Original scientific paper
DOI: /10.5513/JCEA01/19.2.2073
Journal of Central European Agriculture, 2018, 19(2), p.308-317

Influence of age at first farrowing of maternal breed sows on their reproductive performance

Wpływ wieku pierwszego oproszenia loch ras matecznych na ich użytkowość rozpłodową

Maria BOCIAN, Hanna JANKOWIAK* and Weronika ZBONIK

Department of Pig Breeding and Horses, UTP University of Science and Technology in Bydgoszcz, 85-084 Bydgoszcz, Mazowiecka 28, Poland, *correspondence: jankowiak@utp.edu.pl

Abstract

The aim of the study was to determine the relationship between the age of the first farrowing of maternal breed sows Polish Large White (PLW) and Polish Landrace (PL), and the parameters of the previously conducted life performance test and the results of the reproductive performance. Offspring of 4-5 litters born in 2009-2014 years from 564 PLW and 300 PL sows were subjected to the analysis. A total of 4,064 litters. In the performance test took into the consideration the body weight on the day of the assessment, standardized daily gains, and standardized thickness of backfat, the percentage of meat content in a carcass and the value of the selection index. In the reproductive assessment took into account the age of the first farrowing, the number of alive and dead piglets in a litter, the number of piglets in 21st day of life, the mortality rate of piglets, the percentage of gilts in a litter. The obtained results were compiled and analyzed in three groups of sows formed according to the age of the first farrowing: group I ≤ 340 days, II 340-380 days and III > 380 days. The age of the first farrowing varied between the groups of sows and ranged from 322 to 400 days. It was shown that the gilts demonstrating in the performance test the greatest body weight, the largest gains, and the smallest meatiness obtained the highest index value and were characterized by the youngest age of the first farrowing ($P<0.01$ and $P<0.05$). The number of born and reared piglets till 21st day, was not significantly related to the age of the first farrowing.

Keywords: age at first farrowing, performance test, reproductive performance, sows

Streszczenie

Celem badań było określenie zależności między wiekiem pierwszego oproszenia loch ras matecznych wielkiej białej polskiej (wbp) i polskiej białej zwisłouchej (pbz) a parametrami wcześniej przeprowadzonej oceny przyżyciowej oraz wynikami oceny rozpłodowej. Analizie poddano wyniki 564 loch wbp i 300 loch pbz oraz ich potomstwo z 4-5 miotów urodzonych w latach 2009-2014. Łącznie 4064 mioty. W ocenie przyżyciowej loszek uwzględniono masę ciała w dniu oceny, standaryzowane

przyrosty dobowe, standaryzowaną grubość słoniny, procentową zawartość mięsa w tuszy oraz wartość indeksu selekcyjnego. W ocenie użytkowości rozpłodowej uwzględniono wiek pierwszego oproszenia, liczbę prosiąt żywych i martwych w miocie, liczbę prosiąt w 21 dniu życia, śmiertelność prosiąt, procentowy udział loszek w miocie. Uzyskane wyniki zestawiono i analizowano w trzech grupach loch utworzonych w zależności od wieku pierwszego oproszenia: grupa I ≤ 340 dni, II 340-380 dni i III > 380 dni. Wiek pierwszego oproszenia był zróżnicowany między grupami loch i wynosił od 322 dni do 400 dni. Wykazano, iż loszki wykazujące w ocenie przyżyciowej największą masę ciała, największe przyrosty, najmniejszą mięsność, osiągały największą wartość indeksu, charakteryzowały się najmłodszym wiekiem pierwszego oproszenia (P<0,01 i P<0,05). Liczba prosiąt urodzonych i odchowanych do 21 dnia nie była istotnie związana z wiekiem pierwszego oproszenia.

