KRMIVA

GENETIC PARAMETERS OF REPRODUCTION TRAITS OF PROLIFIC AND CONVENTIONAL PUREBRED PIGS

GENETSKI PARAMETRI REPRODUKCIJSKIH SVOJSTAVA VISOKO PLODNIH I KONVENCIONALNIH PASMINA SVINJA

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ABSTRACT

Trials were performed on four farms including 1887 highly fertile Landrace and Yorkshire sows, and 24 boars of Danish origin, or 6324 consecutive parities, in the period from 2009 to 2011. In evaluating genetic parameters of conventional Landrace and Yorkshire breeds 3628 sows were included mating with 48 males or the total of 12344 litters. Estimated genetic parameters of litter size traits show the similar tendency and the regulatory of the purebred sows that produce 11-15 weaned piglets less per sow/year. Environmental factors, HYS, showed significant effect on the examined traits. Heritability and repeatability of alive and stillborn piglets, litter size on the fifth day after birth and number of piglets weaned have a low hereditary traits coefficient whose values vary within the limits of 0.08 to 0.10 for the heritability and from 0.15 to 0.19 for the repeatability. There was a tendency to lower values of genetic parameters in the conventional compared to highly fertile sows. Research suggests that both prolific breeds L and Y sows had first farrowing at the age of one year. This indicates heavier animal at entering the production, which guarantees the continuity of a stable production of pigs and optimal replacement. Conventional selection animals of the same L and Y breeds were at least one month younger at farrowing and of smaller size. This indicates shorter life production and smaller litter size. The differences between genetic parameters of prolificacy and conventional purebred L and Y belong to selection efficiency during generations.

Key words: pigs; genetic parameters; selection differential

INTRODUCTION

Knowing the value of genetic parameters serves breeders, primarily to study the natural activity of genes, namely addition, modeling selection criteria, and selection direction of breeding. The nucleus of the farms is genetically superior material, completely healthy and used to produce desirable effects in the selection of purebred and hybrid animals of both sexes. The current strategy of selection and crossbreeding shows significant improvement when talking about litter size at birth and weaning.

This is obtained by selecting Landrace and Yorkshire, particularly in Denmark, which produce 11-14 more weaned piglets per sow per year over the existing selection. The selection in our conditions showed almost identical pattern. A similar trend

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was also observed in hybrid sows. We analyzed the value of genetic parameters in sow population that were highly fertile and of the same breed of national selection, which produce significantly fewer piglets per unit of time.

The purpose of this study is to analyze the values of genetic parameters for the traits: weight and litter size at birth and weaning in sows with a high level of fertility compared to the conventional local selection of the same breed.

MATERIALS AND METHODS

The study was carried out on 1567 Landrace and Yorkshire sows, and 24 boars of Danish origin, born in our midst, or 5294 consecutive parities, in the period from 2009 to 2011. Studies of evaluations of genetic parameters of conventional Landrace and Yorkshire breeds included 2987 sows mated with 46 boars or 11 674 litters in the same period.

To correct the impact of environmental factors, a mixed model equation (MME), was used, model 1:

$$Y_{ijkl} = \mu + F_i + HYS_{ij} + P_{ijk} + E_{ijkl}$$

Y_{ijkl} – the observed traits;
μ - general mean value;
F_i – random sire (father) effects;
HYS_{ij}–fixed effect of differences between farms, years and seasons;
P_{ijk} – effect of farrowing-parity;
E_{ijkl} – random error.

The traits treated are as follows: age of sows at first farrowing, number of alive and stillborn piglets, live born piglets on fifth day after birth, litter size and weight at weaning. The length of lactation was 28 days. Diet of lactating sows was ad libitum of efficient technology, according to stage of lactation and production. Technology of diet was the same at all stages of production and farming.

The selection differential was measured by formula:

$$S = i \times \delta_p$$

$$i = S / \delta_p$$

i = standardized selection differential;
$\delta_{p=}$ phenotypic standard deviation;
S= selection differential.

