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Analysis of intercrossing performance of sows Pulawska breed with boars Polish Large White and Polish Landrace breed

Analiza efektywności krzyżowania loch rasy puławskiej z knurami rasy wielkiej białej polskiej i polskiej białej zwisłouchej

Summary. The preformed analyses aimed at determining the effects of intercrossing sows Pulawska (Pul) breed with boars Polish Large White (PLW) and Polish Landrace (PL) in relation to the obtained reproduction effects. The evaluation covered six families of the sows Pulawska breed and 1158 litters produced by them.The obtained results indicate high phenotypic variation within the population of Pulawska breed. Regarding the litter size on 1 and 21 days of piglet age the estimated heterosis effect proved most beneficial for the model of intercrossing of Pulawska x PLW in the Akra family: 5.73 and 5.36, piglet death losses over the raising period – Pulawska x PL (the Fajka family: -6.30), length of inter-litter period – Pulawska x PL (the Dazerka family: -7.36).

Key words: reproductive performance, crossbreeding, Pulawska breed

INTRODUCTION

The main objectives and methods of the breeding work on the Pulawska breed population changed within the period of over 75 years of its management. One of the basic breeding practices aiming at, among others, breeding and upgrading the breed proved to be crossbreeding. This method allowed to adjust pig performance to the requirements of the consumer market [Surdacki 1992, Walkiewicz *et al.* 2000].

The analyses and investigations exploring the potential crossability of the breed indicate a high level of fattening and slaughter traits of crosses with the Pulawska breed contribution [Kondracki 1994, Surdacki *et al.* 1995]. Currently, due to this breed placement among these considered as dam component, the reproductive herds of mass breed-

ing include both, purebred pigs and crosses. The producers expect the gilt crosses to show the reproductive performance exceeding that of purebreds`.

The objective of the work was to determine the crossbreeding effects of Pulawska and Polish Large White, Polish Landrace in relation to the performance parameters.

MATERIAL AND METHODS

The analysis covered 6 following families: Akra, Dazerka, Fajka, Fura, Multa, Sama Pulawska (Pul) breed gilts mated with boars Polish Large White (PLW), Polish Landrace (PL) breed, and 1158 litters produced by them. The animals were maintained in the breeding farms in the Lublin province. Animal nutrition and the zoohygienical conditions complied with the breeding-performance standards.

For each genetic and family group, minimum 3 reproductive cycles were considered to compute:

– the number of piglets born and reared up to 21 day of life,
– piglet death loss over the rearing period,
– reproductive period length.

For each family group and reproductive performance traits, the heterosis effect was estimated after the formula:

$$E_h = [(X_F - X_R) : X_R] \cdot 100\%$$

where: E_h – heterosis effect expressed in %,
X_F – phenotypic value of crosses` trait
X_R – mean phenotypic value of parent breeds` trait

The results of reproductive performance were analyzed statistically with the SPSS/PC program including one-factor variance analysis.

RESULTS AND DISCUSSION

One of the basic characteristics of domestic pig is its multiparity expressed by the true fertility indicator. In 2005, its value for the Polish pig breeds was found within 11.04–11.64 heads [Orzechowska and Mucha 2006].

Gilts of Pulawska breed have been characterized by high reproductive performance for many years. These properties acquired through long-term selective work and developed under the environmental conditions, place the Pulawska breed in a group of pigs of the dam component [Walkiewicz *et al.* 2000].

This fact is confirmed by a litter size indicator recorded on 1 day of life for the gilts of Pulawska breed in each family group (Table 1). Out of six gilt families evaluated, the highest litter size on 1 day of life was reported for the Dazerka population, while the most beneficial crossing system proved to be: gilt Pulawska breed x boar Polish Landrace breed.

Table 1. Number of piglets born alive in litter
Tabela 1. Liczba żywych prosiąt urodzonych w miocie

Specification Wyszczególnienie		Family – Rodzina						Mean Średnia
		Akra	Dazerka	Fajka	Fura	Multa	Sama	
Pul × PLW	Mean	11.63[a]	11.76[a]	10.90[b]	11.13	10.82[b]	11.28	11.25
	SD	2.02	2.74	1.86	1.60	1.93	1.86	1.99
	E_h	5.73	3.16	-0.41	-0.76	1.45	1.26	1.03
Pul × PL	Mean	11.67	11.95[a]	10.91[b]	11.24	10.96[b]	11.49	11.40
	SD	1.53	2.44	2.47	1.66	1.51	1.86	1.98
	E_h	5.51	4.82	-0.09	0.45	3.01	3.42	2.61
Pul × Pul	Mean	10.96[b]	11.73[a]	10.69[b]	11.23	10.63[b]	11.05	11.07
	SD	1.50	2.03	2.19	2.10	1.46	1.96	1.96
	Mean	11.39	11.76[a]	10.79[b]	11.18	10.61[b]	11.24	-
	SD	1.80	1.20	2.06	1.90	1.71	1.91	
PLW	Mean	11.20						
	SD	1.35						
PL	Mean	11.15						
	SD	1.43						

