THE SIGNIFICANCE OF THE EFFECTS INFLUENCING THE REPRODUCTIVE PERFORMANCE IN PIGS

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Abstract

The aim of this study was to demonstrate the significance of year, season, parity and sire-line effects on the reproductive performance in the breeding herd of LW_S sows.

For this purpose the total of 1 369 sows was monitored during the course of 10 years. All purebred LW_S sows were inseminated by LW_S boars of various lines within the purebred breeding.

The following reproduction traits were monitored for each sow: identity, boar-line, number of total, live born and reared piglets per sow/litter, number of stillbirths, dead piglets and percentage of piglets´ losses, parity of sows and farrowing interval. Nutrition was carried out with respect to sows´ reproduction cycle with the use of commercial complete feeding mixtures (CFM) for nursing (KPK) and gravid (KPB) sows.

The results (with regards to the individual monitored traits) were evaluated with the use of the ANOVA-program, and all statistical analyses were performed using the GLM procedure of SAS 9.1. (SAS Institute Inc., 2001). Year, season, parity and line were set as fixed effects while their conclusiveness was evaluated with the help of the Tukey test.

Based on the analysis of the sows reproductive performance it can be stated that the monitored herd shows an above-average reproductive performance parameters, piglets losses exceeding 20% and a gradual improvement of zo-technical work, as illustrated by the reduction of the insemination index and by the shortening of the farrowing interval.

Another discovered results include the fact, that parity significantly ($P \leq 0.0001$) influenced the total number of born piglets and also the number of dead piglets and their losses. The study also showed that the year and the season do not significantly affect reproduction in pigs.

Key Words: Pig, sow, reproduction, fertility, effects, parity, year, season, line

Unprofitable pork meat production seems to be the leading cause for the gradual decline in pig production in the CR. Preventing this decline is a question of achieving a high breeding efficiency. This is a function of breeding modern genotypes in pigs (Pedersen, 2010). The major goal of stocks management is to minimize the difference between potential and real pig performance. Achieving this goal requires an overview of all the performance problems (which are characterized by a complex of production and reproduction traits) and, moreover, knowing how these manifest in the given environment (Bracscamp, Haley, 1994). Knowledge, including the impact of individual effects serves as a guide to a gradual optimization of zo-technical and organizational actions leading to cost-effective farming.

An integrating status in pigs hybridization hold breeding herds whose role it is to improve and stabilize the hereditary characteristics in the general population (Webb, 1985). The most problematic aspect of this process seems to be the act of reproduction (English et al., 1988). The first cause of this is the low heritability of most of the characteristic features (Diekman et al., 1994). The second cause of the problem is the fact that the farming management shows to have little knowledge of the significance of influences affecting the given performance trait. It is therefore important to quantify these components, specifically to determine how significant is their influence on the given traits. In the case of reproduction, this area is controled by a number of factors, the most significant of them being parity, line, season and year (Jakubec, 1993).

The aim of this study is to demonstrate the significance of year, season, parity and sire-line effects on the reproductive performance of the breeding herd of LW_S sows.

Material and Method

Animals

In this study a total of 1 369 LW_D sows were monitored. These were inseminated by LW_S boars in accordance with the principles of purebred breeding. In these sows the reproductive performance was monitored during the period of over 10 years. As a part of this study the following indicators were monitored: boar line (CRK), insemination index (PP), number of total (PVNS) and alive (PŽNS) born piglets per litter, number of weaned (POS) piglets, number of stillbirths (PMNS), dead (PUS) piglets per litter, piglet losses (IB), parity (PV) and farrowing interval (DM).

Nutrition and feeding

Nutrition and feeding of the animals were carried out (with regards to their reproductive cycle) with the use of industrially produced complete feed mixtures for gravid and lactating sows.

Method, model

The results (with regard to individual monitored factors) were evaluated using the ANOVA program, while the statistical analyses were performed using the GLM procedure of SAS 9.1. (SAS Institute Inc., 2001). The year (Y), season (S), parity (P) and line (L) were determined as fixed effects and differences in their conclusiveness were tested with Tukey test. The following model was used:

$Y_{ijk} = \mu + P_i + Y_j + S_k + L_l + e_{ijkl}$, where:

Y_{ijk} = observed variable,
μ = population average,
P_i = parity effect (i = 1,2,3,…6),
Y_j = year effect (j = 2002, 3, 4, …2010),
S_k = season effect (k = spring, summer, autumn, winter),
L_l = line effect (l = L1, L2, L3… L16),
e_{ijkl} = residual error.

