

THE INFLUENCE OF THE SEASON OF THE BIRTH OF DUROC AND PIETRAIN BOARS AND THEIR CROSSBREEDS ON SPERM TRAITS

Kazimierz Pokrywka¹, Krzysztof Tereszkievicz²

¹ State Higher Vocational School in Krosno, Poland

² Rzeszow University of Technology, Poland

Abstract. The aim of this study was evaluation of the quality of ejaculates of boars from Duroc and Pietrain breeds, and also crossbreeds born in different seasons. Materials used for the study were gathered during the process of breeding boars. There were 143 boars of breeds Duroc, Pietrain and their crossbreeds (Duroc x Pietrain and Pietrain x Duroc). The 20 442 of boars' ejaculates were examined between 1997–2009 in the Małopolska Biotechnology Centre – Examinations Station of Boars in Czermin. Ejaculates were evaluated basing on: the volume of spermatozoid fractions, the percentage of progressive spermatozoids, spermatozoid concentration, total count of progressive spermatozoids and the total number of insemination doses obtained from one ejaculation. The parameters of examined ejaculates of boars races were analyzed statistically accordingly with their births seasons: spring (from 22nd March to 21st June), summer (from 22nd June to 21st of September), autumn (from 22nd September to 21st of December), winter (from 22nd December to 21st of March). The studies have shown the significance of impact that season of birth has on semen quality of boars and crossbreeds of evaluated races. The highest reproductive potential expressed as a number of insemination doses, was found in boars of Duroc and Pietrain breeds born in the summer. In case of crossbreeds, the best quality of sperm was found in males born in the winter season.

Keywords: birth season, boar, breed, crossbreed, traits of ejaculate

INTRODUCTION

In the recent years there has been a significant increase in the number of artificial inseminations of sows in Poland. Currently 50% of all swine breeding is based on artificial insemination. What is more, forecasts indicate that Poland will reach similar results to ones that are currently being achieved in those countries where pig breeding is fully developed and insemination is on levels of 80% [Kondracki 2010]. The popularization of artificial insemination allowed for the further progress of improvement of the genetic value

Corresponding author – Adres do korespondencji: dr inż. Kazimierz Pokrywka, Institute Economic and Social Policy, State Higher Vocational School in Krosno, Kazimierza Wielkiego 6, 38-400 Krosno, Poland, e-mail: kpok-wka@wp.pl

of pigs and additionally, thanks to organizational changes it helped to significantly reduce the costs of pork production. [Blicharski and Hammermeister 2006].

The dynamic development of artificial insemination of pigs in Poland has significantly contributed to the development of research on the usefulness of insemination boars and the efficient use of their semen. Various publications [Ciereszko et al. 2000, Szostak 2003, Brucka-Jastrzębska et al. 2008, Szostak and Sarzyńska 2008, Smital 2009] indicate that the effectiveness of breeding boars that are used in insemination is determined by genetic and environmental factors and also by interactions of these factors. Other studies [Kondracki et al. 2004, Milewska and Falkowski 2004, Janett et al. 2005, Wysokińska et al. 2009] indicate that among the environmental factors the one of a particular importance is the season when the insemination takes place – having impact on shaping of the characteristics of boar semen. The research of [Milewska and Falkowski 2004, Pokrywka and Ruda 2004, Smital 2009] indicates that the best quality of ejaculates is achieved in autumn – winter season. Ejaculates obtained during this period characterize with the highest volume and sperm concentration. According to Kondracki [1997], this phenomenon can be explained by atavistic tendency of pigs to be more sexually active in the autumn – winter season. The seasonal differences in sexual activity of boars depend on their breed. According to Banaszewskiej et al. [2007] particularly vulnerable to influence of seasonal factors are boars of PL, Duroc and Pietrain breeds. Szostak and Przykaza [2010] reported that young boars, particularly in their first year of breeding, are the most sensitive to season changes.

