UNIWERSYTET TECHNOLOGICZNO-PRZYRODNICZY
IM. JANA I JĘDRZEJA ŚNIADECKICH
W BYDGOSZCZY
ZESZYTY NAUKOWE NR 248 – ZOOTECHNIKA 36 (2006) 83-92

ANALYSIS OF THE INFLUENCE OF MATERNAL EFFECT ON REPRODUCTION AND PRODUCTION TRAITS OF SOWS

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Analizę płodności loch w zależności od kolejności miotu (miot ich pochodzenia) wykonano w grupie eksperymentalnej loch rasy Wielkiej Białej Czeskiej. Najwyższą liczbę żywo urodzonych prosiąt odnotowano dla loch urodzonych z 11. i 3. miotu (11,50 i 9,84 prosiąt). Najniższą liczbę żywo urodzonych prosiąt odnotowano dla loch z 7. i 8. miotu (7,25 i 7,33 prosiąt). Nie odnotowano istotnych różnic pomiędzy badanymi cechami (liczba wszystkich urodzonych, żywo urodzonych i odchowanych prosiąt) testując diametralne różnice określonych wartości fenotypowych. Ujawniono jedynie określone przesunięcia w przypadku loszek z 6. i 7. miotu, u których odnotowano lepszą płodność.

Słowa kluczowe: locha, płodność, miot, pochodzenie

1. INTRODUCTION

Recently breeding work in nucleus and breeding herds is characterized by reducing back fat thickness and increasing lean meat percentage in sire breeds as well as in dam breeds. A common task is a relation between the meatness and fertility of sows. An optimal level of lean meat percentage, or an optimal level of backfat thickness, is defined and predicted with difficulty. A negative correlation between fertility and meatness in pigs is known. That is the reason why breeding work does not get along without analysing the fertility from a viewpoint of phenotypic variability.

An influence of maternal effect is one of the components which have an influence on its phenotypic variability. Some authors mention negative correlation between mother fertility and daughter fertility. Daughters whose origin is numerous litter or whose mothers demonstrated high fertility reach lower reproductive traits than daughters whose mothers showed lower fertility [1, 8, 17].

Schlegel et al. [18], Jarczyk [9], Lewczuk et al. [12] report on similar conclusions; gilts whose origin is less numerous litter reach higher fertility than gilts from more numerous litter, which suggest a negative influence of maternal effect on daughters. These studies coincide with an earlier study by Falconer [6] about a negative influence of a maternal effect in multiparital animals, related to different weight of animals. Nelson and Robison [15] found gilts with an origin in small litters (6 piglets) demonstrated

at 1.01 ($P < 0.05$) higher number of ovulated eggs, higher number of embryos on the 28th day of gravidity ($P < 0.01$) and at 1.18 ($P < 0.05$) higher number of born piglets than gilts with an origin in litter with 14 piglets. Similar conclusions were reached by Steen der Van [19] who found gilts from litters with an average number of 6 piglets for 0.48 piglet better fertility than gilts from litters with an average number of 12 piglets. In a different study Rudlegde [17] mentions gilts from litters with about 6 piglets having 1.2 – 2 piglets more than gilts from more numerous litters. On the other hand study by Pavlík [16] does not confirm considerations about a negative influence of high number of piglets in mother's litter on reproductive efficiency of the daughter.

In literature problems of an influence of litter order of sow origin on their fertility is not analysed too much. Czarnecki [2] did not find an influence of litter order of sows origin. Sows from the first to seventh litter did not show conclusive difference. In Czech Large White breed Pavlík [16] did not find more expressive influence of litter order of sows origin on reproductive results either. In comparison with that, Jarczyk [8] found that sows from the 3rd litter reached the highest fertility and sows from the 5th litter reached the lowest traits of fertility.

A litter order also influences the number of born piglets in litter. It is seen from the subsequently mentioned studies that sows fertility increases till the 3rd-4th litter and then it decreases gradually [7, 11, 20, 10, 13 etc.].

The aim of the study is to carry out an analysis of chosen reproductive and productive traits of dam breed Czech Large White sows according to a litter order of their origin based on information from the performance test from two nucleus herds of pigs.

2. METHODS AND MATERIAL

Monitoring and collecting experimental data were carried out in nucleus breed of Czech Large White pig breed (CLW). The evaluation was performed over 1999-2002. 232 gilts of Czech Large White breed were involved.

