



PAPER ID: 11A14G



PRODUCTIVE QUALITIES OF HYBRID PIGS

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ARTICLE INFO

Article history:

Received 06 March 2020
Received in revised form 10
June 2020
Accepted 20 July 2020
Available online 10 August
2020

Keywords:

Pig reproductive
qualities; Hybrid piglets;
Crossbred breeding
system; Genotypes pigs;
Pig farming
development; Danish
Landrace boars;
Canadian Landrace
boars; Pig fattening; Pork
quality; Large White;
Yorkshire; Landrace.

ABSTRACT

This research focuses on the reproductive qualities of cross-breeding sows of different breeding options, growth rate and development of hybrid piglets during periods of suckling and nursery, and on the assessment of fattening and meat qualities with different genotypes. The best reproductive performance was observed when crossing crossbred sows (LW x L) with Duroc boars: multiple fertility reached 14 baby piglets, the weight of a piglet 1.6 kg, livability up to weaning 93.8%, live weight before weaning 6.5 kg. Hybrid piglets from the first and second groups were characterized with the best growth rate during suckling and nursery periods; they were obtained from a combination of sows of Large White x Landrace of Canadian and Danish breeding with Duroc boars. Best results in fattening and slaughter qualities of hybrid young animals were obtained with a combination of sows (LW x Y) with Canadian Landrace boars, and also with a combination of sows (LW x Y) with Danish Landrace boars: early maturity 145-146 days, average daily gain 990.4 g, slaughter yield 80.9% and 79.6%, respectively. The length of the carcasses of young animals of the third group in this experiment was larger in comparison to their herd mates in the second and first groups, respectively. Piglets from the second group (LW x L c.) xD had the smallest fat depth, and fattening livestock from the third and fourth groups had the largest one; these animals also had a higher pre-slaughter weight. Fat depth in the second (LW x L c.) xD group was less, compared to the third and the fourth groups. According to research results, for increasing the production of pork and for improving its quality under industrial conditions, it is recommended to use Canadian and Danish Landrace boars at the final stage of crossbreeding in a three-breed combination i.e., Large White x Yorkshire x Landrace.

Disciplinary: Agriculture and Animal Sciences, Swine Science, Pig Husbandry, Pig Farming and Production, Biotechnology.

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1 INTRODUCTION

Development of livestock farming and its transfer to modern European technologies is one of the main tasks of ensuring the food security of our country (Perevozchikov et al., 2015; Chabaev et al., 2019). It is possible to intensify production by developing the livestock of domestic pig breeding, creating a network of breeding centers in some regions of the Russian Federation, as well as increasing the competitiveness and economic efficiency of pork production (Ilyin et al., 2017; Ovchinnikov et al., 2015; Nekrasov et al., 2018). At the current stage of animal husbandry development, the effectiveness of its separate sectors, including pig breeding, is largely determined by the quality of the genetic potential of animals. In most regions of Russia, pigs of foreign breeding are used for this purpose (Ovchinnikov et al., 2014a, 2014b; Polozyuk and Maximov, 2016). Currently, development and implementation of effective methods for pork production based on crossbreeding of highly productive breeds of foreign and domestic selection allows obtaining a significantly higher level of productivity, producing high-quality pork, and reducing production costs due to the high genetic potential of animals (Alekseev et al., 2013; Batanov et al., 2009; Kosilov and Perevoyko, 2014; Ovchinnikov et al., 2014; Nekrasov et al., 2018). Domestic pig breeding does not suffer from a shortage of livestock of highly specialized meat breeds what makes it possible to ensure the full volume of commercial pig breeding concerning early maturing meat hybrids of domestic selection, and to create a regional selection and genetic centers on their basis (Zinovieva et al., 2012; Kazantseva et al., 2018; Perevozchikov et al., 2014; Perevoyko 2011).

At the same time, stock development was considered as a separate most important strategic direction in pig breeding industry; it is a significant factor with an effect on the productive potential of commercial pig breeding (Neupokoeva and Iltyakov, 2018; Ovchinnikov, 2010; Perevozchikov et al., 2017). Scientific evidence revealed that crossbreeding effectiveness depends on the correct combination of breeds and high-quality selection of animals, so, crossbreeding of hybrid sows with terminal boars is considered a more effective way to obtain final hybrids for meat fattening. A special technique in pork production that reduces production cost is crossbreeding what is proved by the practical part of many scientific works (Batanov et al., 2010; Kazantseva and Karenina, 2006; Kazantseva et al., 2018; Nemirov, 2016; Nikolaev et al., 2014; Martynova et al., 2013; Perevoyko and Babaylova, 2013; Griksas et al., 2019). A stable heterosis effect on young animals obtained under conditions of industry intensification will be observed when optimal crossbreeding and hybridization patterns are created (Kazantseva et al., 2012; Ovchinnikov et al., 2013). But, to solve this problem, it is necessary to experimentally confirm the effectiveness of various combinations of pig genotypes that will be optimal for certain conditions of keeping and breeding (Kazantseva et al., 2013; Lazarevich et al., 2016; Ovchinnikov and Zatsarinin, 2011; Pogodaev et al., 2010).