Because each herd has a given herd structure (the optimal structure is considered to be one where 1/3 of sows are in the 1st+2nd parity, 1/3 in the 3rd+4th and 1/3 in the 5th+6th parity), the observed animals were evaluated in such way where their litters were divided into the 1st to 5th litter and into the 6th litter animals from the higher parites were included (due to their low frequency). Regarding the frequency of line numbers, only lines with more than 40 animals were included. With regard to the season, the spring period was considered to be March + April + May, summer period was considered to be June + July + August, autumn September + October + November and winter period consisted of December + January + February.

Results and Discussion

The technique of determining the influence of fixed effects on pig performance is described in the work of Jakubec (1993). This technique is based on biometric genetics (Jakubec, 1990) and the author indicates that the effects of parity, year, season and line significantly affect the reproductive performance of sows. The determination of a combined influence of all of these effects on reproduction in pigs is a question of employed statistical models, and the knowledge of their significance can be a valuable clue in the breeding practice. The significance of the above mentioned factors for the given herd is shown Table 1.

As it is evident from these findings, the effect of parity significantly ($P \leq 0.0001$) influences the number of total piglets per litter, as well as the number of dead piglets and their losses. The effect of year and season do not appear to be significant, however the effect of line (with respect to the number of total and alive piglets in the litter) has been shown to be as significant as the effect of parity ($P \leq 0.0001$).

The significance of this effect was confirmed by Hughes (1998) and similarly by Riha et al. (2003), who also observed high significance of the line effect. Unlike in the works of the above mentioned authors, the significance of the year and season effects in a combined action were not demonstrated in this study. This fact is also stated in the works of Kyriazakis (1994), Hartog et al. (1994) and Líkař (2009), who associate the insignificance of these effects with the implementation of advanced farming technologies.

With regards to the work of Young et al. (2004), the cause for the low number of weaned piglets can be found in nutritional mistakes made during the weaning period. These mistakes can also affect the health status of sows, the process of integrating new gilts into the herd (Dee, 2000; Drabek, Dubanský, 2001) etc.

Table 1. The significance of the observed effects on reproductive performance in sows

Indicator	Effect			
	P	Y	S	L
PVNS	≤.0001	0.11	0.59	≤.0001
PMNS	0.03	0.07	0.82	0.02
PŽNS	0.00	0.14	0.76	≤.0001
PUS	≤.0001	0.00	0.06	0.19
ZS	≤.0001	0.00	0.10	0.13
DM	0.00	0.00	0.00	0.00
POS	0.07	0.37	0.63	0.00

Number of total born (PVNS) and alive (PŽNS) born piglets per litter, number of weaned (POS) piglets, number of stillbirths (PMNS), dead (PUS) piglets per litter, piglet losses ZS), farrowing interval (DM), year (Y), season (S), parity (P) and line (L)

Table 2. Reproductive performance of sows with respect to parity in the given herd

Indicator	1		2		3		4		5		6 and more	
	μ	SD	μ	SD	μ	SD	μ	SD	μ	SD	μ	SD
	n=356		n=282		n=226		n=171		n=137		n=197	
PP	1.34^{ABab}	0.68	1.28^{C}	0.64	1.23^{ac}	0.55	1,23^{bd}	0,64	1,17^{A}	0,46	1,11^{BCcd}	0,38
DM	156.8^{E}	2.68	181.6^{ABCDE}	52.42	167.5^{A}	37.64	167,8^{B}	47,65	163,6^{C}	34,34	161,4^{D}	30,87
PVNS	9.91^{ABCDE}	3.34	10.54^{AFGH}	3.12	11.10^{B}	3.20	11,61^{CF}	3,50	11,58^{DG}	3,30	11,41^{EH}	3,45
PMNS	0.57^{Aa}	0.95	0.54^{Bb}	0.94	0.69	1.32	0,67	0,93	0,80^{ab}	1,24	0,84^{AB}	1,09
PŽNS	9.34^{ABCDE}	3.29	10.00^{AFGa}	2.97	10.41^{B}	3.04	10,94^{CF}	3,41	10,79^{DG}	3,08	10,57^{Ea}	3,32
PUS	1.25^{ABCD}	1.63	1.49^{EFG}	1.89	1.65^{AHab}	2.13	2,06^{BEa}	2,10	2,11^{CFb}	2,32	2,17^{DGH}	2,25
POS	8.09^{ABab}	2.74	8.52^{a}	2.48	8.80^{A}	2.46	8,87^{B}	2,58	8,68^{b}	2,52	8,41	2,55
ZS	22.46^{ABCD}		23.77^{EFGH}		26.61^{AIa}		30.85^{BEF}		33.47^{CGa}		35.75^{DHI}	

