Effect of different factors on variations in reproductive performance of sows

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Abstract

The aim of this study was to determine the influence of sire, genotype, farrowing year and the fertilization season on reproductive traits. The study included 3693 litters from 1622 mothers, genotype Swedish Landrace and crosses F1 generation. Progeny derived from the 25 boar - sires. The study results show the following: genotype had no statistically significant effect ($P>0.05$) on the studied traits; parity for the second, however for second and third farrowing showed statistically significant and highly significant effect ($P<0.05$, $P<0.01$); the year of farrowing showed no impact only for the traits - the total number of piglets per litter and number of live born piglets, for all three parities; sire had no effect on the number of weaned piglets in the first litter ($P>0.05$); season of fertilization of mothers had no effect on the number of live born piglets except in the first litter where $P<0.01$.

Key words: sire, boar, genotype, farrowing year, season

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Introduction

Since a large number of factors have an impact on the expression of reproductive traits, their more accurate determination is required in order to recognize the individual impact of these factors and more accurate estimate of breeding value. A large number of authors have dedicated their research to the study of the reproductive traits. These traits are subject to the influence of sire, to the maternal effect, as well as the influence of external factors. The goal of breeders is to reduce the mortality of piglets per litter and increase the number of weaned piglets and litter weight at weaning, which would impact on increasing the profitability of production. Therefore, a large number of authors have dedicated their research to examining the following factors: the influence of genotype, environmental factors, the influence of the mother, the influence of boar-sire, parity, selection, age at first fertilization, the weaning-fertilization period (Holm et al., 2004; Luković et al., 2004; Bobček et al., 2006). It is known that in sows maternal effect is pronounced depending on each individual (genotype and maternal milk yield, age at first reproduction, transfer of passive immunity to the progeny, as well as the behavior of sow towards the litter) and also how this affects the number of piglets and weight of litter at weaning. Many factors influence litter size. These include genetics, gilt management, lactation length, parity distribution, disease, stress and boar fertility (Lawlor and Lynch, 2007).

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Materials and methods

Reproductive traits were monitored for a period of five years using 3693 litters, i.e. 1622 animals. The research included the following genotypes: Swedish Landrace (SL), and F1 generation crosses SLxLW (the first parent is mother (SL), while the latter parent is sire Large White (LW)). The progeny derived from 25 boar-sires. For the purpose of accurate monitoring of the factor – season, the entire sample was divided according to the time of insemination to warm - *season 1* (June, July, August and September) and cold - *season 2* (January, February, March, April, May, October, November and December) period of the year.

Processing of data was done by implementation of adequate programme, i.e. use of the method of least squares (LSMLMW and MIXMDL-Harvey, 1990) in order to determine the significance (P<0.001) of systematic influences on reproductive traits. The models for analysis are included fixed effect of sire (B), fixed effect of genotype (G), fixed effect of farrowing year (F), fixed effect of fertilization season (S), fixed effect of parity (P) and random error.

In examining the first farrowing, the following mixed model of least squares was used:

$$Y_{ijklm} = \mu+B_i+G_j+F_k+S_l+e_{ijklm}$$

The following mixed model was used in examining thr first and second farrowing:

$$Y_{ijklmn} = \mu+B_i+G_j+P_k+F_l+S_m+e_{ijklmn}$$

The following mixed model was used in examining thr first, second and third farrowing:

$$Y_{ijklmn} = \mu+B_i+G_j+P_k+F_l+S_m+e_{ijklmn}$$

Results and discussion

The effect of different factors was studied by the method of least squares. Thus, in Table 1 the general averages of least squares (μ) are presented, their errors (SE) and the F-test of examined impacts for the first farrowing. The F-test revealed a statistically highly significant (P<0.01) influence of the sire, the farrowing year and fertilization season on the total number of piglets per litter, but no statistical significance (P>0.05) of the genotype impact which is inconsistent with research by Radojkovic et al . (2007).