This research aims to study the productive qualities of pigs of different genotypes with intensive pork production technology. The tasks include to study the reproductive qualities of cross-breeding sows with different breeding options; to identify the intensity of growth and development of hybrid young animals during suckling and nursery; to study the quantitative and qualitative characteristics of animals of different genotypes.

2 METHOD AND RESEARCH MATERIAL

This research was performed based on the economy of the Udmurt Republic. The object of

research at OOO “Kigbaevsky Bekon: in the Sarapulsky District was pigs obtained by industrial two- and three-breed crosses using the following breeds: Large White, Landrace, Duroc, Yorkshire. Landrace pigs of Danish and Canadian breeding were used for this study. To experiment, four groups of similar sows were formed, 10 animals in each group, taking into account age, development, and productivity. Sows were inseminated with sperm of boars of specialized breeds according to the research scheme (group 1 – (LWxLd.)xD; group 2 – (LWxLc.)xD; group 3 – (LWxY)xLc; group 4 (LWxY)xLd, where LW is a large white, Lc is a landrace of Canadian selection, Ld is a landrace of Danish selection, D is Duroc, Y is Yorkshire) All boars were full-aged, corresponded to the elite class. According to the adopted technology, pigs of all sex and age groups were fed and kept in the complex. Weaning of piglets was carried out in 28 days, the nursery period was 58 days. Fattening was stopped when pigs reached a live weight of 110-115 kg. Evaluation of the reproductive qualities of sows was carried out according to the following parameters: multiple pregnancies, live weight of one piglet at birth, number of piglets in the litter at weaning, the weight of one piglet at weaning, percentage of piglets’ livability at weaning. Growth and development of experimental young animals during suckling and nursery periods were evaluated using parameters: live weight, average daily, absolute, and relative gains. Quantitative indicators of piglets were studied by the method of balanced groups, 30 animals in each, according to the following parameters: age of reaching a live weight of 100 kg, average daily gain, and live weight when removed from fattening. Quality parameters were studied based on control slaughter (five animals from each group) by determining slaughter yield, half-carcass length, and fat depth at the level of 6th-7th thoracic vertebrae.

3 RESEARCH RESULTS

Herd reproduction is one of the most important production processes, see Figure 1.



Figure 1: Farrowing shop.

To predict the effectiveness of using sows, it is necessary to evaluate animals for reproductive qualities. The results of the farrowing in experimental groups are shown in Table 1.

Table 1: Productive qualities of hybrid sows.

Parameter	Group			
	1 (LWxL d.)xD	2 (LWxL c.)xD	3 (LWxY)xL c.	4 (LWxY)xL d.
Fertility, pigs	11.6±0.73	14.0±0.89*	12.0±0.76	12.6±1.28
Weight of a piglet, kg	1.44±0.11	1.61±0.07	1.50±0.09	1.54±0.09
The number of piglets at weaning, pigs	10.6±3.17	13.14±2.55	9.72±2.33	9.96±2.29
Live weight per animal, kg	6.24±0.26	6.59±0.46	6.45±0.38	6.00±0.34
Livability, %	91.37	93.85	81.00	79.04

Note: *- $P \geq 0.95$, **- $P \geq 0.99$ (hereinafter)

Analysis of the reproductive qualities of hybrid sows showed that sows of the second group (Large White x Landrace Canadian combined with Duroc boars) were distinguished by high fertility; the number of live piglets per litter was 14 what is 2.4 animals higher than the fertility in the first group ($P \geq 0.95$). Larger piglets were obtained in the second group (LWxL c.) x D; live weight of one piglet was 1.61 kg what is 0.17 kg higher than in the first group. The number of piglets per litter at weaning was the best in sows of the first and second groups: the number of piglets was 10.6 and 13.14, respectively. Piglets of the second group turned out to be the largest by the time of weaning – the weight of one piglet was 6.59 kg; the smallest was the piglets of the fourth group (a combination of crossbred sows LWxY with Danish Landrace boars) – 6.00 kg. Low piglet livability was observed in the third and fourth groups and ranged from 79 to 81%. The highest livability of piglets at weaning was observed in the first and second groups, with Duroc boars as male parents. Thus, the first and second groups can be noted among all combinations for all reproductive qualities, namely in these groups livability at weaning was better, and the live weight of one animal at weaning was higher.