RESULTS AND DISCUSSION

The research results are shown in tables 1-10 and figures 1-2. Results of F-test show a significant difference between sires on observed trait. All fixed factors (FYS) had significant effects. Similar laws have been found by Vidović et al. (2011), Vidović and Lukač (2010), Vincek (2005), Vidović (1976). This indicator shows that despite the modern conditions of keeping pigs in a farm where automatic control of production parameters such as light, humidity and temperature, are not balanced with females genome. It means it is necessarily to improve and optimize environment factors. Parity had a significant impact on the observed traits of both conventional as and highly fertile sows meaning that further studies are needed to stabilize the genome of these breeds. Heritability and repeatability were not significantly different comparing highly fertile to conventional selection of breeds which have much lower genetic potential Vidović et al. (2011a), Vidović et al. (2011b), Tretinjak et al. (2009); Chen et al. (2003), Lucia et al. (2002), Crump et al. (1997), Gordon (1997), Hue et al. (1993). This justifies the use of new knowledge in optimization of environment, technology of feeding sows and age with weight when introducing them into reproduction (Višnjić et al., 2012; Vidović and Šubara, 2011).

Age of fertile sows at first parity was 366 in Landrace and 372 days in Yorkshire. The difference is not significant. Sows of conventional Landrace and Yorkshire were younger 32 and 42 days compared to highly fertile. Indirectly, conventional sows were lighter at insemination and farrowing by 29-32 kg of body weight. Litter size at birth and weaning did not differ significantly in some parity between the two fertile breeds, but within a breed with the expected trend, and therefore had identical criteria for selection. There were no differences in weight or the number of piglets at weaning. Number of piglets on the fifth day was smaller than the number of live born by 0.7. These differences arise from small piglets. It can be the consequence of high selection pressure by increasing the genotype of these traits, i.e., more piglets at birth, and possibly optimal nutrition during gestation to produce uniform piglets. Also, this is partly a consequence of the lack of milk for such a large number of born piglets. These two traits are important and open questions for future work of breeders and nutritionists.

Table 1: Litter size of prolific and conventional type of Landrace

Tablica 1. Veličina legla visoko plodnog i konvencionalnog tipa landras

Farrowing-Prašenje	Prolificacy-Visoko plodne			Conventional-Konvencionalne		
	Live born - Živih	Stillborn - Mrtvih	Weaned - Odbijenih	Live born - Živih	Stillborn - Mrtvih	Weaned - Odbijenih
1.	13.6	2.1	12.8	10.6	0.8	9.4
2.	14.2	2.3	13.1	11.1	1.0	10.5
3.	14.5	2.4	13.2	11.6	1.3	10.9
4.	14.4	2.4	13.6	11.9	1.6	11.2
5.	14.1	2.6	13.4	12.2	1.8	11.5
1+2+3+4+5	14.3	2.4	13.3	11.2	1.6	10.8

Table 2: Litter size of prolificacy and conventional tipy of Yorkshire

Tablica 2. Veličina legla visoko plodnog i konvencionalnog tipa jorkšir

Farrowing - Prašenje	Prolificacy-Visoko plodne			Conventional- Konvencionalne		
	Live born - Živih	Stillborn - Mrtvih	Weaned - Odbijenih	Live born - Živih	Stillborn - Mrtvih	Weaned - Odbijenih
1.	13.3	2.1	12.7	10.4	0.7	9.2
2.	13.8	2.2	13.0	11.0	1.0	10.3
3.	14.2	2.4	13.1	11.4	1.5	10.7
4.	14.0	2.3	13.5	11.8	1.6	11.0
5.	13.8	2.5	13.4	12.1	1.7	11.4
1+2+3+4+5	13.9	2.3	13.1	11.3	1.6	10.6

Table 3: The heritability of litter size of prolificacy Landrace breed

Tablica 3. Heritabilnost veličine legla visoko plodne pasmine landras

Farrowing - Prašenje	Age at farrowing - Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5^{th} day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.14	0.10	0.03	0.09	0.02	0.11
2.	-	0.11	0.02	0.09	0.03	0.10
3.	-	0.09	0.04	0.09	0.01	0.10
4.	-	0.08	0.03	0.08	0.03	0.09
5.	-	0.09	0.02	0.10	0.02	0.08
1+2+3+4+5	-	0.10	0.03	0.08	0.02	0.10