Recently, the relationship of boars insemination efficiency and the season of their birth is also being closely analyzed. According to Owsiany et al. [2004] the boars born in the spring characterize with larger testicles, which indicates better physical and morphological quality of sperm. They are also more sexually active when compared with boars born in autumn. Additionally the previous studies [Pokrywka et al. 2009] show that the quality of ejaculates depends on the season in which the boars were born. There also has been noticed a significant relationship between season of birth and the breed of tested boars. It was found that a high production efficiency, expressed as the number of insemination doses, is characteristic to boars of PL breed, born in the autumn and winter, boars of PLW breed born in spring and summer, Duroc and Hampshire breeds in spring and autumn. Only in case of Pietrain breed boars the seasons have no influence over their ejaculates quality. The results of quoted studies show that season of birth is a strong differentiation factor, that has an impact on the efficiency of breeding boars, however only pure-bred boars in these studies are included.

The aim of this study was evaluation of the quality of ejaculates of boars from Duroc and Pietrain breeds, and also crossbreeds born in different seasons.

MATERIAL AND METHODS

Materials used for the study were gathered during the process of breeding boars. There were 143 boars of breeds Duroc, Pietrain and their crossbreeds (Duroc x Pietrain and Pietrain x Duroc). The 20 442 of boars' ejaculates were examined between 1997–2009 in the

Małopolska Biotechnology Centre – Examinations Station of Boars in Czermin. Semen was manually collected from boars and then tested in accordance with the rules of CSHZ [1998]. Ejaculates were evaluated basing on: the volume of spermatozoid fractions, the percentage of progressive spermatozoids, spermatozoid concentration, total count of progressive spermatozoids and the total number of insemination doses obtained from one ejaculation.

The parameters of examined ejaculates of boars races were analyzed statistically accordingly with their births seasons: spring (from 22nd March to 21st June), summer (from 22nd June to 21st of September), autumn (from 22nd September to 21st of December), winter (from 22nd December to 21st of March). The statistical analysis was based on arithmetical calculations and means of standard deviations. The calculations were based on the univariate analysis of variance and the significance of differences between average arithmetic results was determined with the Tukey's test. The statistical conclusion was carried out at two levels of significance $P \leq 0.01$ and $P \leq 0.05$. All statistical calculations were conducted with use of the program Statistica®9.0 PL.

RESULTS AND DISCUSSION

According to [Smital 2009] the average volume of ejaculates obtained from boars of Duroc breed is 185 cm^3 and it is more than 70 cm^3 lower when compared with the volume of semen obtained from boars of Pietrain breed. The same time the semen of Duroc breed boars has a significantly higher concentration of spermatozoids – similar data was presented by Kondracki [2010].

The evaluation results of the physical characteristics of the of semen from boars of Duroc and Pietrain breeds including seasons of birth are shown in Table 1. Boars of both evaluated races born in the summer characterized with the highest average volume of sperm. The average volume of sperm in boars of Duroc breed born in this season was 202.03 cm^3 , and boars of Pietrain breed was 256.36 cm^3 . The boars of both breeds that were born in the spring characterized with the lowest volume of semen. However worth mentioning is the fact, that less variability of the average semen volume during the seasons was noted in boars of Pietrain race. The difference between the volume of semen that was obtained from boars born in the summer and spring was only 28.76 cm^3 , whereas in case of boars of Duroc breed the difference was 84.14 cm^3 (Table 1).

It was also found that semen samples collected from boars of which mothers were of breed Pietrain, showed both the highest and lowest volume of semen in the same season of birth as in the initially examined races. In the case of Duroc x Pietrain crossbreed boars the highest volume ($= 237.45 \text{ cm}^3$) was reported in case of animals born in winter (Table 2). The research of [Smital 2009] shows that the average volume of Duroc x Pietrain crossbreeds is 224.04 cm^3 .

