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FERTILITY TRAITS OF SOWS BY GENOTYPES IN C. SERBIA

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Invited paper

Abstract

The aim of the research was to determine the fertility of purebred sows (Large White -LW, Landrace -L, Swedish Landrace -SL, Danish Landrace - DL, Duroc -D, Pietrain -P, Hampshire -H, Norwegian Landrace -NL, German Landrace -Ne.L.) and seven F1 hybrid genotypes (Landrace and Large White). The influence of genotype and parity of sows on litter size traits (Number of live born piglets -NLBP, number of stillborn piglets -NSP, total piglets born -TPB, number of reared piglets and litter weight) and lactation duration was examined. Research showed that the highest number of live born piglets was in F1 crossbreeds (13.36 NLBP), while among purebreds the highest NLBP was in the Landrace breed (12.44 NLBP) and Large White (12.17 NLBP). Looking at parities for all tested genotypes, NLBP in the first litter was over 11.53 piglets. For breed L and LW, the highest NLBP was in the fourth litter 12.88 and 12.55 piglets. F1 crosses LxLW (♀Lx♂LW) also had the highest NLBP in the fourth litter 12.85 piglets. For the genotype F1 crosses LWx L (♀LWx♂L), the highest average number of live-born piglets was 12.32 piglets in the second and third litters. Variation in litter size at birth and weaning by genotype and parity was statistically significant ($P<0.01$), except for the number of stillborn piglets of L sows by parity, where a significant difference was found ($P<0.05$).

Keywords:live born piglets, stillborn piglets,reared piglets,litter weight, parity

Introduction

Every production should be based on the basic economic principle of maximum productivity, economy and profitability. In other words, every agricultural producer in modern conditions of production should achieve high and stable yields of good quality, while preserving the environment, and having minimal investments and achieving maximum profit. In the Republic of Serbia, there is a great potential for growing a significantly larger number of pigs, that is, preconditions for an economically justified increase in production. This is primarily due to the available domestic raw material base for animal nutrition and due to preserved old and newly installed production capacities in the complete production chain, from farms to processing capacities. In our country, pork production is very important because the share of pork makes up 58.7% of the total production of all types of meat in our country (Radović et al., 2022). Many factors affect the economy, that is, sustainable development. Economic results in pig production

depend on numerous factors of a genetic and non-genetic nature, whether it is the production and rearing of young pigs, the production of fattening pigs with a large proportion of meat in half and good physico-chemical and technological properties of the produced meat.
In light of the above, there is an obvious need for continuous research and monitoring of indicators of fertility, growth intensity and meat yield, in order to determine heritability, genetic and phenotypic correlations as precisely and accurately as possible, since most quantitative traits are influenced by numerous genes at different loci (Radović et al. 2013). The importance of pork production in the framework of world livestock production, both in terms of the volume of production and in terms of the economic effects that are realized in this branch of livestock production, is largely based on the fertility that characterizes this type of domestic animals (in addition to intensive growth, efficient use of food and very favorable tissue structures in the trunk). Fertility of pigs, as a species, is limited in sows by the number of ovulated eggs, the capacity of the uterus and the ability of the embryo to survive, on the one hand, as well as the duration of the individual stages of the reproductive cycle on the other hand, and in this sense, the parameters that characterize the fertility of boars such as libido, volume of ejaculate, concentration and motility of spermatozoa. The effects of selection on litter size traits are limited mainly by the low heritability coefficient, as well as by the fact that these are sex-determined traits (they are manifested only in females) that are manifested relatively late in the productive life. Additionally, the negative correlation between direct additive (reliably hereditary) and maternal effects, as well as the relatively low intensity of selection, which is usually the result of a high overhaul percentage, leads to a reduction in effects. From the perspective of assessing the total reproductive potential of sows, it is necessary to look at and record the number of stillborn piglets, that is, to determine the total number of piglets born in the litter. Although the appearance of a certain number of mummified and stillborn piglets is relatively frequent and common, it is very important to determine the reasons that led to its manifestation. They can be various infectious diseases of sows, inadequate treatment and procedure during farrowing, inadequate nutrition and quality of feed for sows during farrowing, high coefficient of kinship between sows and farrowings, poor housing conditions and microclimate in facilities for sows, and they can also be hereditary. character. Proper detection of the causes of stillbirths is a prerequisite for taking measures and procedures to eliminate them and, in this way, increase the litter size at farrowing. The number of reared piglets is essentially the most important feature of pig fertility, because it represents the final result of the technological phase of pig reproduction.