Słowa kluczowe: lochy, ocena przyżyciowa, użytkowość rozpłodowa, wiek pierwszego oproszenia

Introduction

The age of the first farrowing of sows is an important feature determining if the piglet production is profitable. The gilts which start the reproductive cycle earlier shorten the unproductive period, which has a positive effect on the economy of production. However, their physiological and somatic state of development may be insufficient to the birth and rearing of numerous offspring not only in the first litter (Schukken et al., 1994; Szulc et al., 2009; Szostak and Przykaza, 2010).

Suckling the piglets from a large litter usually exceeds the ability of a sow to produce a sufficient amount of milk from the consumed feed, which initiates the use of body's own energy reserves. Maintaining adequate body tissue reserves throughout a sow's lifetime is thought to be important to maximize herd productivity (Novotni-Danko et al., 2015). The loss of body weight of sows, especially the primiparous, during lactation is a negative phenomenon, though commonly observed (Kapelańska et al., 2012). That is why it is preferable in reproduction to mate gilts in later estrus at the appropriate body weight (Kapelańska et al., 2001; Bocian et al., 2010, 2015). It has also been shown that the age of the first farrowing of sows influences the life reproductive performance and their longevity (Le Cozler et al., 1998; Babot et al., 2003; Serenius et al., 2008).

A great significance in the prediction of the reproductive performance of sows has the alive breeding assessment which includes in the form of the selection index the results of the assessment of growth rate, backfat thickness and the muscularity of the carcass conducted at the age of 150-210 days of gilts' life (Rekiel and Więcek, 2002; Matysiak et al., 2010; Flisar et al., 2012; Bocian et al., 2015).

The aim of the study was to determine the relationship between the age of the first farrowing of PLW and PL maternal sows and the parameters of the previously conducted life performance test and the results of the reproductive assessment.

Material and methods

The research material were sows of Polish Large White (PLW) and Polish Landrace (PL) breed, which came from a pedigree breeding farm from the Kuyavian and Pomeranian region. The results of the life performance test and reproductive performance were analyzed from 564 sows of the Polish Large White breed and 300 sows of the Polish Landrace breed. The animals were kept according to the welfare requirements and fed according to the norms (Grela and Skomiał, 2014). The litters 2,689 from sows of the PLW breed and 1,375 litters from sows of the PL breed were assessed (on average 4-5 litters from each sow). All litters were obtained and reared from 2009 to 2014 years.

In the life performance test of sows, the following characteristics were taken into account: the body weight of sows on the assessment day, standardized daily gains, standardized thickness of backfat, the percentage content of meat in a carcass and the selection index according to Eckert et al. (2015).

In the reproductive performance of sows, the following characteristics were analyzed: the age of the first farrowing, the total number of piglets in 1^{st} and 21^{st} day, the number of dead piglets; the number of gilts in 21^{st} day, and also the mortality of piglets from 1^{st} to 21^{st} day of rearing.

The obtained results were compiled and analyzed in three groups, depending on the age of the first farrowing of the PLW and PL sows. Group I constituted sows with the earliest age of the first farrowing of less than 340 days (n=292), group II constituted sows from 340 to 380 days (n=338), and group III sows over 380 days (n=234).

The obtained results were statistically developed. The arithmetic mean and the standard deviation was calculated. A two-way analysis of variance was performed in order to compare the performance test and reproductive performance of sows from the PLW and PL breeds depending on the age of the first farrowing according to the following formula:

$$y_{ijk} = \mu + m_i + w_j + e_{ijk}$$

where:

y_{ijk} – feature value; ijk- of this sow;

μ – average mean;

m_i – constant effect i- age at first farrowing (i = I < 340 days, II 340-380 days, III > 380 days);

w_j – constant effect j-this genotype (j = 1 PLW, 2 PL),

e_{ijk} – random error.

For the groups which derived from the distribution of the test material, according to the factors included in the variance model analysis, conducted the least significant difference test (LSD) for the medium object pairs.