An analysis of population started by including gilts to performance test (PT) in conformity with the methodology of "Control of pigs efficiency and heritability" according to Czech state norm ČSN 46 6164. An individual start weight and a weight in the end of the test (PT) were given in kg. Individual animals were weighed on individual digital scale with an accuracy of 0.5 kg. Performance test measuring was done with PIGLOG 105 and included the following parameters:

- backfat thickness in mm on two decimal places on a level of 3rd-4th lumbar vertebra, 70 mm laterally from the central line of back,
- backfat thickness in mm on two decimal places on a level of 3rd-4th semi-final rib, 70 mm laterally from the central line of back,
- depth of *musculus longissimus lumborum et thoraci* (*m.l.l.t.*) in mm on a level of 3rd-4th semi-final rib, 70 mm laterally from the central line of back,
- lean meat percentage (% LM).

Measuring with PIGLOG 105 apparatus proceeded in individual pen and measured proper-posture standing animals.

An average daily gain from birth (in g) and an average daily gain in performance test (in g) were calculated from the data. Recognized average phenotypic values in the field test of daily gain and backfat thickness were revised for the weight of 90 kg and

lean meat percentage was revised for the weight of 100 kg according to performance test methodology.

After the end of performance test (field test) gilts were observed again. Every mating was monitored but only successful one was statistically evaluated. Previous monitoring during mating was not used.

These traits were noted in day of the first successful mating: age during the 1st successful mating in days, gain from birth in g, backfat thickness in mm, depth of *m.l.l.t.* in mm, % of lean meat, total number of born piglets, number of alive born piglets, number of weaned piglets.

Studied file of CLW gilts was divided according to litter of gilts mother origin:

from 1st litter	from 6th litter
from 2nd litter	from 7th litter
from 3rd litter	from 8th litter
from 4th litter	from 9th litter
from 5th litter	from 11th litter

There was only one gilt from 10th litter, so it was not statistically verified.

Basic statistical characterizations (mean, variability, standard deviation) were calculated from determined phenotypic values of the traits evaluated. Next coefficients of correlation between traits which were approached as linear were determined in the gilts studied. One-factor analysis of covariance was used for determination of correlative coefficients. Values of F-tests and t-tests of correlative relations were rated as presumable ($P \leq 0.05$), significant ($P \leq 0.01$), highly significant ($P \leq 0.001$). Data were evaluated with the statistical program UNISTAT 4.53.

3. RESULTS AND DISCUSSION

In Tables 1-2, there are shown basic statistical characterizations (mean and standard deviation) of chosen reproductive and productive traits in different phases of reproductive cycle of gilts divided according to a litter order of gilts origin.

Gilts from 11th litter had the highest daily gain from birth to 90 kg (645.5 g) and in field test of performance test (919.0 g). Gilts from the 1st litter had the second highest (636.9 g and 910.4 g). Gilts from 5th litter had the lowest daily gain from birth to 90 kg (609.6 g) and gilts from 8th litter had the lowest gain in performance test (830.7 g). We can positively evaluate narrow range of gains in gilts from different litters (609.6-645.5 g and 830.7-919.0 g).

In another trait studied, backfat thickness – gilts from 8th litter had the highest average value (1.02 mm) as compared to gilts from 6th litter (7.40 mm). Backfat thickness is connected with another trait of carcass value – lean meat percentage. The highest percentage of lean meat was found in gilts from 6th litter (62.48%), as compared to gilts from the 8th litter (58.89%). With growing values of lean meat percentage backfat thickness showed decreasing tendency which is created by negative correlation between the amount of lean tissue and fat content in animal body. Mrode and Kennedy [14] determined genetic correlation between % LM and backfat thickness $r_G = -0.87$. Lower value are reported by Ducos [5] $r_G = -0.65$.