Table 4: The heritability of litter size at conventional type of Landrace

Tablica 4. Heritabilnost veličine legla konvencionalnog tipa landras

Farrowing - Prašenje	Age at farrowing - Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5th day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.12	0.10	0.03	0.09	0.01	0.10
2.	-	0.09	0.02	0.07	0.02	0.10
3.	-	0.09	0.02	0.08	0.02	0.09
4.	-	0.08	0.03	0.08	0.01	0.08
5.	-	0.07	0.02	0.08	0.03	0.06
1+2+3+4+5	-	0.10	0.03	0.08	0.03	0.09

Table 5: The heritability of litter size of prolificacy Yorkshire breed

Tablica 5. Heritabilnost veličine legla visoko plodne pasmine jorkšir

Farrowing - Prašenje	Age at farrowing- Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5th day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.12	0.10	0.03	0.07	0.02	0.10
2.	-	0.08	0.02	0.08	0.02	0.10
3.	-	0.08	0.04	0.09	0.02	0.09
4.	-	0.09	0.03	0.09	0.01	0.08
5.	-	0.09	0.02	0.07	0.02	0.08
1+2+3+4+5	-	0.10	0.03	0.08	0.02	0.09

Table 6: The heritability of litter size of conventional type of Yorkshire

Tablica 6. Heritabilnost veličine legla konvencionalnog tipa jorkšir

Farrowing - Prašenje	Age at farrowing - Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5th day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.14	0.10	0.04	0.10	0.02	0.10
2.	-	0.08	0.05	0.08	0.01	0.08
3.	-	0.06	0.02	0.09	0.02	0.07
4.	-	0.08	0.03	0.07	0.02	0.07
5.	-	0.08	0.03	0.07	0.01	0.06
1+2+3+4+5	-	0.09	0.03	0.08	0.02	0.07

Table 7: The repeatability of litter size of prolificacy Landrace

Tablica 7. Ponovljivost veličine legla visoko plodne pasmine landras

Farrowing - Prašenje	Age at farrowing - Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5th day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.21	0.15	0.09	0.14	0.04	0.18
2.	-	0.15	0.09	0.15	0.04	0.18
3.	-	0.16	0.09	0.15	0.04	0.17
4.	-	0.18	0.07	0.17	0.02	0.17
5.	-	0.18	0.07	0.17	0.03	0.16
1+2+3+4+5	-	0.17	0.08	0.16	0.04	0.17

Table 8: The repeatability of litter size of conventional type of Landrace

Tablica 8. Ponovljivost veličine legla konvencionalnog tipa landras

Farrowing - Prašenje	Age at farrowing - Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5th day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.18	0.15	0.08	0.13	0.03	0.16
2.	-	0.16	0.08	0.15	0.03	0.16
3.	-	0.15	0.09	0.16	0.04	0.17
4.	-	0.17	0.07	0.15	0.04	0.17
5.	-	0.18	0.08	0.17	0.05	0.18
1+2+3+4+5	-	0.17	0.08	0.15	0.05	0.18