The Pearson linear correlation coefficients were calculated for the population of sows from the PLW and PL breeds between the first farrowing and the features of the life performance test and the reproductive performance. For the statistical calculations used the statistical program Statistica 8.0 PL (2008).

Results

Table 1 summarizes the results of the life performance test of sows of the maternal breed PLW and PL, which were analyzes in groups formed according to the age of the first farrowing.

The most numerous group constituted gilts with average age of the first farrowing amounting to 340-380 days (n=338, including 217 gilts PLW and 121 PL). The gilts from group I were the youngest at the first farrowing, below 340 days (n=292, including 177 PLW and 115 PL), and the least numerous group III constituted gilts over 390 days old (n=234, including 170 PLW and 64 PL).

The gilts with greater body weight in the day of the life performance test were characterized by greater standardized daily gains and higher value of the selection index were the gilts found in the group of the youngest gilts at the first farrowing (significant differences at $P<0.05$ and $P<0.01$).

The reproductive performance of sows of the PLW and PL breeds was compiled according to the age of the first farrowing in Table 2.

The age of the first farrowing was statistically significantly varied among the groups and ranged from 322 to 400 days ($P<0.01$). Such a large variation of the age of sows at the birth of the first litter, up to 80 days, did not affect the number of born piglets. Statistically significant differences were found in the number of dead piglets of sows from the PLW breed, and among group I and III, and also among the PLW and PL breed in group I and II. The sows from the PL breed delivered more dead piglets in a litter ($P<0.05$). The distribution of data concerning the number of dead piglets is quite irregular and does not suggest significant differences connected both with the breed of gilts and with the age of the first farrowing. Irrespectively of the age of the first farrowing in the litters from all groups about 56% of gilts were found. The mortality of piglets from the 1 to 21 day of rearing was low and constituted about 5% of all assessed groups.

Table 3 summarizes the results of the simple correlation coefficients between the age at first farrowing and the characteristics of the life performance test and the reproductive performance of sows from the PLW and PL breeds. The negative correlations between the age of the first farrowing and the performance test concerned the body weight at the day of the assessment, standardized daily gains and the value of the selection index ($P<0.01$) and were found primarily in the PLW breed of sows. The PL breed of sows had only significantly lower the standardized gains ($P<0.05$). In the characteristics of the reproductive performance, the age of the first farrowing was not correlated with the number of born and reared piglets. Only in sows from the PL breed, the share of gilts in a litter in the 21st day of life was higher ($P<0.05$).

Table 1. The results life performance test of gilts

Characteristic	Breed	Age at first farrowing (days)		
		I ≤ 340	II 340-380	III > 380
Number of gilts (n)	PLW	177	217	170
	PL	115	121	64
Average		292	338	234
Body weight of gilts (kg)	PLW	83.73^{A} ±7.42	83.16^{A} ±7.49	81.09^{B} ±7.39
	PL	84 ±7.38	83.55 ±7.46	82.73 ±7.55
Average		83.83^{A} ±7.39	83.3^{A} ±7.47	81.54^{B} ±7.45
Standardized daily gains (g)	PLW	686^{A} ±60	664^{A} ±69	659^{B} ±70
	PL	685^{Aa} ±57	661^{B} ±60	664^{b} ±62
Average		685^{A} ±59	663^{B} ±66	660^{B} ±68
Standardized backfat thickness (mm)	PLW	10.67 ±2.05	10.56 ±2.28	10.66 ±2.14
	PL	10.23 ±2.3	10.73 ±2.34	10.65 ±2.56
Average		10.5 ±2.16	10.62 ±2.3	10.66 ±2.26
Meat in carcass (%)	PLW	58.58^{a} ±2.45	59.13^{b} ±2.74	59.01 ±2.48
	PL	58.81 ±1.99	59.24 ±2.64	59.23 ±2.55
Average		58.67^{a} ±2.28	59.16^{b} ±2.7	59.07 ±2.49
Selection index value (pts)	PLW	120.62^{a} ±10.15	119 ±11.12	117.8^{b}±11.32
	PL	121.16^{a} ±8.01	118.83^{b} ±8.98	119.26 ±8.94
Average		120.83^{Aa} ±9.36	118.94^{b} ±10.39	118.2^{B}±10.72

PLW- Polish Large White, PL- Polish Landrace. Significance of differences: $^{A, B}$ P<0.01, $^{a, b}$ P<0.05.

