

## **COMPARISON OF LIMOUSINE CATTLE WITH THEIR CROSSBREDS WITH BLACK-AND-WHITE BREED MANAGED UNDER ORGANIC CONDITIONS ON THE CZARNOCIN FARM IN THE YEARS 2008–2009**

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**Abstract.** The aim of this study was to compare pure-bred Limousine cattle with their crossbreds with Black-and-White breed in regard to the selected zoometrical measurements, selected fertility indices as well as birth weight of calves and their daily body weight gains. The research was conducted on the Czarnocin organic farm located in the West Pomerania Province. Pure-bred cows were characterized by a higher mean body weight, higher hip height and lower chest girth than crossbreds. Pure-bred individuals had slightly better fertility indices in comparison with their crossbred age mates. Significantly ( $P \leq 0.05$ ) higher body weight and daily body weight gains at 210 days of age were found in bull calves compared with heifers.

**Keywords:** beef cattle, body weight, daily body weight gains, Limousine, organic breeding, zoometrical measurements

### **INTRODUCTION**

Productivity and fattening effectiveness depend, first of all, on the adopted management system together with appropriate feeding. Beef may be produced under a conventional and organic system. In the latter case, its consumption value and selling price are higher. Taking into account the growing consumer demands with respect to health value of food, organic beef production may be of great significance in the future [Strzetelski and Maciaszek 2005].

In our country, good conditions exist for farming and breeding of beef cattle due to the large areas of permanent grassland that are not fully utilized and constitute considerable feed reserves. Beef cattle breeding supports rural landscape protection and allows preservation of ecological functions of grassland that are especially important for the production of healthy and safe food [Litwińczuk et al. 2004].

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As it is emphasized by Pilarczyk et al. [2010], many studies aimed at comparing the results of crossing cattle of various beef breeds have been conducted in the USA, Canada and New Zealand over the last half century. These studies have shown a 20–30% higher level of culinary beef production in the herds of crossbreeds compared with pure-bred beef herds. This enables production of a larger amount of beef from a smaller number of cows. In our country, the crossing of the native Black-and-White cattle with beef bulls, including absorptive crossing to obtain desirable beef breed, as well as breeding of the pure-bred beef cattle are mainly performed.

The aim of this study was to compare pure-bred Limousine cattle with their crossbreeds with Black-and-White breed kept on the Czarnocin organic farm in the years 2008–2009.

## MATERIAL AND METHODS

The study was conducted on the Czarnocin Organic Farm located in the West Pomerania Province and involved the herd of Limousine beef cows (96 individuals and crossbreeds with Black-and-White breed) managed according to the rules of organic farming.

Grazing period on the farm started around February, when cows were gradually shifted to green forage feeding. Water, to which animals had permanent access, was drawn from a drilled well using a combustion pump. Cows had also free access to salt blocks. In winter, the animals were moved to a loose barn. They were fed hay and straw obtained from organic crops. The barn was fitted with drinkers and feeding racks.

Reproduction on the farm was based on natural mating service. Two Limousine bulls that mated females in estrus stayed in the herd all the time.

- To perform the analysis, cows were divided into two groups according to genotype:
- crossbreeds (individuals with 50.00–87.49% of Limousine genes),
  - pure-bred (individuals with 87.50–96.88% of Limousine genes).

Data on the performance of beef cows were collected based on the breeding documentation (“heifer-beef cow” charts) and the information from the farm according to the guidelines of The Polish Association of Beef Cattle Breeders and Producers for the years 2008–2009. For the evaluation of the growth and development of animals, the following selected zoometrical parameters were compared: body weight, hip height and chest girth. Some reproduction parameters (age at first calving, calving interval) and the estimated lactation yield of cows were also analysed.

In calves, body weight at 1st and 210 days of age as well as body weight and daily body weight gains until 210 days of age were investigated.

The data were analysed using MS Office Excel. The obtained results are presented in tables and figures. Mean values ( $\bar{x}$ ), standard deviation (S), minimum (Min) and maximum (Max) values as well as coefficient of variation (V%) were calculated. The significance of differences was verified using one-way analysis of variance and Duncan’s multiple range test by means of Statistica<sup>®</sup>9 PL software.