Table1. The general averages of least squares (μ) and their errors (SE) for reproductive traits – first farrowing and F-test of studied impacts

Traits	μ	SE	F-test of studied impacts			
			Sire	Genotype	Farrowing year	Season
df1			*24*	*1*	*4*	*1*
Remainder			*1591*	*1591*	*1591*	*1591*
Total number of piglets in the litter	9.88	0.144	3.618 **	0.383 ns	3.465 **	7.858 **
Number of live born piglets	9.62	0.147	3.731 **	0.370 ns	3.265 **	7.953 **
Number of piglets weaned at 28 days	8.94	0.049	1.317 ns	0.082 ns	4.631 **	0.029 ns
Litter weight at birth, kg	15.11	0.228	3.496 **	0.501 ns	5.401 **	6.146 **
Litter weight at 28 days, kg	63.27	0.418	1.215 ns	0.166 ns	8.529 **	2.993 ns
Ind. weight of piglets at birth, kg	1.54	0.006	1.057 ns	0.010 ns	3.884 **	0.002 ns
Ind. weight of piglets at 28 days, kg	7.06	0.041	1.425 ns	0.004 ns	9.075 **	3.659 ns

** - P<0.01; * - P<0.05; NS - P>0.05

F-test showed that the influences of the sire, the year of farrowing and fertilization season were highly statistically significant (P<0.01) on litter weight at birth, while the effect of genotype was not significant (P>0.05). By analyzing the studied factors, it can be seen that the sire, genotype and season had not statistically significantly (P>0.05) influenced the individual weight of piglets at birth and individual weight of piglets at 28 days, while the year of farrowing had statistically highly significant (P<0.01) impact.

In Table 2 we can see the general averages of least squares (μ), their errors (SE) and the F-test of examined impacts for the first and second farrowing.

The sire, the parity and year of farrowing showed statistically highly significant (P<0.01) influence, unlike genotype whose impact was not statistically significant (P>0.05). F-test showed that the sire and parity statistically highly significantly (P <0.01) influenced the number of live born and weaned piglets, while the

year of farrowing exhibited significant effect (P<0.05) on live born piglets and highly significant on reared piglets. The genotype showed no significant impact (P> 0.05) on live born and reared piglets.

Table 2. The general averages of least squares (μ) and their errors (SE) for reproductive traits – first and second farrowing and F-test of studied impacts

Traits	μ	SE	F-test of studied impacts				
			Sire	Genotype	Parity	Farrowing year	Season
df1			*24*	*1*	*1*	*4*	*1*
Remainder			*2753*	*2753*	*2753*	*2753*	*2753*
Total number of piglets in the litter	10.08	0.159	5.328 **	0.261 ns	20.572 **	3.710 **	3.101 ns
Number of live born piglets	9.85	0.156	5.136 **	0.273 ns	27.510 **	3.157 *	3.156 ns
Number of piglets weaned at 28 days	9.07	0.054	1.933 **	0.257 ns	11.153 **	10.038**	0.056 ns
Litter weight at birth, kg	15.80	0.261	5.500 **	0.524 ns	83.258 **	8.026 **	4.819 *
Litter weight at 28 days, kg	65.04	0.485	1.763 *	0.168 ns	45.501 **	12.376**	20.482 **
Ind. weight of piglets at birth, kg	1.58	0.006	1.366 ns	0.109 ns	72.363 **	8.877 **	1.532 ns
Ind. weight of piglets at 28 days, kg	7.19	0.042	1.671 *	0.132 ns	43.625 **	4.049 **	26.116 **

** - P<0.01; * - P<0.05; NS - P>0.05

Table 3. The general averages of least squares (μ) and their errors (SE) for reproductive traits – first, second and third farrowing and F-test of studied impacts