Wysokińska et al. [2009] believe that the percentage of progressive spermatozoids in the sperm should be at least 60%. Our own research proves that semen of boars of all evaluated groups meets these requirements. However, it should be noted that the largest percentage of progressive spermatozoids was found in the semen of Duroc and Pietrain breeds born in spring (Table 1). It was also noted that the semen of crossbreeds, regardless of

season of their birth, was characterized by a higher percentage of progressive spermatozooids when compared to the pure-bred boars. The highest values were found in the semen of animals born in the winter (Duroc x Pietrain = 69.12% and Pietrain x Duroc = 69.87%) (Table 2). It was also found that the semen of crossbreeds, mothers of which were of Pietrain breed was characterized by greater than 69% percentage of progressive spermatozooids in all the seasons of birth.

Table 1. The quality of ejaculates of purebred boars born in different seasons of the year
Tabela 1. Jakość ejakulatów knurów czystorasowych urodzonych w różnych porach roku

Trait Cecha	Bred Rasa	Season of year – Pora roku				Significance of differences Istotność różnic AB:P≤0.01; ab:P≤0.05	
		spring wiosna (A, a)	summer lato (B, b)	autumn jesień (C, c)	winter zima (D, d)		
Volume Ejaculates, cm ³ Objętość ejakulatu, cm ³	Duroc	\bar{x}	117.89	202.03	162.54	177.51	A–B,C,D; B–C,D;
		SD	39.04	68.10	55.15	35.67	
	Pietrain	\bar{x}	227.60	256.36	238.88	234.66	A–B,C; B–C,D
		SD	72.59	111.16	88.81	80.93	
Percentage of progressively motile spermatozoa, % Odsetek plemników o ruchu postępowym, %	Duroc	\bar{x}	69.12	66.30	68.20	68.57	A–B; B–C,D
		SD	2.85	4.95	5.52	3.51	
	Pietrain	\bar{x}	68.63	67.97	67.58	68.45	A–B,C; B–C,D; C–D
		SD	6.06	5.76	6.06	5.35	
Concentration of spermatozoa, x 10 ⁶ · cm ⁻³ Koncentracja plemników, x 10 ⁶ · cm ⁻³	Duroc	\bar{x}	514.74	577.16	448.25	380.99	A–D; B–C,D; C–D a–b,c
		SD	89.94	116.66	116.55	73.93	
	Pietrain	\bar{x}	425.84	436.71	440.42	436.50	a–c
		SD	130.43	160.69	161.11	130.46	
Total number of progressively motile spermatozoa, x 10 ⁹ Ogólna liczba plemników o ruchu postępowym, x 10 ⁹	Duroc	\bar{x}	41.32	78.03	50.46	46.57	A–B; B–C,D a–c
		SD	12.49	26.69	19.61	11.18	
	Pietrain	\bar{x}	66.86	71.34	68.83	69.03	A–B; B–D a–d; b–c
		SD	19.69	23.27	25.39	23.46	
Number of insemination doses Liczba dawek inseminacyjnych	Duroc	\bar{x}	13.38	25.03	16.56	15.43	A–B; B–C,D a–c
		SD	4.00	8.13	6.25	3.56	
	Pietrain	\bar{x}	22.33	23.49	22.68	22.91	A–B; B–D a–d; b–c
		SD	6.32	7.19	8.10	7.34	

Similarly, the ejaculation of crossbreeds born in the winter season, was characterized by the highest concentration of sperm and the largest total number of progressive spermatozooids. As a result, the ejaculates of crossbreeds born in the winter produced the largest number of insemination doses. Significantly lower semen parameters, reducing the number of insemination doses produced, were received from crossbreed born in the spring.

In case of Duroc x Pietrain boars born in the spring, an average 19.24 of portions were obtained from the ejaculate, which is nearly 7 doses less when compared with the boars born in the winter. Also the boars from Pietrain breed mothers born in the spring, produced fewer insemination doses (= 23.08 pc), but the differences in the seasons of birth were not that significant (Fig. 1).