## RESULTS AND DISCUSSION

When comparing the mean body weights of Limousine cows (Fig. 1), it was found that the pure-bred individuals gained lower mean body weight (549.2 kg) in 2008 compared with crossbreds (554.2 kg). On the other hand, a higher body weight in pure-bred animals (557.2 kg) and the body weight of 551.0 kg in crossbreds were recorded in 2009.

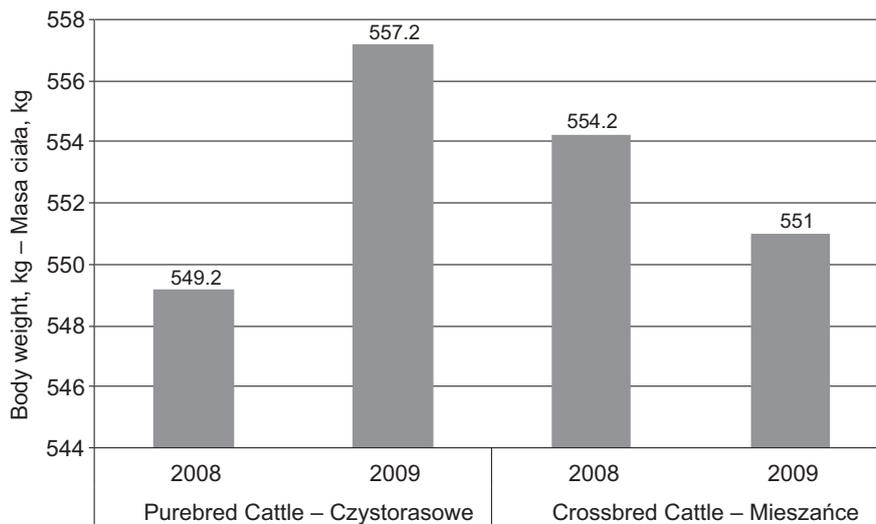


Fig. 1. Comparison of the body weight of pure-bred Limousine beef cattle and their crossbreds in the years 2008–2009

Rys. 1. Porównanie masy ciała czystorasowego bydła mięsnego rasy limousine oraz jego mieszańców w latach 2008–2009

Przysucha et al. [2006], who analysed data from The Polish Association of Beef Cattle Breeders and Producers for the years 1999–2004, found the mean body weight for Limousine individuals to be 612 kg. The mean values of the measurements showed a downward tendency in subsequent years and amounted to 634 kg and 597 kg in 1999 and 2004, respectively.

In another study, Przysucha and Grodzki [2007] showed that the body weight for the pure-bred population between 1999 and 2005 was 602 kg and for the crossbreds it amounted to 553 kg.

From the study by Zalewski et al. [1998] on Limousine crossbreds, it appears that the body weight of cows ranged from 479 kg to 523.6 kg. Litwińczuk et al. [2000] obtained results ranging between 552 and 570 kg. Similar results (568.1 kg) were also recorded by Klupczyński and Miciński [2000]. When analysing the results of hip height measurements in 2008 (Table 1), a small difference (only 0.3 cm) was found for pure-bred and crossbred cattle (136.2 cm and 135.9 cm, respectively). The same results were obtained in 2009.

The chest girth in pure-bred individuals was 189.5 cm and remained the same in the whole analysed period. Crossbreds had a mean chest girth of 189.7 and 190 cm in 2008

and 2009, respectively, so it was higher than the mean for pure-bred individuals (by 0.3 and 0.5 cm in 2008 and 2009, respectively).

Stąporek and Ziemiński [2000], analysing the population of Limousine cows imported from Denmark, the Netherlands and France, showed that the animals after first calving had a hip height of 135 cm (from 131 cm to 137 cm for Denmark and France, respectively) and chest girth of 193 cm (from 190 cm to 198 cm for Germany and the Netherlands, respectively). The cited authors also found that cows after fourth calving had a hip height of 144 cm (from 140 to 146 cm for the Netherlands and France, respectively) and the chest girth of 204 cm (from 202 cm to 207 cm for Germany and France, respectively).