Table 2. Results of reproductive performance of sows

Characteristic	Breed	Age at first farrowing (days)		
		I	II	III
		≤ 340	340-380	> 380
Number of litters (n)	PLW	867	1,069	753
	PL	511	564	300
Total		1,378	1,633	1,053
Age at first farrowing (days)	PLW	323.42^{A}±11.26	358.06^{B}±11.62	399.58^{C}±14.8
	PL	322.35^{A}±12.09	357.16^{B}±10.99	400.84^{C}±13.99
Average		323^{A}±11.59	357.74^{B}±11.39	400.03^{C}±14.56
Av. number of alive piglets born (n)	PLW	12.54 ±1.65	12.47 ±1.68	12.54 ±1.73
	PL	12.38 ±1.65	12.57 ±1.74	12.34 ±1.66
Average		12.48 ±1.65	12.5 ±1.7	12.48 ±1.71
Number of dead (n)	PLW	0.34^{ax} ±0.65	0.38^{x} ±0.67	0.42^{b} ±0.73
	PL	0.47^{y} ±0.75	0.5^{y} ±0.75	0.46 ±0.77
Average		0.39 ±0.69	0.42 ±0.7	0.43 ±0.74
Av. number of piglets reared until 21st day (n)	PLW	11.93 ±1.48	11.88 ±1.47	11.90 ±1.48
	PL	11.82 ±1.44	11.96^{a} ±1.54	11.75^{b} ±1.38
Average		11.89 ±1.46	11.91 ±1.49	11.86 ±1.45
Number of gilts at 21st day (%)	PLW	56.16	56.48	55.88
	PL	58.12	56.1	56.17
Average		56.85	56.34	55.99
Mortality of piglets from 1st to 21st day (%)	PLW	4.86	4.73	5.1
	PL	4.52	4.85	4.78
Average		4.73	4.72	4.97

PLW- Polish Large White, PL- Polish Landrace. Significance of differences – in rows: $^{A, B, C}$ P<0.01, $^{a, b}$ P<0.05. Significance of differences – in columns: $^{x, y}$ P<0.05.

Table 3. Coefficients of linear correlation between age at first farrowing and parameters of life performance test and characteristics of reproductive performance

Characteristic	Age at first farrowing (days)	
	Breed	
	PLW	PL
Life performance test		
Body weight of gilts (kg)	-0.155**	-0.091
Standardized daily gains (g)	-0.157**	-0.133*
Standardized backfat thickness (mm)	0.018	0.068
Meat in carcass (%)	0.047	0.077
Selection index value (pts)	-0.117**	-0.078
Reproductive performance		
Av. number of alive piglets born (n)	0.001	-0.055
Av. number of dead (n)	0.055	-0.012
Av. number of piglets reared until 21st day (n)	-0.03	-0.073
Av. number of gilts at 21st day (n)	-0.066	-0.123*

PLW- Polish Large White, PL- Polish Landrace. **Significance at P<0.01. *Significance at P<0.05.

Discussion

The age of gilts entering the reproductive cycle is significant in determining the reproductive performance. The gilts intended for reproduction are subjected to life performance test forecasting their breeding value. Testing the suitability of this assessment in relation to the age of the first farrowing is a topic for further discussion. The assessed groups of gilts of both breeds entering the reproductive cycle as the earliest showed significantly greater body weight and higher standardized daily gains in the performance test. They also had less carcass meatiness and had a higher score of the selection index. This speaks for the positive effect of the increased growth rate of young gilts for earlier entrance into the reproductive cycle. A significant correlation between the growth rate of gilts and their age of the first mating was demonstrated by Tummaruk et al. (2001).