Table 1. Basic statistical characterizations of chosen reproductive and productive traits in different phase of reproductive cycle in CLW gilts with an origin from 1st-5th litter

Tabela 1. Podstawowa charakterystyka statystyczna wybranych cech reprodukcyjnych i produkcyjnych w różnych fazach cyklu reprodukcyjnego u loszek rasy Czeskiej Wielkiej Białej pochodzących z 1. do 5. miotu

Litter order Kolejnośc miotu	1. litter – 1. miot			2. litter – 2. miot			3. litter – 3. miot			4. litter – 4. miot			5. litter – 5. miot		
Trait Cecha	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Performance test – Test wartości użytkowej															
Gain from birth (g) Przyrost od urodzenia (g)	25	636.9	69.09	39	611.4	48.92	17	628.4	46.42	32	634.3	48.40	10	609.6	69.61
Gain in performance test (g) Przyrost wartości testu wartości użytkowej (g)	25	910.4	102.2	39	894.4	103.2	17	909.9	80.25	32	987.5	99.79	10	866.6	101.8
Back fat thickness (mm) Grubośc słoniny (mm)	25	8.0	1.7	39	8.9	1.5	17	7.8	1.0	32	8.8	1.8	10	9.1	1.5
Muscle depth *m.l.l.t.* (mm) Głębokośc mięśnia (mm)	25	51.72	6.74	39	51.08	5.17	17	51.00	4.20	32	50.15	4.59	10	53.40	4.06
% lean meat (%) Mięso chude (%)	25	61.57	1.54	39	60.72	1.50	17	61.63	1.05	32	60.78	1.92	10	60.71	1.26

Table 1 continued – ciąg dalszy tabeli 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ultrasound during the 1st successful mating – Ultradźwięki podczas 1. pomyślnego okresu godowego															
Age during the 1st successful mating (days) Wiek podczas 1. pomyślnego okresu godowego (dni)	25	277.2	32.45	39	263.1	34.28	17	288.5	41.95	32	267.9	41.00	10	253.8	35.96
Gain from birth (g) Przyrost od urodzenia (g)	25	540	50.0	39	550	50.0	17	570	70.0	32	600	60.0	10	580	70.0
Back fat thickness (mm) Grubośc słoniny (mm)	25	13.4	3.0	39	14.0	2.6	17	15.0	2.9	32	14.7	3.5	10	14.5	2.7
Muscle depth *m.l.l.t.* (mm) Głębokośc mięśnia (mm)	25	56.28	5.12	39	56.10	5.80	17	57.53	5.92	32	56.41	5.77	10	53.40	3.41
% lean meat (%) Mięso chude (%)	25	58.27	2.88	39	57.67	2.48	17	56.84	2.91	32	57.11	3.27	10	56.88	2.58
Trait Cecha	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x
Piglets on 1st litter (number) – Prosięta na 1. miot (liczba)															
All Wszystkie	25	10.04	2.96	39	9.36	3.01	17	11.05	2.88	32	8.74	3.71	10	9.40	3.17
Alive Żywe	25	8.96	2.78	39	8.46	2.79	17	9.84	2.73	32	7.58	3.34	10	8.70	3.27
Weaned Odchowane	25	8.44	2.36	39	7.84	2.37	17	9.06	2.08	32	7.03	3.15	10	7.90	2.56

Table 2. Basic statistical characterizations of chosen reproductive and productive traits in different phase of reproductive cycle in CLW gilts with an origin from 5^{th}-11^{th} litter

Tabela 2. Podstawowa charakterystyka statystyczna wybranych cech reprodukcyjnych i produkcyjnych w różnych fazach cyklu reprodukcyjnego u loszek rasy Czeskiej Wielkiej Białej pochodzących z 5. do 11. miotu

Litter order Kolejność miotu	6. litter – 1. miot			7. litter – 7. miot			8. litter – 8. miot			9. litter– 9. miot			11. litter – 11. miot		
Trait Cecha	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Performance test – Test wartości użytkowej															
Gain from birth (g) Przyrost od urodzenia (g)	13	620.7	50.86	4	641.0	41.11	6	629.5	41.92	7	626.4	65.42	2	645.5	65.76
Gain in performance test (g) Przyrost wartości testu wartości użytkowej (g)	13	892.4	84.21	4	914.0	110.0	6	830.7	24.70	7	875.6	73.45	2	919.0	38.18
Back fat thickness (mm) Grubość słoniny (mm)	13	7.4	1.8	4	7.6	1.5	6	10.2	0.8	7	9.0	0.9	2	9.3	0.4
Muscle depth *m.l.l.t.* (mm) Głębokość mięśnia (mm)	13	54.62	7.46	4	53.00	2.83	6	47.00	4.00	7	52.00	5.10	2	44.00	7.07
% lean meat (%) Mięso chude (%)	13	62.48	2.13	4	62.01	1.15	6	58.89	0.84	7	60.49	1.03	2	59.78	1.10