Table 1. Comparison of the selected zoometrical measurements of pure-bred Limousine beef cattle and their crossbreds in the years 2008–2009

Tabela 1. Porównanie wybranych pomiarów zoometrycznych czystorasowego bydła mięsnego limousine oraz jego mieszańców w latach 2008–2009

		Pure-bred – Czystorasowe									
Parameters Badane parametry	Units Jednostki	2008					2009				
		$\bar{x}$	min.	max.	S	V%	$\bar{x}$	min.	max.	S	V%
Hip height Wysokość w krzyżu	cm	136.2	134	138	1.32	0.97	136.2	134	138	1.17	0.86
Chest girth Obwód klatki piersiowej	cm	189.5	186	193	1.51	0.80	189.5	188	190	0.78	0.41
		Crossbreds – Mieszańce									
Parameters Badane parametry	Units Jednostki	2008					2009				
		$\bar{x}$	min.	max.	S	V%	$\bar{x}$	min.	max.	S	V%
Hip height Wysokość w krzyżu	cm	135.9	131.0	138.0	2.01	1.48	135.9	131.0	139.0	2.18	1.60
Chest girth Obwód klatki piersiowej	cm	189.7	186.0	192.0	1.64	0.86	190.0	186.0	195.0	2.06	1.08

Waller [1995] reports that it is required in the United States that the heifers at the age of 14–15 months gain an appropriate body weight and condition for mating, continue their growth and calve for the first time at the age of approx. 24 months and for the second time at the age of 36 months.

Based on the analysis of data in Table 2, it appears that, in 2008, the age at first calving in pure-bred individuals averaged 1089 days (36 months) and in the crossbreds it was 1390 days (46 months). In 2009, the first calving in pure-bred cows occurred, on average, at 1002 days of age (33 months), whereas in crossbreds it took place at 1052 days (35 months) with the difference of 50 days.

Many authors emphasize that the appropriate mating date for heifers depends on the level of their development and not on their age (Antkowiak and Rytlewski 1997). On the other hand, Małecki-Tepicht et al. [2000] explain that excessively long calving-to-conception and calving intervals are most often caused by insufficient organization of herd

reproduction. Inappropriate recognition of estrus signs results in ineffective mating and, consequently, excessive prolongation of these intervals [Kowalski et al. 2003].

According to Stanek [2006], a mean age at first calving in the population of Limousine heifers was 28.1 months. This author also analysed the population of Hereford heifers and recorded lower age at first calving (27.6 months) in this case. Stąporek and Ziemiński [2000], who conducted research on Limousine cows imported from France, Germany, Denmark and the Netherlands, found that the lowest age at first calving was characteristic of individuals imported from Denmark (27.0 months) and Germany (29.0 months), whereas worse results were obtained for the animals from France and the Netherlands (34.0 months). Calving interval was the shortest in cows from Germany (396.0 days and 368.0 days for calvings 1–2 and 3–4, respectively) and Denmark (405.0 and 365.0 days for calvings 1–2 and 3–4, respectively), whereas the longest one occurred in individuals from France (459.0 days and 391.0 days for calvings 1–2 and 3–4, respectively).

Table 2. Comparison of the selected fertility indices and lactation yield of pure-bred Limousine beef cattle and their crossbreds in the years 2008–2009

Tabela 2. Porównanie wybranych wskaźników płodności i mleczości czystorasowego bydła mięsnego limousine oraz jego mieszańców w latach 2008–2009

		Pure-bred – Czystorasowe										
Parameters Badane parametry	Units Jednostki	n	2008					2009				
			$\bar{x}$	min.	max.	S	V%	$\bar{x}$	min.	max.	S	V%
Age at first calving Wiek pierwszego wycielenia	days dni		1089	655	2029	301	27.62	1002	733	2029	286	28.54
Calving interval Okres międzywycieleniowy	days dni		415	319	652	112	27.01	513	311	825	164	31.92
Milkiness Mleczość	kg		1970	1611	2250	178.20	9.04	1913	1542	2348	238.71	12.48
		Crossbreds – Mieszańce										
Parameters Badane parametry	Units Jednostki	n	2008					2009				
			$\bar{x}$	min.	max.	S	V%	$\bar{x}$	min.	max.	S	V%
Age at first calving Wiek pierwszego wycielenia	days dni		1390	735	2200	533	38.37	1052	597	2200	367	34.89
Calving interval Okres międzywycieleniowy	days dni		410	267	695	125	30.49	529	347	937	197	37.27
Milkiness Mleczość	kg		2072	1821	2332	152.85	7.38	1954	1629	2587	248.32	12.71

As can be seen from Table 2, calving interval in pure-bred cows was 415 and 513 days in 2008 and 2009, respectively, whereas in crossbreds it amounted to 410 and 529 days in 2008 and 2009, respectively.