The method of raising young pigs during periods of suckling and nursery largely determines the reproductive and productive qualities of sows and boars. Compliance with the feeding conditions and keeping sucking piglets, especially in the first month, is an important part of the technological chain of production of high-quality pork. Combining genetic material within a species creates certain opportunities for increasing productive qualities. This is since the resulting offspring with good heredity, due to a combination of the beneficial qualities of parents, have great potential for increasing productivity. Data in Table 2 show that there were no significant differences between experimental groups of piglets in live weight at weaning; the best result was in the second (LWxL c.)xD group, i.e. 6.59 kg.

Table 2: Growth of piglets during the suckling period

Parameter	Groups			
	1 (LWxL d.)xD	2 (LWxL c.)xD	3 (LWxY)xL c.	4 (LWxY)xL d.
Live weight of 1 piglet at birth, kg	1.44±0.11	1.61±0.07	1.50±0.09	1.54±0.09
Live weight at weaning, kg	6.24±0.26	6.59±0.46	6.45±0.38	6.00±0.34
Absolute gain, kg	4.80±0.29	4.98±0.32	4.95±0.35	4.46±0.49
Average daily gain, g	171.4±10.31	177.9±10.75	176.8±11.9	159.3±16.57
Relative gain, %	333.3	309.3	330.0	289.6

The same trend was observed in absolute gain: the best value was 4.98 kg in the second group with combination (LWxL c.)xD; young animals from the third group is a little bit less – 4.95 kg.

The highest daily average gain was observed in the second (LWxL c.)xD and the third (LWxY)xL c. groups where it amounted to 177.9 and 176.8 g, respectively. The smallest average daily gain, in this case, was in the combination of (LWxY)xL d. – 159.3 g. These values demonstrated that the first (LWxL d.)xD group had a high relative gain of 333.3%; this is higher than in the second (LWxL c.)xD and the third (LWxY)xL c. and the fourth (LWxY)xL d. groups by 24%, 3.3% and 43.7%, respectively.

A challenging technological stage of industrial pig farming is the raising of young animals. Therefore, the main task is to maximize using high growth and development potential of piglets. The next significant period of the technological process of pork production is the period of raising piglets from the moment of their weaning and before starting fattening. Table 3 shows changes in the development of piglets in the nursery period.

Table 3: Growth of piglets during the nursery period

Parameter	Groups			
	1 (LWxL d.)xD	2 (LWxL c.)xD	3 (LWxY)xL c.	4 (LWxY)xL d.
Live weight at weaning, kg	6.24±0.26	6.59±0.46	6.45±0.38	6.00±0.34
Live weight of 1 piglet at the start of fattening, kg	43.07±1.57*	42.89±0.53**	41.51±0.98	39.58±0.67
Absolute gain, kg	36.83±1.59	36.30±0.52	35.06±0.64	33.58±1.28
Average daily gain, g	646.1±27.96	636.8±9.20	615.1±11.27	589.1±22.52
Relative gain, %	590.2	550.8	543.6	559.7

Absolute gain during nursery was also higher in the first and second groups – 36.83 and 36.30 kg, respectively. In these groups, Duroc boars were used as male parents. In this case, the smallest absolute gain was observed in the fourth group 33.58 kg. It should be noted that the highest average daily gain during nursery was in piglets of the first and second groups 646.1 and 636.8 g, respectively. During the nursery period, the highest relative gain could be observed in the combination (LWxL d.)xD; it amounted to 590.2%. This is 46.6% higher than the absolute gain of the third group (LWxY) xL c. by. Thus, hybrid piglets from the first and second groups grew and developed most intensively during the nursery period.

The final stage of production is fattening, the results of the whole work depend on its quality. The main task of fattening as a technological element is the high yield of pork at minimal cost for production. Table 4 shows data on the fattening of hybrid young animals of various combinations.

Table 4: Fattening qualities of experimental young animals

Parameter	Groups			
	1 (LWxL d.)xD	2 (LWxL c.)xD	3 (LWxY)xL c.	4 (LWxY)xL d.
Pre-slaughter live weight, kg	115.4±3.23	114.2±3.20	119.4±4.11	121.8±4.07
Average daily gain, g	931.3±25.32	859.0±36.50	973.3±21.63	990.4±28.22
Age of reaching a live weight of 100 kg, day	150±8.25	151±5.15	145±6.33	146±5.41

Results of fattening experimental young animals showed that the highest live weight was obtained in the fourth group 121.8 kg, the smallest one in the second 114.2 kg. It was established that hybrid young animals from the fourth group (LWxY)xL d. were characterized by a higher growth rate; average daily gain in live weight in this group was higher than that in the third, first and second groups by 17.1; 59.1 and 131.4 g, respectively. We should note that experimental young animals from all groups were characterized by high early maturity, that is, animals have reached a live weight of 100 kg, on average, during 145-151 days. The best value was observed in the third group; piglets from this group (LWxY)xL c. reached a live weight of 100 kg forward by 5, 4, and 1 day in comparison to young animals from the first, second, and fourth groups, respectively.