Table 2 continued – ciąg dalszy tabeli 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Ultrasound during the 1st successful mating – Ultradźwięki podczas 1. pomyślnego okresu godowego															
Age during the 1st successful mating (days) Wiek podczas 1. pomyślnegp okresu godowego (dni)	13	280.5	46.43	4	293.0	47.58	6	251.3	34.35	7	266.0	38.47	2	210.5	14.85
Gain from birth (g) Przyrost od urodzenia (g)	13	550	70.0	4	560	50.0	6	590	30.0	7	560	80.0	2	600	110.0
Back fat thickness (mm) Grubość słoniny (mm)	13	13.8	2.9	4	16.3	3.2	6	16.2	3.4	7	16.3	3.5	2	12.3	3.2
Muscle depth *m.l.l.t.* (mm) Głębokość mięśnia (mm)	13	55.23	7.53	4	58.25	6.99	6	52.50	2.26	7	56.57	5.06	2	55.00	7.07
% lean meat (%) Mięso chude (%)	13	57.69	2.26	4	55.80	2.40	6	55.12	3.10	7	55.46	3.22	2	59.20	2.12
Trait Cecha	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x	n	Mean Średnia	s_x
Piglets on 1st litter (number) – Prosięta na 1. miot (liczba)															
All Wszystkie	13	8.92	3.45	4	8.50	1.29	6	8.50	2.26	7	9.57	1.90	2	12.00	1.42
Alive Żywe	13	7.84	3.18	4	7.25	1.71	6	7.33	0.52	7	8.14	2.73	2	11.50	0.71
Weaned Odchowane	13	7.00	3.39	4	7.25	1.71	6	7.33	0.52	7	7.29	2.21	2	9.50	0.71

The lowest age during the first successful mating was found in gilts from the 11th litter (210.5 days) and from the 8th litter (251.3 days). Gilts from the 11th litter had a better growth ability. The highest backfat thickness during the first successful mating was found in gilts from the 7th litter and the 9th litter (16.3 cm) in weight during measuring by ultrasound 162.88 kg and 147.93 kg. Gilts from these litters had the fist successful mating for 55-83 days later than gilts from 11th and 8th litters, which had the first successful mating sooner.

Gilts from the 11th litter had on average 12.00 of all born piglets, 11.50 alive born and 9.50 weaned piglets. Gilts from the 3rd litter had 11.05 of all born piglets, 9.84 alive born and 9.06 weaned piglets. Gilts from the 1st litter had 10.04 of all born piglets, 8.96 alive born and 8.44 weaned piglets. Whittemoore et al. [20] draw attention to sufficient backfat thickness in sows of the first litter, which guarantees successful reproductive efficiency of the second litter as well.

Gilts from the 7th litter had, on average, 3.50 of all born piglets less (8.50) and 4.25 alive born piglets less (7.25) than the gilts with the highest phenotypic level of reproductive traits in division according to the litter order. This group of gilts showed the lowest gain from birth to the date of farrowing (500 g per animal per day). Čeřovský [3] reports on stagnation of gain in gilts after the end of performance test significantly prolonging the period from birth to the first insemination.

Sows from the 11th litter weaned the highest number of piglets (9.50). Sows from the 5th litter reached 7.90 weaned piglets. There were some tendencies of decreasing fertility according to growing litter order of sows origin, but the differences between the fertility parameters studied were not significant. Czarnecki [2] did not find an influence of litter order of sows origin on their fertility either; sows from the first till the seventh litter did not show a significant difference in fertility. Sows from the 7th litter had more litters during their life than sows from the 1st-4th litter ($P < 0.05$). Pavlík [16] did not find more expressive influence of litter order of sows origin on the results of reproduction either. Jarczyk [8] found in his study that sows from the 3rd litter reached the highest fertility and sows from the 5th litter – the lowest values of fertility traits.

4. CONCLUSIONS

An analysis of sows fertility according to a litter order of sows origin was performed in experimental group of Czech Large White sows. There were not found significant differences among the traits studied (number of all born piglets, number of alive and number of weaned piglets) by testing the diametral difference of determined phenotypic values. There were only some tendencies when better fertility was reached by gilts which originated from the 6th and 7th litter.

Acknowledgements
The research was supported by the project MZe QF 3218.

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