Material and methods

Research included purebred sows (Large White -LW, Landrace -L, Swedish Landrace -SL, Danish Landrace -DL, Duroc -D, Pietrain -P, Hampshire -H, Norwegian Landrace -NL, German Landrace -Ne.L.) and seven genotypes of the F1 generation (Landrace and Large White). Of the total number (n=25391) of litters, the largest number was of the Large White breed (11588 litters). The traits of litter size (Number of live born piglets -NLBP, number of stillborn piglets -NSP, total piglets born -TPB, number of reared piglets and Litter weight) and lactation duration were examined. For the genotypes with the highest number of litters, an analysis of the litter size by sow parities was performed. The statistical package IBM SPSS Statistics 20 was used for data processing. Two models of variance analysis were used in order to determine the significance ($P<0.01$) of genotype

(Gi =1,...16) and patency of sows (Pi =1,...10). on the studied characteristics of litter size and duration of the lactation period.
Model 1: $Yi = \mu + G_i + e_j$and
Model 2: $Yi = \mu + P_i + e_j$.

Results and discussion

Table 1 shows the size of the litter at birth for the tested genotypes. Out of the total number of litters (table 1), the largest number is of sows of the Large White breed (VJ; 45.64%), while the share of Landrace litters was 14.16%. The highest proportion of crossbred sows was recorded with genotype F1 ♀LWx♂L (15.00%) and F1 ♀Lx♂LW (11.76). The highest fertility was in F1 crosses where the mother and father were Large White and Danish Landrace, respectively (13.36 live-born piglets), while the lowest number was in the Pietren and Durok breeds (10.99 and 10.95 live-born piglets). Variation in litter size at birth by genotype was statistically significant (P<0.01).

Table 1. Average values and variability of fertility traits of sows by genotypes

Genotype [1)]	*Number of litters*	NLBP[2)]		NSP		TPB	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
SL	193	11.64	1.92	0.19	0.65	11.83	2.04
H	13	11.31	1.60	0.00	0.00	11.31	1.60
P	206	10.99	2.34	0.51	0.90	11.50	2.35
NL	41	11.49	1.40	0.22	0.61	11.71	1.62
Ne.L	20	10.35	0.81	0.05	0.22	10.40	0.82
L	3596	12.44	2.43	0.43	0.87	12.87	2.53
DL	399	12.33	3.78	1.34	1.88	13.66	4.21
D	342	10.95	2.28	0.60	1.04	11.55	2.32
LW	11588	12.17	2.32	0.37	0.84	12.54	2.45
F1♀NLx♂LW	177	12.82	2.44	0.42	0.86	13.24	2.58
F1♀LWx♂DL	682	13.36	3.53	1.32	1.74	14.69	3.93
F1♀DLx♂LW	1242	13.36	3.82	1.34	1.71	15.48	1.44
F1♀LWx♂L	3808	12.10	2.37	0.58	0.94	12.68	2.57
F_1♀NeL♂LW	33	13.09	2.39	0.82	1.16	13.91	2.93
F_1♀Lx♂LW	2985	12.33	2.52	0.57	1.00	12.90	2.70
F_1♀LW♂NeL	66	10.83	1.33	0.24	0.86	11.08	1.49
$\sum/\overline{X}$	25391	12.28	2.55	0.53	1.03	12.84	2.66
F		38.36**[3)]		114.7**		130.43**	