Table 9. The repeatability of litter size of prolificacy Yorkshire breed

Tablica 9. Ponovljivost veličine legla visoko plodne pasmine jorkšir

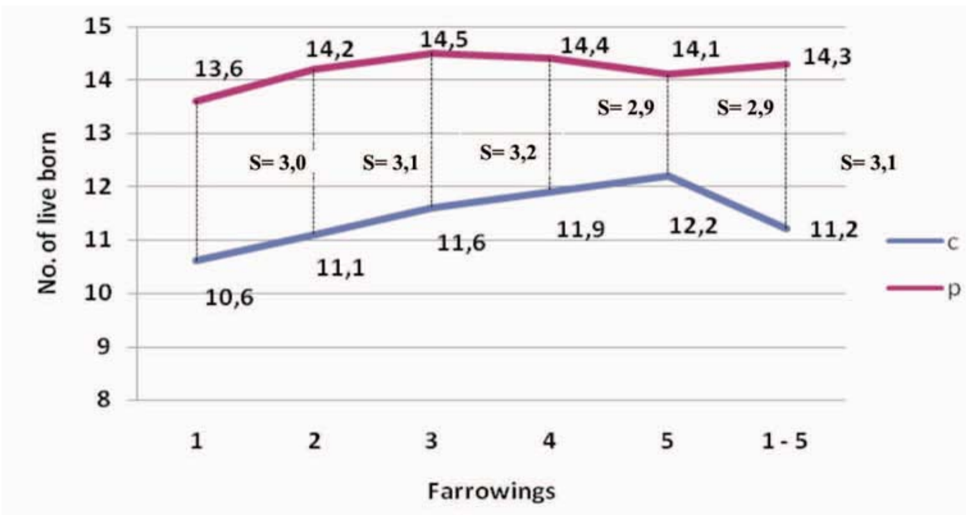
Farrowing - Prašenje	Age at farrowing - Dob kod prašenja	Born – Rođeno			Weaned - Odbijeno	
		Live born - Živih	Still born - Mrtvih	5th day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.19	0.14	0.09	0.14	0.03	0.18
2.	-	0.15	0.10	0.14	0.04	0.18
3.	-	0.15	0.09	0.16	0.05	0.17
4.	-	0.17	0.06	0.17	0.03	0.17
5.	-	0.20	0.07	0.19	0.03	0.16
1+2+3+4+5	-	0.17	0.09	0.17	0.04	0.17

Table 10. The repeatability of litter size of conventional type of Yorkshire

Tablica 10. Ponovljivost veličine legla konvencionalnog tipa jorkšir

Farrowing-Prašenje	Age at farrowing - Dob kod prašenja	Born - Rođeno			Weaned - Odbijeno	
		Live born - Živih	Stillborn - Mrtvih	5^{th} day - 5.og dana	Losses - Uginulih	Weaned - Odbijenih
1.	0.19	0.14	0.07	0.14	0.02	0.15
2.	-	0.15	0.08	0.15	0.03	0.16
3.	-	0.15	0.08	0.16	0.04	0.17
4.	-	0.17	0.08	0.16	0.05	0.17
5.	-	0.19	0.08	0.15	0.05	0.18
1+2+3+4+5	-	0.18	0.07	0.16	0.04	0.17

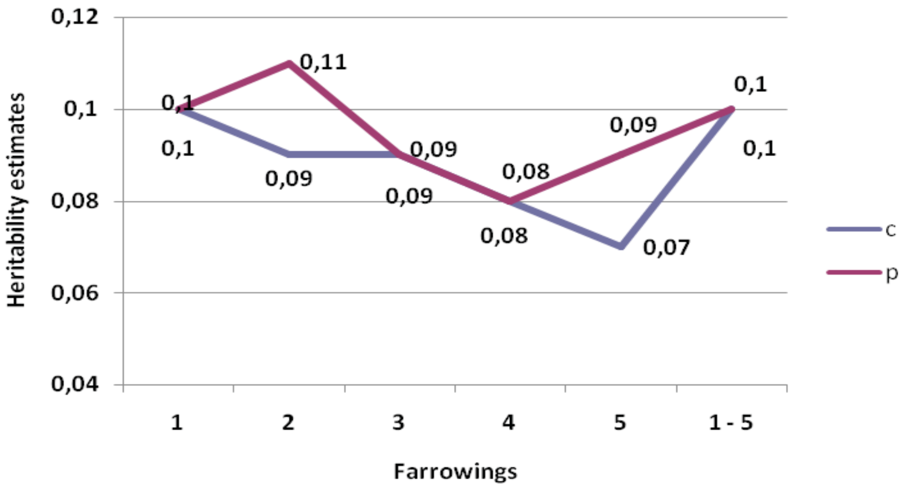
Almost the same figure applies to conventional breeds. However, a highly fertile breed, on average, has higher values of genetic parameters for all analyzed properties, which is considered the contribution of selection. Selection differential was the same as standardized one showing significant differences between prolificacy and conventional selection of sows. In spites of statistical differences between two types of selection criteria, genetic parameters did not shown significant differences. It means that selection criteria are very important the same as intensity of selection and generation interval. Feeding regime, effect of age, weight and curve of feeding sows during different reproductive phases have a significant influence, which is part of management.