Traits	μ	SE	F-test of studied impacts				
			Sire	Genotype	Parity	Farrowing year	Season
df1			*24*	*1*	*2*	*4*	*1*
Remainder			*3660*	*3660*	*3660*	*3660*	*3660*
Total number of piglets in the litter	10.42	0.162	5.610 **	0.186 ns	78.088 **	1.898 ns	2.232 ns
Number of live born piglets	10.19	0.153	5.106 **	0.199 ns	79.888 **	1.510 ns	1.376 ns
Number of piglets weaned at 28 days	9.07	0.051	1.936 **	0.278 ns	5.644 *	12.893**	0.017 ns
Litter weight at birth, kg	16.39	0.274	6.108 **	0.414 ns	117.195**	5.170 **	2.927 ns
Litter weight at 28 days,kg	65.88	0.460	1.703 *	0.166 ns	34.400 **	14.288**	35.315 **
Ind. weight of piglets at birth, kg	1.58	0.007	1.645 *	0.117 ns	38.427 **	8.158 **	0.643 ns
Ind. weight of piglets at 28 days, kg	7.28	0.041	1.677 *	0.150 ns	40.278 **	3.318 *	49.494 **

** - P<0.01; * - P<0.05; NS - P>0.05

From Table 3 we can see the general averages of least squares (μ), their errors (SE) and the F-test of examined impacts for the first, second and third farrowing. On the basis of these results we can see that, where the sire and parity showed statistically highly significant (P<0.01) impact, while genotype, year of farrowing and fertilization season had no effect (P>0.05). The average number of live born piglets was 10.19. F-test showed that the sire and parity highly significantly (P<0.01) influenced the number of piglets born alive, while the genotype, year of farrowing and season were not significant (P<0.05) impact. The sire and farrowing year statistically highly significantly (P<0.01) influenced the number of weaned piglets, while the parity had a significant effect (P<0.05), unlike the genotype without statistically significant effect (P>0.05). The conclusion that the parity has statistically very high impact on the number of live born piglets is in line with research from several authors (Radović et al., 2007; Petrović et al., 2000; Huang et al., 2003; Kosovac et al., 2005 and Radojković et al., 2007).

Kosovac et al. (2005) have found that parity has the most significant influence on the properties of the number of live born piglets and the number of piglets at weaning, which is in line with our research. The influence of the sire on the traits total number of piglets born, number of live born piglets, number of weaned piglets and litter weight at weaning is highly significant for all three parities, which is in line with research by Radojković et al. (2007), except in the first farrowing where the sire has no influence on the number of weaned piglets and litter weight at weaning. For the first two parities as well as for the first three parities, year and season have statistically high impact (P<0.01) on litter weight at weaning, which coincides with research of Radojković et al. (2007). Litter size usually increases from first to second litter and again from second to third litter (Lawlor and Lynch, 2007), which is consistent with our results. In studies of Radović et al. (2011) the following average values are established: the number of live born piglets 10.16, the total number of born piglets 10.74, as well as the number of weaned piglets 8.83 in Central Serbia, while Radojković et al. (2014) report: 9.60, 10.25 and 8.41, respectively. Considering all three tables, going from

first to third farrowing, an increase in the number of live born piglets and total number occurs, which is in line with research of Radović et al. (2007) and Radojković et al. (2007).

From the results we can see that the genotype had no significant effect on the studied reproductive traits in the first, first and second, and first, second and third farrowing. It was expected that difference between pure breeds and crossbreeds F_1 should be obvious due to heterosis effect, especially in the number of piglets born alive and total number of piglets born but we did not get such a result. Probably the reason for obtaining this result is the selection and management. The inclusion of the sire in the model, also the parity, the farrowing year and season we see that the significance ranged from insignificant to highly significant. Based on our research and studies of other authors, it is apparent that the factors included in the model influence the reproductive performance and that they must be taken into account when analyzing the reproductive traits.

Conclusions

Based on the investigation of factors using the F-test for the first farrowing, it is apparent that the sire and season exhibited statistically significant effect on the total number of piglets per litter, number of live born piglets and litter weight at birth, while the year of farrowing highly significantly influenced all investigated traits. The genotype did not statistically affect the studied traits for all parities ($P>0.05$). The influence of the sire, the parity, the farrowing and fertilization season ranged from statistically insignificant ($P>0.05$) to statistically highly significant ($P<0.01$).

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