[1)]LW - Large White, L –Landrace, SL - Swedish Landrace, DL- Danish Landrace, D –Duroc, P-Pietrain, H- Hampshire, NL- Norwegian Landrace, Ne.L.- German Landrace; [2)]NLBP- Number of live born piglets, NSP- Number of stillborn piglets, TPB-Total piglets born; [3)]**P<0.01

The size of the litter at farrowing (number of reared piglets and weight of the litter at farrowing) and the duration of lactation by genotypes are shown in table 2. The highest number of reared piglets was in the Danish Landrace 11.77 and in the F1 crossbreed where the mother and father are Large White and Danish Landrace, respectively (11.75 and 11.71 reared piglets) The lowest number of reared piglets was in the breed German Landrace (9.63 reared piglets) and Hampshire (10.23 reared piglets) with the longest duration of lactation of 36 days. The average duration of

lactation for the examined genotypes was 32.78 days. Variation in litter size at weaning and duration of lactation by genotypes was statistically significant (P<0.01).

Table 2. Average values and variability of lactation duration, number of reared piglets and litter weight by genotypes

Genotype [1)]	*Number of weaned litters*	*Lactation duration. days*		*Number of reared piglets*		*Litter weight. kg*	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
SL	173	33.36	3.84	10.82	1.91	99.20	19.01
H	13	36.92	3.40	10.23	1.79	100.62	16.16
P	201	32.86	3.63	10.59	1.45	96.91	15.54
NL	38	34.11	2.95	10.32	1.04	89.97	10.95
Ne.L	19	36.32	3.61	9.63	1.21	92.15	14.80
L	3357	33.84	7.37	11.22	1.65	99.32	18.80
DL	375	30.08	7.32	11.77	1.83	77.81	18.30
D	324	32.70	4.58	10.51	1.48	93.26	16.70
LW	10903	33.03	4.70	11.31	1.82	99.33	19.55
F1♀NLx♂LW	164	33.38	2.60	11.12	1.66	97.16	14.32
F1♀LWx♂DL	655	31.30	7.96	11.71	1.93	79.70	19.65
F1♀DLx♂LW	1172	32.24	8.46	11.75	1.96	76.44	17.83
F1♀LWx♂L	3642	31.27	4.76	11.38	1.77	96.49	17.58
F_1♀NeL♂LW	31	33.32	3.69	11.61	1.80	96.06	9.82
F_1♀Lx♂LW	2841	32.96	3.63	11.09	1.62	99.00	17.42
F_1♀LW♂NeL	61	33.74	2.77	10.41	1.16	92.09	10.18
$\sum/\overline{X}$	23969	32.78	5.49	11.30	1.78	96.57	19.65
F		36.70**[2)]		22.06**		155.71**	

[1)] LW - Large White, L –Landrace, SL - Swedish Landrace, DL- Danish Landrace, D –Duroc, P-Pietrain, H-Hampshire, NL- Norwegian Landrace, Ne.L.- German Landrace; [2)] **P<0.01

Table 3. Average values and variability of fertility traits of L sows by parity

Parity	*Number of litters*	NLBP[1)]		NSP		TPB		NRP*	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
1	476	11.68	2.17	0.33	0.71	12.01	2.22	10.84	1.42
2	623	12.51	2.55	0.33	0.75	12.84	2.65	11.34	1.66
3	548	12.84	2.68	0.42	0.79	13.26	2.78	11.62	1.78
4	503	12.88	2.61	0.51	1.02	13.39	2.64	11.58	1.79
5	396	12.79	2.30	0.50	0.89	13.29	2.42	11.40	1.70
6	343	12.70	2.11	0.45	0.96	13.15	2.17	11.27	1.48
7	257	12.29	2.10	0.46	1.00	12.76	2.25	10.87	1.45
8	198	12.00	2.08	0.46	0.93	12.45	2.38	10.76	1.25
9	143	11.68	2.31	0.48	0.92	12.15	2.23	10.50	1.51
≥10	109	11.66	2.36	0.51	0.83	12.17	2.44	10.44	1.70
$\sum/\overline{X}$	3596	12.44	2.43	0.43	0.87	12.87	2.53	11.22	1.65
F		10.375**		2.0104*		10.899**		13.639**	