c – conventional pig types – konvencionalni tip svinja
p – prolific pig types – visoko plodni tip svinja

Graph 1: Selection differential of live born pigs of conventional and prolific types

Grafikon 1. Selekcijski diferencijal za živorođenu prasad konvencionalnih i visoko plodnih tipova svinja



c – conventional pig types – konvencionalni tip svinja
p – prolificacy pig types – visoko plodni tip svinja

Graph 2: Heritability estimates of live born pigs of conventional and prolific types

Grafikon 2. Heritabilnost za živorođenu prasad konvencionalnih i visoko plodnih tipova svinja

CONCLUSIONS

Research suggests that sows of both prolificacy breeds L and Y sows have the first litter had at the age of one year. This indicates heavier females at the entrance to the production, which guarantees the continuity of a stable production of pigs and optimal replacement. Conventional selection animals of the same L and Y breeds were at least one month younger and of smaller size. As a consequence they indicate shorter life production and smaller litter size. Genetic parameters indicate that reproduction belongs to low-hereditary traits regardless of the level of genetic potential and significantly larger litters than the conventional selection animals of these breeds in our conditions. The data justify the use of new information technologies in the area of feeding sows, and optimization of stall parameters, e.g. humidity, air velocity, temperature and light, which significantly affect the development of the genome. A particularly important aspect is the adaptation of modern management in production at the farm. As expected the repeatability values were significantly higher than heritability. The differences between genetic parameters of prolificacy and conventional purebred L and Y belong to selection efficiency during generations.

Selection differential is nearly the same as standardized one showing significant differences between prolificacy and conventional selection of sows. In spite of statistical differences between two types of selection criteria genetic parameters did not show significant differences. It means that selection criteria are very important the same as intensity of selection and generation interval as well. Feeding regime, effect of age, weight and curve of feeding sows during different reproductive phases have a significant influence, which is part of management.

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SAŽETAK

Istraživanja su provedena na četiri farme, i obuhvatila su 1887 visoko plodnih krmača pasmine landras i jorkšir parenih s 24 nerasta danskog porijekla, ili 6324 uzastopna prašenja u razdoblju 2009. - 2011. U procjeni genetskih parametara konvencionalnih pasmina landrasa i jorkšira bilo je uključeno 3628 krmača koje su parene sa 48 nerasta, ili ukupno 12344 legala u istom razdoblju. Procijenjeni genetski parametri za veličinu legla pokazuju sličnu tendenciju i zakonitost čistih pasmina plotkinja koje proizvode 11-15 zalučene prasadi manje po krmači godišnje. Heritabilnost i ponovljivost, u oba tipa krmača, za broj živooprašene i mrtvooprašene prasadi, veličinu legla i broj prasadi u leglu 5.og dana nakon rođenja, kao i broj odbijene prasadi, su niskog koeficijenta nasljednosti, čija je vrijednost u granicama 0,08–0,10 za heritabilnost, i 0,15-0,19 za ponovljivost. Prema očekivanju, procijenjene vrijednosti ponovljivosti bile su znatno veće od heritabilnosti. Genetski parametri pokazuju da su reproduktivna svojstva niskog stupnja nasljednosti, bez obzira na nivo genetskog potencijala, tj selekcijskog diferencijala. Razlike između farmi, godina i sezona, tehnologija prehrane i menadžmenta pokazale su signifikantan utjecaj na ispitivana svojstva. Konvencionalne selekcije landrasa i jorkšira bile su najmanje mjesec dana mlađe, po masi lakše, imale su manje leglo i nižu dugovječnost. Dob i razvijenost plotkinje na ulazu u proizvodnju koja garantira kontinuiranu stabilnost proizvodnje i optimalan remont stada od signifikantnog su značenja. Korištenje novih tehnologija u oblasti prehrane krmača i optimiranju parametara kao što su relativna vlažnost zraka, brzina kretanja zraka, temperature i svjetlosti opravdano je jer znatno utječe na razvoj genoma životinje.

Ključne riječi: svinje; genetski parametri; selekcijski diferencijal