The age of the first farrowing depends primarily on the effectiveness of the first mating. Most of the breeders use gilt mating in the second spontaneous estrus, thus

providing the optimal period for the physical and hormonal development of the gilts while starting the reproduction. Every inefficient mating prolongs the age of farrowing of gilts. This may be due to insufficient manifestation of the estrus symptoms or the lack of the standing reflex (Sterning et al., 1998; Tummaruk et al., 2007; Matysiak et al., 2010).

In the present study found a large variation of the first farrowing up to 80 days, nevertheless, it had no further effect on the fertility of sows. The number of piglets in following assessed 4-5 litters was the same in the younger and older groups of sows at the first farrowing. A similar study was conducted by Le Cozler et al. (1998) on a much larger groups of sows divided into groups according to the age of the first farrowing. Their results are consistent with this study. No adverse effect of the early age of the first farrowing was demonstrated. Nevertheless, the herd with the average lower age of the first farrowing had a slightly lower productivity, which suggests according to the authors the need to improve the maintenance conditions of sows (Le Cozler et al., 1998).

The general correlations calculated separately in both breeds between the age of the first farrowing and the tested characteristics of the performance test and reproductive assessment showed that in a few cases slight interrelations. In the gilts from the PL breed, these correlations were related to a greater body weight, higher standardized gains and higher score of the selection index in gilts, which entered earlier the reproduction cycle. A lower degree of correlation of the tested characteristics was observed in the sows from the PL breed. In the life performance test, only the growth rate was higher in the younger sows, and in the reproduction assessment there was a higher number of gilts in a litter.

Conclusion

The conducted studies on the relationship of the age of the first farrowing of sows and their life performance test and reproductive assessment including 4-5 litters, showed that the gilts characterized by higher growth rates entered into the reproductive cycle slightly earlier. The number of born and reared piglets to 21st day of life was not significantly related to the age of the first farrowing. The age of the first farrowing sows did not show any significant effects on their reproductive performance.

References

Babot, D., Chavez, E. R., Noguera, J. L. (2003) The effect of age at the first mating and herd size on the lifetime productivity of sows. Animal Research, EDP Sciences, 52 (1), 49-64. DOI: http://dx.doi.org/10.1051/animres:2003001

Bocian, M., Jankowiak, H., Grajewska, S., Gajdosova, L., Kapelańska, J., Kapelański, W. (2010) Evaluation of breeding and reproductive value of Polish Large White and Polish Landrace sows from the Kujawy-Pomerania region. Roczniki Naukowe Zootechniki, 37 (2), 137-144.

Bocian, M., Jankowiak, H., Górski, J., Frątczak, K., Kapelański, W. (2015) Backfat thickness during gestation and lactation period in respect to reproductive performance of primiparous and multiparous sows. Journal of Central European Agriculture, 16 (1), 100-111. DOI: http://dx.doi.org/10.5513/JCEA01/16.1.1548

Eckert, R., Żak, G., Bereta, A. (2015) Results of performance tested gilts. In: Report on pig breeding in Poland. National Research Institute of Animal Production, Kraków, 34-47.

Flisar, T., Malovrh, S., Urankar, J., Kovač, M. (2012) Effect of gilt growth rate and backfat thickness on reproductive performance. Acta argiculturae Slovenica, Supplement 3, 199–203.

Grela, E. R., Skomiał, J. (2014) Polish Pig Feeding Standards. Pigs feeding standards. Feeding recommendations and nutritional value of feed for pigs. Jabłonna: Wyd. IFiŻZ PAN.