When comparing the estimated lactation yields of the studied animals in 2008, higher yields in crossbreds (2072 kg) were found compared with pure-bred cows (1970 kg). Likewise, in 2009, crossbreds were superior to pure-bred animals by 1954 and 1913 kg.

According to The Polish Association of Beef Cattle Breeders and Producers, the estimated amount of milk produced in 2009 by the population of pure-bred Limousine cows in the West Pomerania Province was 2010.8 kg, whereas the mean for the whole domestic population was 2002.4 kg. It was also found that the crossbreds in our Province were characterized by a higher estimated milk yield (2044.4 kg) compared with the mean for the whole country, which amounted to 1959.6 kg.

As can be seen from Table 3, the birth weight of bull calves in 2008 amounted to 38 kg and was 0.7 kg higher than the mean body weight of heifers (37.3 kg). In 2009, bull calves, with a mean body weight of 36.9 kg, were 0.2 kg heavier than heifers (36.7 kg).

Klupczyński et al. [1996] reported that the birth weight of Limousine calves was 40.4 kg for bull calves and 36.6 kg for heifer calves. From the study by Litwińczuk et al. [2002], it appears that the pure-bred Limousine bull calves had a mean birth weight of 31.2 kg, whereas their crossbreds weighed 38.2 kg. The respective values for heifer calves were 31.1 kg and 32.5 kg. In the study by Pilarczyk and Wójcik [2005], Limousine bull calves had a birth weight of 35.2 kg, whereas heifer calves weighed 31.8 kg. These authors found that the bull calves of this breed at 210 days of age had body weight gains of 1052 g and body weight of 256.1 kg, whereas the respective values for heifers were 948 g and 230.8 kg. Pilarczyk et al. [2010] showed that pure-bred Charolaise heifers gained the mean birth weight of 38.5 kg and the crossbreds with 75% of genes of this breed had a mean birth weight of 37.2 kg. Pure-bred bull calves and crossbreds with 75% of genes of this breed were characterized by similar results (from 39.1 kg to 38.9 kg).

When comparing the body weights of bull calves and heifers at 210 days of age in 2008, it was found that the body weight of bull calves averaged 255.8 kg and that for heifers was 242.4 kg, on average. These differences were significant ( $P \leq 0.05$ ). In 2009, bull calves were characterized by the mean body weight of 239.1 kg and the weight for heifers was 240.1 kg, so the latter were 1 kg heavier.

Szarek and Adamczyk [1997] reported that Limousine bull calves imported from Denmark had a mean body weight of 309 kg and daily body weight gains of 1228 g at 210 days of age. Litwińczuk et al. [2002] recorded body weights of 235.4 kg and 280.9 kg at 210 days of age for pure-bred bull calves and crossbreds, respectively. For the pure-bred heifer calves, the best results in the cited study were obtained for the Limousine breed (219 kg) compared with all the remaining beef breeds. Dobicki and Szulc [1998] observed that the crossbred Angus bull calves were characterized by the lower body weight (179.2 kg) in comparison with Limousine crossbreds (280.9 kg).

In the present study (Table 3), it was found that the daily body weight gains up to 210 days of age in 2008 were 1048.2 kg and 980.7 kg for bull calves and heifers, respectively. The difference was significant ( $P \leq 0.05$ ) and amounted to 67.5 g, whereas no statistically significant differences were noticed in 2009, when comparing daily body weight gains of the studied animals.

Table 3. Comparison of the body weight and body weight gains of Limousine beef heifers and bull calves in the years 2008–2009

Tabela 3. Porównanie wskaźników masy ciała oraz przyrostów jałówek i buhajków mięsnych limousine w latach 2008–2009