E_h – heterosis effect (%) – efekt heterozji
a, b – $P \leq 0.05$

Table 2. Number of piglets in litter on the 21st day
Tabela 2. Liczba prosiąt w miocie w 21 dniu

Specification Wyszczególnienie		Family – Rodzina						Mean Średnia
		Akra	Dazerka	Fajka	Fura	Multa	Sama	
Pul × PLW	Mean	10.61	10.59	10.00	10.12	10.13	10.29	10.25
	SD	1.68	1.83	1.18	1.33	1.74	1.42	1.47
	E_h	5.36	1.29	-1.09	-1.96	0.50	1.13	0.64
Pul × PL	Mean	10.33	10.85[a]	10.18[b]	10.41	10.33	10.51	10.44
	SD	2.08	1.82	2.56	1.40	1.66	1.51	1.75
	E_h	-1.71	3.53	0.39	1.66	2.18	3.04	3.37
Pul × Pul	Mean	9.87[a]	10.63[b]	9.94[a]	10.14	10.18	10.07	10.12
	SD	1.39	1.51	1.77	1.52	1.46	1.49	1.52
	Mean	10.24	10.66[a]	9.99[b]	10.20	10.19	10.26	-
	SD	1.58	1.62	1.61	1.44	1.65	1.47	
PLW	Mean	10.28						
	SD	1.43						
PL	Mean	10.34						
	SD	1.25						

E_h – heterosis effect (%) – efekt heterozji
a, b – $P \leq 0.05$

The number of liveborn piglets per litter depicts its size on 21 day of life; however, this trait value is affected in 90% by a group of the environmental factors. The obtained results in relation to the number of piglets raised indicate substantial variability of this trait that refers to both, gilt family and a breed of a boar used for mating (Table 2). For

the crosses of Pul x PLW, the highest value was noted for the Akra family (10.61 units), whereas for individuals Pul x PL and purebred gilts – the Dazerka family: 10.85 and 10.63 respectively.

Table 3. Losses of piglets from birth to 21 day of life (%)
Tabela 3. Straty prosiąt od narodzin do 21 dnia życia (%)

Specification Wyszczególnienie		Family – Rodzina						Mean Średnia
		Akra	Dazerka	Fajka	Fura	Multa	Sama	
Pul × PLW	Mean	8.77	9.94[a]	8.26	9.07[a]	6.38[b]	8.81[a]	8.86
	SD	1.26	1.67	1.74	2.01	0.86	2.11	1.84
	E_h	-3.40	13.00	7.20	1.23	2.80	2.71	7.69
Pul × PL	Mean	10.48[a]	9.20[a]	6.69[b]	7.38	5.75[b]	8.53	8.23
	SD	1.49	1.24	1.20	1.51	0.74	1.59	1.41
	E_h	21.86	10.58	-6.30	13.07	0.35	4.79	2.99
Pul × Pul	Mean	9.95[A]	9.38[A]	7.02[A]	9.71[A]	4.20[B]	9.03[A]	8.79[A]
	SD	1.52	1.41	1.36	1.63	0.80	1.68	1.52
	Mean	9.46	9.78[A]	7.60	8.83	5.39[B]	8.76	-
	SD	1.39	1.47	1.51	1.75	0.81	1.82	
PLW	Mean	8.21						
	SD	1.34						
PL	Mean	7.26						
	SD	1.20						

E_h – heterosis effect (%) – efekt heterozji
a, b – $P \leq 0.05$

Table 4. Farrowing interval of sows (days)
Tabela 4. Okres międzymiotu (dni)

Specification Wyszczególnienie		Family – Rodzina						Mean Średnia
		Akra	Dazerka	Fajka	Fura	Multa	Sama	
Pul × PLW	Mean	187.2	192.0[a]	190.3	182.1	183.9[b]	185.4	186.1
	SD	26.9	33.6	32.3	19.14	35.1	21.6	21.1
	E_h	-0.69	-3.13	3.14	-3.14	-2.39	-1.54	-1.27
Pul × PL	Mean	189.6	181.8[a]	190.9	194.1[b]	191.4[b]	191.1[b]	188.9
	SD	26.7	17.9	20.8	18.27	23.5	28.4	23.5
	E_h	1.34	-7.67	4.20	3.96	2.32	2.19	0.96
Pul × Pul	Mean	184.5[a]	203.8[Ab]	176.4[Bb]	183.5[a]	184.3[a]	184.1[a]	185.6
	SD	24.8	29.4	23.2	22.61	33.1	20.5	23.4
	Mean	185.9[a]	198.7[b]	183.0[a]	184.3[a]	185.1[a]	186.5[a]	-
	SD	26.2	27.3	27.9	21.15	32.7	23.7	
PLW	Mean	192.5						
	SD	27.8						
PL	Mean	189.8						
	SD	20.7						

