted lean meat content. [b] SIRE = sire of the sow; [c] YS = combined effect of year and season ([1] = of birth; [2] = of conception; [3] = of farrowing); [d] AFF = age at first farrowing; LD = lactation duration.

Gilts from the group with the least adjusted lifetime average daily gain in the test (≤468.7 g/day) were the oldest at first conception (253.5 days). With the increase of ALADG, AFC decreased, so the fourth group with the most adjusted lifetime average daily gain (≥534.4 g/day) was the youngest (Table 3).

Difference between the first and the fourth group of gilts in regard to AFC was 0.9 SD of the trait or 19.2 days, which is relatively high interval of variation between classes and can be of significance to breeders in situations of price fluctuations on the market and their motivation to direct the selection towards improvement of LADG. *Knox (2005)* stated that with the decrease of age at puberty for one standard deviation (~20 days) the profit of commercial producers can be increased by 4.5%.

Table 3. Least-squares means (LSM ± SE) of some reproductive traits by adjusted performance traits to 100 kg body weight

Performance trait	Group	Reproductive trait		
		AFC (day)	NBA	NTB
ALADG (g/day)	1	253.5 ± 2.31	8.47 ± 0.34	8.86 ± 0.32
	2	245.1 ± 1.92	8.80 ± 0.29	9.18 ± 0.27
	3	240.9 ± 1.94	9.05 ± 0.29	9.42 ± 0.27
	4	234.3 ± 2.25	9.52 ± 0.33	9.92 ± 0.32
AABF (mm)	1	243.0 ± 3.33	9.41 ± 0.48	9.64 ± 0.46
	2	244.1 ± 2.50	8.86 ± 0.36	9.17 ± 0.35
	3	244.8 ± 2.53	8.62 ± 0.37	9.05 ± 0.35
	4	241.9 ± 3.71	8.94 ± 0.53	9.51 ± 0.51
ALM (%)	1	243.5 ± 3.52	8.96 ± 0.51	9.22 ± 0.49
	2	239.6 ± 2.56	9.38 ± 0.37	9.71 ± 0.36
	3	243.2 ± 2.48	9.03 ± 0.36	9.45 ± 0.35
	4	247.5 ± 3.40	8.46 ± 0.49	8.99 ± 0.47

See Table 2 for abbreviations.

Primiparous sows with the lowest ALADG farrowed in average 8.47 live born, i.e. 8.86 piglets in total (Table 3). Contrary to them, primiparous sows with the highest ALADG as gilts, farrowed the most live born piglets (9.52 piglets), i.e. the most total piglets in the litter (9.92 piglets).

Assumption is that gilts with more intensive growth expressed earlier puberty oestrus (maybe during performance test) and continued with regular cycles. It is known that with the increase of order of puberty oestrus also the number of ovulated ova increases, which means that maybe in gilts with more intensive growth this would be the second or third puberty oestrus preceding the conception. Evaluated statistical significance of the effect of ALADG indicates that with the selection of animals in performance test on increase of lifetime daily gain also the age at first conception will decrease, number of live born piglets and total born piglets in litter will increase. Obtained results in this paper, in regard to the effect of ALADG on AFC are in accordance with results obtained by *Rydhmer et al. (1995)*, *Tummaruk et al. (2000)* and *Holm et al. (2004)*. However, contrary results were obtained by several researchers in regard to the effect of ALADG on traits of litter size in primiparous sows *(Stalder et al.,* 2005; *Holm et al., 2004)*. So, *Imboonta et al. (2007)* and *Kerr and Cameron, (1996)* established positive phenotypic and/or genetic correlations between average daily gain and number of total born piglets.

Established statistical significance of the effect of ALADG on number of live born piglets and total born piglets in this paper (Table 2) and absence of phenotypic trend in this trait can, partially, help explain relatively slow phenotypic trend for traits of litter size in this population (NBA: b=0.011^{NS}; NTB: b=0.041^{NS}).

Classes AABF and ALM were no statistically significant source of variation for any of the investigated reproductive traits (Table 2).