Table 2. The quality of ejaculates of crossbreed boars born in different seasons of the year
Tabela 2. Jakość ejakulatów knurów mieszańców urodzonych w różnych porach roku

Trait Cecha	Crossbreed Mieszaniec	Season of year – Pora roku				Significance of differences Istotność różnic AB:P<0.01; ab:P<0.05
		spring wiosna (A, a)	summer lato (B, b)	autumn jesień (C, c)	winter zima (D, d)	
Volume Ejaculates, cm ³ Objętość ejakulatu, cm ³	Duroc x Pietrain	\bar{x} 196.56 SD 62.06	206.17 66.40	225.22 69.56	237.45 79.78	A–B,C,D; B–C,D; C–D
	Pietrain x Duroc	\bar{x} 204.80 SD 68.28	257.20 66.91	241.84 81.45	216.44 84.41	A–B,C,D; B–D; C–D
Percentage of progressively motile spermatozoa, % Odsetek plemników o ruchu postępowym, %	Duroc x Pietrain	\bar{x} 68.09 SD 4.06	66.97 6.38	69.02 1.59	69.12 3.95	A–B,C,D; B–C,D; c–d
	Pietrain x Duroc	\bar{x} 69.55 SD 2.70	69.45 4.64	69.63 3.97	69.87 1.34	A–B,D; B–C,D; C–D a–c
Concentration of spermatozoa, x 10 ⁶ · cm ⁻³ Koncentracja plemników, x 10 ⁶ · cm ⁻³	Duroc x Pietrain	\bar{x} 445.70 SD 125.07	451.74 130.62	463.17 137.56	477.73 136.65	A–B,C,D; B–D; c–d
	Pietrain x Duroc	\bar{x} 490.22 SD 142.62	434.19 110.34	472.94 133.23	527.64 144.02	A–B,C,D; B–C,D; C–D
Total number of progressively motile spermatozoa, x 10 ⁹ Ogólna liczba plemników o ruchu postępowym, x 10 ⁹	Duroc x Pietrain	\bar{x} 58.97 SD 21.74	64.35 20.54	70.29 19.45	78.69 25.87	A–B,C,D; B–C,D; C–D
	Pietrain x Duroc	\bar{x} 69.06 SD 20.31	75.65 18.11	77.33 23.64	77.86 24.41	A–B,C,D
Number of insemination doses Liczba dawek inseminacyjnych	Duroc x Pietrain	\bar{x} 19.24 SD 6.05	21.28 6.43	23.47 6.32	26.20 8.25	A–B,C,D; B–C,D; C–D
	Pietrain x Duroc	\bar{x} 23.08 SD 6.50	25.31 5.95	25.74 7.56	25.75 7.83	A–B,C,D

Season of birth also affects the breeding efficiency, which is expressed by the number of insemination doses produced by pure-bred boars. Significant differences in the number of doses were found mainly in the boars of Duroc breed. Males of this breed, born in the spring gave only 13.38 units of sperm while ones born in the summer almost 25.03. The examination of semen from boars of Pietrain breed, born in different seasons did not show significant differences in the insemination doses produced. However, many more insemination doses were obtained from boars Pietrain breed born in the summer (Fig. 1).