Thus, hybrid young animals of the fourth group showed the best fattening qualities. At the same time, quite good growing results were also observed in young animals of the third group.

Trends of modern technologies in pig breeding are aimed at obtaining carcasses with a large amount of meat. However, in some studies, the authors noted that intensive pork production technologies can only improve the quantitative characteristics of raw materials, and qualitative parameters, as a rule, noticeably worsen (muscle fibers become thick, rough). Meat quality parameters depend on various factors. To determine slaughter qualities after completing the fattening, experimental young animals were slaughtered after reaching 110-120 kg of live weight. Table 5 shows the results.

Table 5: Slaughter and meat qualities of experimental young animals

Parameter	Groups			
	1 (LWxL d.)xD	2 (LWxL c.)xD	3 (LWxY)xL c.	4 (LWxY)xL d.
Pre-slaughter live weight, kg	115.4±3.23	114.2±3.20	119.4±4.11	121.8±4.07
Carcass weight, kg	93.28±2.37	87.84±0.89	98.52±3.04	95.04±2.95
Slaughter yield, %	80.88±1.13	77.07±1.43	80.91±0.23*	79.64±0.52
Fat depth at the level of 6 th -7 th thoracic vertebrae, mm	27.5±0.21	26.6±0.16	29.8±0.19*	29.7±0.12
Carcass length, cm	101.2±0.68	97.7±1.77	102.2±1.37	101.9±1.51

Analysis of Table 5 showed that piglets of the third group had the largest carcass weight of 98.52 kg and the smallest fattening young animals were in the first group – 93.28 kg. Comparing slaughter yield data, we can see that the most successful combination for obtaining carcasses with a high yield is a combination of large white rocks, Yorkshire, Canadian landrace (third group); slaughter yield in this group was 80.91%. In other groups, it was slightly lower, in the range of 77-80%. To determine the meat qualities of pig carcasses, we measured the length of half-carcass and fat depth. Results of studying the length of half carcasses revealed that piglets obtained with the participation of Duroc breed – the first and the second groups – were characterized by shorter carcasses, 101.2 and 97.7 cm, than their herd mates from the third and fourth groups. According to the table, young animals of the third group (LWxY)xL c. had a large length of half-carcass, i.e. 102.2 cm what is higher than in the second group by 4.5 cm, in the first – by 1.0 cm, in the fourth – by 0.3 cm, respectively. According to the results of measuring fat depth above spinous processes at the level of 6th -7th thoracic vertebrae, it is evident that piglets from the second group (LWxL c.)xD had the smallest fat depth – 26.6 mm, and the largest was typical for the feeding stock from the third and fourth groups; pre-slaughter weight was also higher in these animals. Fat depth in the second group was less than 3.2 mm compared to the third, and 3.1 mm compared to the fourth.

4 CONCLUSION

From this study on the productive qualities of pigs of different genotypes under industrial technologies, the best values for all reproductive performance parameters were demonstrated by crossing crossbred sows (LWxL) with Duroc boars: fertility was 14 piglets, weight of a newborn piglet 1.61 kg, livability at weaning 93.85%, live weight at weaning 6.5 kg; hybrid piglets from the first and second groups, obtained from a combination of Large White x Canadian and Danish Landrace sows with Duroc boars, were characterized by the best growth rate during suckling and nursery periods: live weight at weaning was 6.59 and 3.24 kg, average daily gain was growing 646.1 and 636.8 g, respectively; in terms of fattening and slaughter qualities of hybrid young animals. The best results were obtained with a combination of sows (LWxY) with Canadian Landrace boars and also with a combination of sows (LWxY) with Danish Landrace boars: early maturity at 145-146 days, average daily gain 990.4 g, slaughter yield of 80.9% and 79.6%, respectively. A comparison of the meat qualities of experimental young animals revealed the larger carcass length in piglets of the third group (LWxY)xL c. by 4.5 cm in comparison with the second group; in terms of fat depth, the best result was in the second group (LWxL c.)xD 26.6 mm.

From this study results, to increase pork production and to improve its quality in the conditions of industrial technologies, we recommend using Canadian and Danish Landrace boars at the final stage of crossbreeding in a three-breed combination i.e., Large White x Yorkshire x Landrace.

5 AVAILABILITY OF DATA AND MATERIAL

Information can be made available by contacting the corresponding author.

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Note: The original version of this article has been reviewed, accepted, and presented at the International Scientific and Practical Conference “From Inertia to Development: Scientific and Innovative Support for Agriculture” (IDSISA2020) at the Ural State Agrarian University, Ural, Russia, during 19-20 February 2020.