Table 3. Reproductive performance of sows with respect to boar-line in the given herd

line register	AAR		ADL		ACI		ATV		ALT		AOT		PMI		PTO	
no. line	3		5		4		14		6		8		37		42	
Indicator	μ	SD	μ	SD	μ	SD	μ	SD	μ	SD	μ	SD	μ	SD	μ	SD
	n=45		n=157		n=46		n=44		n=114		n=85		n=52		n=44	
PP	1.09^{AB}	0.36	1.46$^{ABC\ DEF}$	0.80	1.22^{C}	0.51	1.23^{F}	0.60	1,13^{D}	0,49	1,27^{Ef}	0,50	1,04^{f}	0,19	1,09	0,36
PV	2.91	2.20	3.12	1.96	2.61	1.44	3.27	2.00	2,70	1,64	2,52	1,89	5,15	2,39	5,43	1,78
DM	152.52$^{B\ C}$	5.44	176.01$^{B\ d}$	40.01	169.15^{E}	30.74	159.47^{L}	19.82	163,32^{Jd}	31,84	194,92$^{C\ EJLP}$	85,82	164,29^{P}	43,83	156,77^{l}	26,55
PVNS	10.07^{JL}	3.61	10.41^{MO}	3.22	10.74^{e}	3.68	11.89^{JMh}	2.80	10,89	3,24	10,60^{Ehi}	3,49	10,90	3,17	11,84$^{LO\ Ei}$	2,76
PMNS	0.42^{D}	0.75	0.59	1.03	0.54	0.86	1.02^{Hj}	1.36	0,52	0,74	0,68^{g}	1,05	0,33^{HIg}	0,58	0,59^{j}	1,00
PŽNS	9.64^{I}	3.43	9.82^{BKf}	3.05	10.20	3.86	10.86^{f}	2.87	10,38	3,29	9,92	3,35	10,58	3,06	11,25^{IKB}	2,83
PUS	1.62	2.37	1.47	2.19	1.91	2.11	1.25	1.30	1,59	1,95	1,82	1,92	1,85	1,94	1,80	1,52
POS	8.02^{CE}	2.15	8.40^{HJ}	2.51	8.28^{Ff}	2.66	9.61$^{CFH\ M}$	2.48	8,79^{g}	2,49	8,09^{MOg}	2,73	8,73^{k}	2,47	9,45^{EJOf}	2,10
ZS	20.31		19.82		22.87		19.12		19.32		23.64		19.93		20.15	

Differences in values marked with the same point are statistically significant. For $P \leq 0.01$ was used A,B,C,…. for $P \leq 0.05$ a,b,c,….

If the model presented here determines the significance of observed effects in a combined action, it is important to consider how much is the observed trait influenced by individual significant effects such as parity and line, as documented in Table 2 and 3.

If the parity effect is concerned, it affects the frequency of litters, as well as piglet losses (Hovorka et al., 1983; Pour, Hovorka, 1982; Stupka et al., 2009). These are a function of age of the piglets, their rearing (Pour, Hovorka, 1982), the age of sow (Clausen, 1955), etc. Regardless the achieved reproduction parameters there are signifiant differences ($P \leq 0.01$; $P \leq 0.05$) in the monitored variables within the individual parities and lines. These facts correspond with the conclusions of Hughes, Varley (2003), Hartog, Vesseur (1993).

The following Table 3. shows the reproductive performance of selected boar lines re the reproduction in sows.

The effect of lines on pig performance was already studied by Moskal (1974) and Moskal et al. (1983). They state that the observed differences between the lines are of such significance and that the monitored traits are overlapping to such extent when it is possible for many genealogical lines to be used as a base for the creation of breeding lines. With regards to the monitored herd, in our case as well were found significant differences between the lines of the monitored reproductive performance traits between the lines of sows. Their levels are a function of the environment (Diekman et al., 1994; Cole, 1999; Guedes et al., 2000) and genotype (Jakubec et al.,(1974). The above stated characteristics of the reproduction and the conclusiveness of differences between the lines ($P \leq 0.01$, $P \leq 0.05$) serve as a guideline for preferential application of individual lines (more precisely boars) in the breeding herd (line PTO, PMI, ATV, ALT, AAR).

Conclusion

The aim of this study was to demonstrate the effects of year, season, parity and sire- line on the sows´ reproductive potential in the breeding herd and to determine how important these effects are. Based on the analysis of reproductive performance of sows for the given herd, the following could be stated:

- if the effects of year, season, parity and line acts separately, then they, in many cases, significantly affect the monitored parameters of reproductive performance,
- in the case of a combined action of these effects (year, season, parity, line):
    - parity very significantly ($P \leq 0.0001$) affects the number of total piglets per litter as well as the number of dead piglets and their losses,
    - boar-line very significantly ($P \leq 0.0001$) affects the number of total as well as alive born piglets in the litters,
    - year and the season does not affect the observed characteristics of sows´ reproduction.

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