[1)]NLBP-Number of live born piglets, NSP-Number of stillborn piglets, TPB-Total piglets born, NRP-Number of reared piglets (of 3357 weaned litters); P<0.05, ** P<0.01*

The variation in the litter size of the Landrace breed at birth and farrowing by sow parities is shown in table 3. In the above table, we see that the average number of live-born piglets from the second to the eighth parity was over 12 live-born piglets. The highest number of piglets born alive was in the fourth parity, 12.88. The number of reared piglets was the highest from the second to the sixth parity and the highest in the third parity (11.62 reared piglets). Variation in litter size at birth and weaning by parity was statistically significant (P<0.01) except for the number of stillborn piglets where a significant difference was found (P<0.05).
Table 4 shows the variation in litter size by birth and weaning parities for the Large White breed. The highest average number of live-born piglets (over 12 live-born piglets) was, as for the Landrace breed, from the second to the eighth parity, while the number of reared piglets of over eleven was from the first to the ninth parity (the highest number reared on 11.52 and 11.53 in the fourth and fifth parity). The highest number of piglets born alive was in the fourth parity, 12.88. The number of reared piglets was the highest from the second to the sixth parity and the highest in the third parity (11.62 reared piglets). Variation in litter size at birth and weaning by parity was statistically significant (P<0.01) except for the number of stillborn piglets where a significant difference was found (P<0.05).

Table 4. Average values and variability of fertility traits of LW sows by parity

Parity	*Number of litters*	NLBP [1)]		NSP		TPB		NRP*	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
1	1903	11.59	2.00	0.41	0.87	12.00	2.10	11.02	1.67
2	2258	12.12	2.35	0.35	0.82	12.47	2.51	11.30	1.71
3	1889	12.34	2.47	0.39	0.78	12.73	2.64	11.47	1.79
4	1509	12.55	2.52	0.44	0.99	12.99	2.71	11.52	1.88
5	1201	12.42	2.29	0.39	0.87	12.82	2.40	11.53	2.08
6	976	12.38	2.38	0.31	0.79	12.68	2.48	11.40	1.96
7	656	12.27	2.26	0.35	0.77	12.62	2.28	11.34	1.77
8	458	12.14	2.13	0.33	0.77	12.48	2.22	11.17	1.82
9	334	11.95	1.86	0.27	0.78	12.20	1.91	11.06	1.57
≥10	404	11.82	1.76	0.28	0.75	12.10	1.88	10.89	1.56
$\sum/\overline{X}$	11588	12.17	2.32	0.37	0.84	12.54	2.45	11.32	1.82
F		13.893**[2)]		2.675**		13.512**		9.086**	

*[1)]NLBP-Number of live born piglets, NSP-Number of stillborn piglets, TPB-Total piglets born, NRP-Number of reared piglets (*of 2841 weaned litters);** P<0.01*

Large White and Landrace sows (♀Lx♂LW) had the most numerous fourth litter with 12.84 NLBP, while the highest number of TPB was in the third litter (table 5). The average number of NLBP in the second and third litters (12.32 NLBP) and the highest number of NRP of 11.68 piglets were the same for crossbred sows whose sire was a landrace breed. Variation in litter size at birth and weaning by parity was statistically significant (P<0.01).
In the research of Živković et al. (2018) with six genotypes, a higher number of live-born piglets was found compared to our research in sows of genotype LW (12.39), as well as the highest number of reared piglets per litter (11.32). For the Polish Large White breed (for four groups of sows) in the first litter, Ward et al. (2021) report a value for NLBP of 10.80 to 11.00 and an average for all