E_h – heterosis effect (%) – efekt heterozji
a, b – $P \leq 0.05$

Multiparity often constitutes the reason for the lack of litter equalization, which in turns may reduce the piglet survivability rate [Kamyczek et al. 1990]. For 18 genetic and family gilts groups, only in the Akra family the mortality rate surpassed 10%, the threshold recognized the biological norm (Table 3). The lowest death loss of piglets in litters, i.e. 4.20–6.38%, was recorded for the purebred gilts and the Multa family crosses.

With the aim of obtaining high performance of gilts measured with the number of the reared piglets per year, a relatively short reproductive cycle should be maintained. For the Pul x PLW crossing system the shortest inter-litter period was observed in the Fura family gilts – 182.1 days, while the longest in the Dazerka family gilts – 192.0 days (Table 4). As for the crosses Pul x PL, the values are inversely proportional and range from 181.8 (Dazerka) up to 194.1 day (Fura).

One of the primary aims of crossbreeding is to attain the heterosis effect, which is also called hybrid luxuriance [Faust *et al.* 1992, Michalska 1996]. This effect is defined as a percentage deviation from the average of the parental breeds. In the breeding program of the Pulawska breed, maternal heterosis is employed and gilt hybrids obtained through crossing with other breeds of the dam component are expected to exhibit higher reproduction performance value.

Heterosis effect estimated for crosses litter size on 1 and 21 days of life assumed both, positive and negative values (Table 1, 2). A heterosis coefficient for true fertility of the hybrids with PL breed contribution showed lower border values, that is from –0.09 (Fajka) up to 5.51 (Akra), while for PLW breed an E_h index oscillated from –0.76 (Fura) up to 5.73 (Akra).

This distribution of values confirms the hypothesis that crossbreeding within one component (dam or sire) does not always brings beneficial results. The reasons for this effect should be sought in the genetic and phenotypic variability reported within the Pulawska breed [Babicz *et al.* 2003].

It is believed that a higher mortality rate in litters occurs in the breeds classified into dam component, which arises from high true fertility [Kamyczek *et al.* 1990]. As Michalska [1996] claims, crossing with PLW gilts contribution yields more beneficial reproduction effects as compared to this breed placement on sire`s side.

Out of the evaluated crossing systems with Pulawska breed, the best heterosis effects for piglet survivability were noted in the Akra family crosses, i.e. –3.40% Pul x PLW and Fajka –6.30% Pul x PL (Table 3). A negative and thus more beneficial heterosis effect was also observed in relation to the reproductive cycle length for most families of crosses Pul x PLW (Table 4). An E_h coefficient ranged from 0.69 (Akra) up to –3.14 (Fura). However, for the the crossing system Pul x PL, the most favourable effect was reported for the Dazerka family (-7.67).

CONCLUSIONS

1. The population of Pulawska breed gilts is characterized by marked variability within the reproductive performance traits. Out of six families submitted for evaluation, the highest litter size on 1 and 21 days of life was reported for the Dazerka family.

2. To obtain a high number of piglets and reduce losses over the raising period the recommended crossing system proved to be mating the gilts Pulawska breed with boars of Polish Landrace breed.

3. The heterosis effect recorded in all the genetic and family groups did not turn out explicitly beneficial. A high and desired E_h coefficient was noted in relation to the following traits: fertility and number of piglets raised up to 21 day of life – the Akra family (Pul x PLW), piglet death losses over the raising period – the Fajka family, length of the inter-litter period – the Dazerka family (Pul x PL).

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Streszczenie. Przeprowadzone analizy miały na celu określenie efektów krzyżowania loch rasy puławskiej (Pul) z knurami ras wielkiej białej polskiej (wbp) i polskiej białej zwisłouchej (pbz) w odniesieniu do uzyskiwanych wyników rozrodu. Oceną objęto sześć rodzin loch rasy puławskiej oraz 1158 uzyskanych od nich miotów. Wyniki tych badań wskazują na dużą zmienność fenotypową w obrębie populacji rasy puławskiej. W odniesieniu do liczebności miotu w 1. i 21. dniu życia prosiąt oszacowany efekt heterozji okazał się najkorzystniejszy dla modelu krzyżowania puławska x wbp w rodzinie Akry: 5,73 oraz 5,36, dla upadków prosiąt w okresie odchowu – puławska x pbz (rodzina Fajki: -6,30), długości okresu międzymiotu – puławska x pbz (rodzina Dazerki: -7,36).

Słowa kluczowe: użytkowość rozpłodowa, krzyżowanie, rasa puławska