Kapelańska, J., Rak, B., Kapelański, W., Bocian, M. (2001) The effect of age at first farrowing on further performance in Polish Landrace sows. In: Jasek, S. and Poznański, W., Trzoda chlewna w gospodarce narodowej. International Scientific Conference. Wrocław, Poland, 5-6 April 2001, Wrocław, Poland: Zeszyty Naukowe Akademii Rolniczej we Wrocławiu.

Kapelańska, J., Grajewska, S., Bocian, M., Jankowiak, H., Kapelanski, W. (2012) Carcass and meat quality of primiparous sows as related to the lactation period of 21 or 28 days and to body weight loss. Acta Veterinaria Brno, 81, 255-260. DOI: http://doi.org/10.2754/avb201281030257

Le Cozler, Y., Dagorn, J., Lindberg, J. E., Aumaître, A., Dourmad, J. Y. (1998) Effect of age at first farrowing and herd management on long-term productivity of sows. Livestock Production Science, 53 (2),135-142. DOI: http://dx.doi.org/10.1016/S0301-6226(97)00157-7

Matysiak, B., Kawęcka, M., Jacyno, E., Kołodziej-Skalska, A., Pietruszka, A. (2010) Relationships between test of gilts before day at first mating on their reproduction performance. Acta Scientiarum Polonorum, Zootechnica, 9 (2), 29-38.

Novotni-Danko, G., Balogh, P., Huzsvai, L., Győri, Zs. (2015) Effect of feeding liquid milk supplement on litter performances and on sow back-fat thickness change during the suckling period. Archives of Animal Breeding 58, 229-235. DOI: https://doi.org/10.5194/aab-58-229-2015

Rekiel, A., Więcek, J. (2002) The effect of body weight, backfat thickness and LD muscle height at first breeding in gilts on their reproductive performance over three subsequent parities. Prace i Materiały Zootechniczne, z. specjalny 13, 131-138.

Schukken, Y. H., Burman, J., Huirne, R. B. M., Willemse, A. H., Vernooy, J. C. M., van den Broek, J., Verheijden, J. H. M. (1994) Evaluation of optimal age at first conception in gilts from data collected in commercial swine herds. Journal of Animal Science, 72, 1387-1392.

Serenius, T., Stalder, K. J., Fernando, R. L. (2008) Genetic associations of sow longevity with age at first farrowing number of piglets weaned and wean to insemination interval in the Finnish Landrace swine population. Journal of Animal Science, 86, 3324-3329.

Statistica (2008) StatSoft, Inc. (data analysis software system), version 8.0. www.statsoft.com

Sterning, M., Rydhmer, L., Eliasson-Selling, L. (1998) Relationships between age at puberty and interval from weaning to estrus and between estrus signs at puberty and after the first weaning in pigs. Journal of Animal Science, 76, 353-359.

Szostak, B., Przykaza, L. (2010) The age analysis of first farrowing of gilts Polish Large White and Polish Landrace breed at pig breed farms in Lublin province. In Polish, summary in English. Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, 12 (7), 114-117.

Szulc, K, Buczyński, J. T., Skrzypczak, E. (2009) Effect of the age of the first farrowing on the selected breeding performance traits of Redone sows. Roczniki Naukowe Polskiego Towarzystwa Zootechnicznego, 5 (3), 85-92.

Tummaruk, P., Lundeheim, N., Einarsson, S., Dalin, A. M. (2001) Effect of birth litter size, birth parity number, growth rate, backfat thickness and age at first mating of gilts on their reproductive performance as sows. Animal Reproduction Science, 66, 225-237. DOI: http://dx.doi.org/10.1016/S0378-4320(01)00095-1

Tummaruk, P., Tantasuparuk, W., Techakumphu, M., Kunavongkrit, A. (2007) Age, body weight and backfat thickness at first observed oestrus in crossbred Landrace × Yorkshire gilts, seasonal variations and their influence on subsequence reproductive performance. Animal Reproduction Science, 99 (1-2), 167-181. DOI: http://dx.doi.org/10.1016/j.anireprosci.2006.05.004