Table 5. Average values and variability of fertility traitsof F_1 crosses LxLW(♀Lx♂LW) by parities

Parity	*Number of litters*	NLBP[1)]		NSP		TPB		NRP*	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1	499	11.81	2.26	0.52	0.88	12.32	2.37	10.97	1.49
2	601	12.35	2.77	0.47	0.89	12.82	2.91	11.31	1.68
3	467	12.84	2.55	0.58	0.96	13.41	2.77	11.27	1.61
4	407	12.85	2.67	0.54	0.94	13.38	2.84	11.18	1.83
5	320	12.54	2.51	0.73	1.12	13.26	2.66	11.12	1.53
6	230	12.33	2.31	0.67	1.13	13.00	2.68	10.86	1.44
7	152	11.90	2.11	0.72	1.04	12.62	2.30	10.80	1.57
8	105	12.42	2.44	0.59	0.99	13.01	2.53	11.14	1.57
9	99	11.62	2.12	0.67	1.01	12.28	2.50	10.72	1.69
≥10	105	11.27	2.52	1.02	2.03	12.29	2.52	10.74	1.39
$\sum/\overline{X}$	2985	12.33	2.52	0.57	1.00	12.90	2.70	11.09	1.62
F		6.879**[2)]		2.64090**		6.732**		4.585**	

[1)]NLBP-Number of live born piglets, NSP-Number of stillborn piglets, TPB-Total piglets born, NRP-Number of reared piglets (*of 2841 weaned litters);** P<0.01

Table 6. Average values and variability of fertility traits of F_1 crosses LWx L (♀LWx♂L) by parities

Parity	*Number of litters*	NLBP[1)]		NSP		TPB		NRP*	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1	613	11.53	2.30	0.44	0.77	11.97	2.43	10.99	1.67
2	657	12.32	2.61	0.48	0.88	12.80	2.77	11.36	1.86
3	675	12.32	2.60	0.57	1.02	12.89	2.86	11.58	1.78
4	550	12.18	2.40	0.63	0.97	12.81	2.59	11.38	1.70
5	465	12.11	2.21	0.58	0.85	12.69	2.44	11.46	1.67
6	388	12.20	1.99	0.76	0.87	12.96	2.19	11.68	1.55
7	191	12.29	2.04	0.80	1.01	13.09	2.20	11.57	1.60
8	110	11.54	2.08	0.65	1.37	12.18	2.13	11.02	1.83
9	85	12.13	2.04	0.56	1.04	12.69	2.09	11.41	2.24
≥10	74	11.76	2.77	0.86	1.88	12.62	3.83	10.30	1.60
$\sum/\overline{X}$	3808	12.10	2.41	0.58	0.96	12.70	2.89	11.40	2.16
F		4.415**		3.73718**		5.362**		5.722**	

*[1)]NLBP-Number of live born piglets, NSP-Number of stillborn piglets, TPB-Total piglets born, NRP-Number of reared piglets (*of 3642 weaned litters);** P<0.01*

litters of NLBP of 11.00 to 11.30, which is significantly less compared to our research (NLBP 12.17 and 11.59 NLBP in first litter). Significantly lower values compared to our research for the number of live born and reared piglets for the genotype Swedish Landrace (10.37 and 8.44 piglets) and crossbreeds F1 Landrace and Large White (10.20 and 8.18) are reported by Kosovac et al. (2005). For the German Landrace, Hellbrugge et al. (2008) report values for NLBP 10.4, NSP 0.8 and 11.2 for TPB which are close to our results for twenty German Landrace litters (10.35 NLBP, 0.05 NSP and 10.40 TPB). In relation to our research, the stated average values for German Landrace traits for NLBP and TPB are significantly lower compared to other Landrace genotypes