After weaning of the first litter, 76.4% primiparous sows remained in reproduction, and only 23.6% were culled. Four group of culled primiparous sows it is characteristic that they remained in the herd in average 63.5 days which indicates reproduction problem. Additional analysis of data indicated that number of days from weaning to culling from the herd varied statistically significantly (P=0.017) only under the influence of AABF. Primiparous sows which belonged to class 2 AABF were culled from the herd after weaning of the first litter by 86 days later than primiparous sows in 4 class AABF (106.1±23.8 *v.* 20.1±35.2).

Conclusion

Based on results of the research it is obvious that reproductive traits of primiparous sows of Swedish Landrace breed, first of all age at first conception, number of live born piglets and total born piglets, were under the influence of lifetime average daily gain, but not under the influence of back fat thickness and lean meat content evaluated *in vivo*. Also, it can be concluded that there are no clear evidence about decline of reproductive traits considering the intensive selection pressure on back fat thickness, i.e. lean meat content.

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Uticaj proizvodnih osobina u direktnom testu nazimica na varijabilnost njihovih reproduktivnih osobina kao prvopraskinja

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Rezime

Očevi su uticali na variranje uzrasta pri prvoj oplodnji, veličinu legla pri rođenju i zalučenju i perioda zalučenje-oplodnja svojih kćeri (P<0.001 do P<0.05).

Uzrast pri prvoj oplodnji, broj živorođene i ukupno rođene prasadi su statistički značajno varirali (P<0.001 do P<0.05) pod uticajem korigovanog prosečnog životnog dnevnog prirasta ali ne i korigovane debljine leđne slanine i mesnatosti.

References

HARVEY W.R. (1990): User's guide for LSMLMW and MIXMDL. Ver. PC–2, 1-91.

HOLM B., BAKKEN M., KLEMETSDAL G., VANGEN O. (2004): Genetic correlations between reproduction and production traits in swine. Journal of Animal Science, 82, 3458-3464.

HOLM B., BAKKEN M., VANGEN O., REKAYA R. (2005): Genetic analysis of age at first service, return rate, litter size, and weaning-to-first service interval of gilts and sows. Journal of Animal Science, 83, 41-48.

IMBOONTA N., RYDHMER L., TUMWASORN S. (2007): Genetic parameters for reproduction and production traits of Landrace sows in Thailand. Journal of Animal Science, 85, 53-59.

KERR J.C., CAMERON N.D. (1996): Genetic and phenotypic relationships between performance test and reproduction traits in Large White pigs. Animal Science, 62, 531-540.

KNOX R.V. (2005): Managing the gilt: Factors influencing attainment of puberty and attrition. http://www.ansci.uiuc.edu/porknet/, 1-8.

PEŠKOVIČOVÁ D., WOLF J., GROENEVELD E., WOLFOVÁ M. (2002): Simultaneous estimation of the covariance structure of traits from field test, station test and litter recording in pigs. Livestock Production Science, 77, 155-165.

RYDHMER L., LUNDEHEIM N., JOHANSSON K. (1995): Genetic parameters for production traits in sows and relations to performance-test measurements. Journal of Animal Breeding and Genetics, 112, 33-42.

STALDER K.J., SAXTON A.M., CONATSER G.E., SERENIUS T.V. (2005): Effect of growth and compositional traits on first parity and lifetime reproductive performance in U.S. Landrace sows. Livestock Production Science, 97, 151-159.

TEN NAPEL J., DE VRIES A.G., BUITING G.A., LUITING P., MERKS J.W., AND BRASCAMP E.W. (1995): Genetics of the interval from weaning to estrus in first-litter sows: distribution of data, direct response of selection, and heritability. Journal of Animal Science, 73, 2193-2203.

TUMMARUK P., LUNDEHEIM N., EINARSSON S., DALIN A.M. (2000): Factors influencing age at first mating in purebred Swedish Landrace and Swedish Yorkshire gilts. Animal Reproduction Science, 63, 241-253.

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