		Bull – Buhajki									
Parameters Badane parametry	Units Jednostki	2008					2009				
		$\bar{x}$	min.	max.	S	V%	$\bar{x}$	min.	max.	S	V%
Birth weight Masa urodzeniowa	kg	38.0	34.0	40.0	1.68	4.42	36.9	25.0	40.0	3.37	9.14
Body weight at 210 days of age Masa w 210. dniu życia	kg	255.8 <sup>a</sup>	223.4	278.3	18.46	7.22	239.1	191.1	314.2	30.72	12.85
Body weight gains at 210 days Przyrosty w 210. dniu	g	1048.2 <sup>b</sup>	892.0	1144.0	81.06	7.73	963.1	786.0	1315.0	139.45	14.48
		Heifer – Jałówki									
Parameters Badane parametry	Units Jednostki	2008					2009				
		$\bar{x}$	min.	max.	S	V%	$\bar{x}$	min.	max.	S	V%
Birth weight Masa urodzeniowa	kg	37.3	34.0	42.0	1.94	5.21	36.7	28.0	40.0	2.80	7.62
Body weight at 210 days of age Masa w 210. dniu życia	kg	242.4 <sup>a</sup>	204.5	288.7	19.81	8.17	240.1	191.1	288.7	25.64	10.68
Body weight gains at 210 days Przyrosty w 210. dniu	g	980.7 <sup>b</sup>	802.0	1184.0	89.19	9.09	968.4	738.0	1184.0	115.32	11.91

a. b – differences significant at  $P \leq 0.05$ .

a. b – różnice istotne na poziomie  $P \leq 0,05$ .

Litwińczuk et al. [2002] revealed that the crossbred Limousine bull calves had the lowest daily body weight gains (1123 g) during the nursing period from among the studied beef breeds. The cited authors recorded daily body weight gains of 966 g for pure-bred bull calves, whereas the crossbred heifer calves showed better results; the values were 244.0 kg and 1007 g for the body weight at 210 days of age and daily body weight gains, respectively. Choroszy et al. [2008] reported the mean birth weights of 33.5 kg and 35.7 kg for pure-bred Limousine heifers and bull calves, respectively. This study also indicates that the body weight at 210 days for the evaluated heifers was 236.4 kg and that for bull calves amounted to 260.7 kg, whereas the body weight gains up to 210 days of age were 959 g and 1064 g for heifers and bull calves, respectively. The cited authors also reported that the crossbred heifers gained the mean body weight of 34.1 kg and that this value was 36.1 kg

for the bull calves. In the population of crossbreds at 210 days of age, heifers weighed 237.4 kg and bull calves 248.5 kg and the daily body weight gains of the calves were 965 g and 1018 g for the heifers and bull calves, respectively.

## CONCLUSIONS

Comparing the obtained results for body weight and selected zoometrical parameters, it was found that the pure-bred Limousine cows were characterized by the higher mean body weight (from 549.2 kg to 557.2 kg) than crossbreds (from 551.0 kg to 554.2 kg). Pure-bred individuals had also higher hip height and lower chest girth. However, these differences were not statistically significant.

When analysing selected fertility indices, it was shown that the pure-bred Limousine primiparous cows calved for the first time earlier (33–36 months) than their age mates being the crossbreds of this breed (35–46 months). Pure-bred individuals were characterized by shorter calving interval (415–513 days) compared with crossbreds (410–529 days). However, these differences were not statistically significant.

Significantly higher ( $P \leq 0.05$ ) body weight and body weight gains at 210 days of age were found in bull calves compared with heifers.

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### **PORÓWNANIE CZYSTORASOWEGO BYDŁA RASY LIMOUSINE I JEGO MIESZAŃCÓW UTRZYMYWANYCH W WARUNKACH EKOLOGICZNYCH W GOSPODARSTWIE W CZARNOCINIE W LATACH 2008–2009**

**Streszczenie.** Celem pracy było porównanie czystorasowego bydła limousine z mieszającami tej rasy pod względem wybranych pomiarów zoometrycznych, wybranych wskaźników płodności oraz urodzeniowej masy ciała cieląt i ich przyrostów dobowych. Badania przeprowadzono w gospodarstwie ekologicznym w Czarnocinie, w województwie zachodniopomorskim. Krowy czystorasowe charakteryzowały się większą średnią masą ciała, wyższymi wymiarami w krzyżu oraz mniejszym obwodem klatki piersiowej niż mieszzańce. Osobniki czystorasowe odznaczały się nieznacznie korzystniejszymi wskaźnikami płodności w porównaniu z rówieśnikami mieszającami rasy limousine. U buhajków stwierdzono istotnie ( $P \leq 0,05$ ) wyższą masę ciała oraz przyrosty dobowe w 210. dniu życia, w porównaniu z jałówkami.

**Słowa kluczowe:** bydło mięsne, hodowla ekologiczna, limousine, masa ciała, pomiary zoometryczne, przyrosty dobowe

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