that were included in our research. Looking at the genotypes, Logar and Kovač (2001) determined the highest number of live-born piglets (10.37 NLBP) and total births (10.85 TPB) in the Swedish Landrace x Large White genotype (the first designated genotype is the mother), which is significantly less compared to our research for the genotype F1♀Lx♂LW L (12.33. NLBP and 12.90 TPB. Serenius et al. (2003) determined that the Great Yorkshire breed had a slightly higher number of total piglets born compared to the Landrace breed observed from 1-5 parities and that the first piglets were the Large White breed had 10.8±2.7 TPB and the Landrace breed 10.4 ±2.6 TPB. The indicated fertility for these two genotypes of the primrose was significantly lower and with greater variation compared to the same genotype of the primrose in our research (LW-12.00 ±2.10 and L-12.01 ±2.22 TPB).

Conclusion

Research showed that the highest number of live birth piglets was in F1 crossbreeds (13.36 NLBP), while among purebreds the highest NLBP was in the Landrace breed (12.44 NLBP) and Large White (12.17 NLBP). Looking at parities for all tested genotypes, NLBP in the first litter was over 11.53 piglets. For the breed L and LW and in F1 crosses LxLW (♀Lx♂LW), the highest NLBP was in the fourth litter 12.88, 12.55 and 12.85 piglets (in the order of the given gewnotypes). For the genotype F1 crosses LWx L (♀LWx♂L), the highest average number of live-born piglets was 12.32 piglets in the second and third litters. Variation in litter size at birth and weaning by genotype and parity was statistically significant ($P<0.01$), except for the number of stillborn piglets of L sows by parity, where a significant difference was found ($P<0.05$).

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References

Kosovac O., Petrović M., Živković B., Fabjan M., Radović Č. (2005): Uticaj genotipa i prašenja po redu na variranje osobina plodnosti svinja. Biotechnology in Animal Husbandry, 21, 3–4, 61–68.

Logar B., Kovač M.(2001): Dvolastnostni model za velikost gnezda po zaporednih prasitvah pri prašičih. Zbornik Bioethniške fakultete, Univerze v Ljubljani, Kmetijstvo Zootehniko, 78-2, 219-227.

HellbruggeB., TolleH.K., Bennewitz J., Henze C.,.PresuhnU. Krieter J. (2008): Geneticaspectsregardingpigletlossesandthematernal behavior ofsows.Part1.Geneticanalysisofpigletmortality andfertilitytraitsinpigs. Animal, 2008,2:9,1273–1280.

Radović Č., Petrović M., Živković B., Radojković D., Parunović N., Brkić N., Delić N. (2013): Heritability, phenotypic and genetic correlations of the growth intensity and meat yield of pigs. Biotechnology in Animal Husbandry, 29, 1, 75-82.

Radović Čedomir, Ratko Lazarević, Dragan Radojković, Radomir Savić, Nenad Stojiljković, Vladimir Živković, Marija Gogić (2022): Proizvodnja svinja i nove tehnologije za procenu mesnatosti. Zbornik radova Akademije inženjerskih nauka Srbije, Beograd 24-11-2022, 115-127.

Serenius T., Sevón-Aimonen M.L, Mäntysaari E.A. (2003): Effect of service sire and validity of repeatability model in litter size and farrowing interval of Finnish Landrace and Large White populations.Livestock Production Science, 81, 213-222.

Živković V., Radović Č., Gogić M., Cekić B., Marinković M., Stojiljković N., Bijelić Z. (2018): Plodnost krmača različitih genotipova na individualnim gazdinstvima u regionima pogodnim za intenzivnu proizvodnju svinja. Selekcija i semenarstvo, XXIV, 2, 10-15.

Warda A., Rekiel A., Blicharski T., Batorska M., Sońta M., Więcek J. (2021): The Effect of the Size of the Litter in Which the Sow Was Born on Her Lifetime Productivity. Animals, 11, 1525. https://doi.org/10.3390/ani11061525