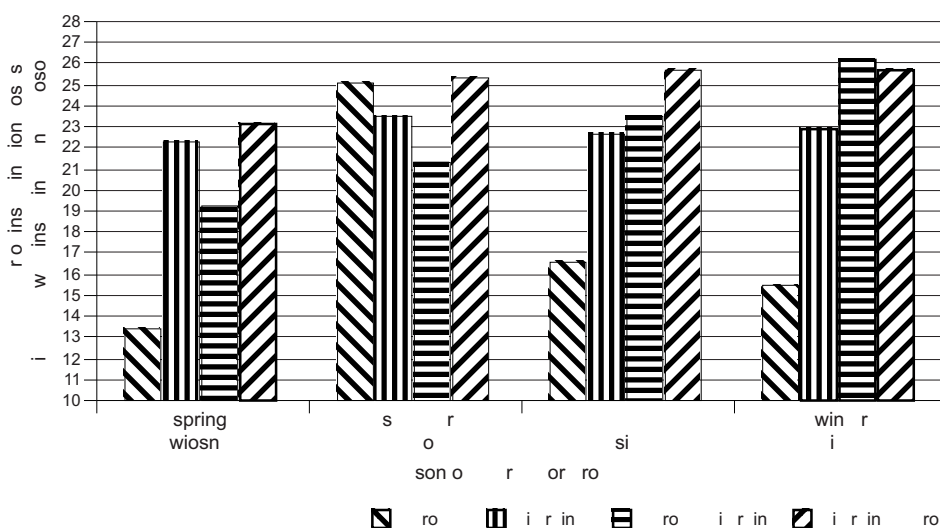


Fig. 1. The number of insemination doses of Duroc, Pietrain and crossbreed boars born in different seasons of the year

Rys. 1. Liczba dawek inseminacyjnych knurów ras duroc, pietrain i ich mieszańców urodzonych w różnych porach roku

The impact of season of birth boars' semen characteristics was studied by Owsianny et al. [2004] who proved that the semen of boars born in the autumn season characterizes with much higher quantitative and qualitative value indicators. Also in our study [Pokrywka et al. 2009] we demonstrated the impact of season of birth on the reproductive potential of boars. The cited studies indicate that the differences in the reproductive potential of boars, born in different seasons, are conditioned by genetic factors associated with the breed. In the group of boars born in the winter the highest number of insemination doses was produced by boars of PL and 990 Line breed, among ones born in the spring highest number of insemination doses was produced by boars of PLW race, and among the boars born in the autumn stand out boars of Hampshire breed.

CONCLUSIONS

The studies have shown the significance of impact that season of birth has on semen quality of boars and crossbreeds of evaluated races. The highest reproductive potential expressed as a number of insemination doses, was found in boars of Duroc and Pietrain breeds born in the summer. In case of crossbreeds, the best quality of sperm was found in males born in the winter season. The results of this study show that season of birth is a factor that should be taken into consideration when choosing insemination boars.

REFERENCES

- Banaszewska D., Kondracki S., Wysokińska A., 2007. Wpływ sezonu na zmiany w budowie morfologicznej plemników wybranych ras knurów inseminacyjnych [The influence of the season on the sperm morphology young boars used for insemination]. *Acta Sci. Pol., Zootech.* 6 (2), 3–14 [in Polish].
- Blicharski T., Hammermeister A., 2006. Wpływ współczesnej hodowli i produktywności świń [Influence of modern breeding and productivity of swine's]. III Międz. Konf. „Zastosowanie osiągnięć naukowych z zakresu genetyki, rozrodu, żywienia oraz jakości tusz i mięsa w nowoczesnej produkcji świń”, Bydgoszcz 18–19 czerwiec 2006. AT-R Bydgoszcz, 11–18 [in Polish].
- Brucka-Jastrzębska E., Białek M., Brzezińska M., Kawczuga D., Drewnowski W., Lisiecki L., 2008. Parametry ejakulatu w zależności od rasy świń [Semen parameters in relation to pig breed]. *Med. Weter.* 64 (10), 1248–1251 [in Polish].
- Central Animal Breeding Station [CSHZ], 1998. Użytkowanie rozplodowe knurów i zasady postępowania w laboratoriach stacji unasielenia loch [Reproductive performance of boars and the rules of procedure in laboratories of sow insemination stations]. Warszawa [in Polish].
- Ciereszko A., Ottobre J.S., Głogowski J., 2000. Effects of season and breed on sperm acrosin activity and semen quality of boars. *Anim. Reprod. Sci.* 64 (1–2), 89–96.
- Janett F., Fuschini E., Keo S., Hässig M., Thun R., 2005. Seasonal changes of semen quality in the boar. *Repr. Dom. Anim.* 40, 356.
- Kondracki S., Antolik A., Zwierz B., 1997. Cechy nasienia knurów w zależności od pory roku [Characters of boar semen depending on the season of the year]. *Rocz. Nauk. Zootech.* 24 (3), 67–76 [in Polish].
- Kondracki S., Banaszewska D., Wysokińska A., Radomska M., 2004. Effect of age on semen traits of Duroc breed used in insemination. *Anim. Sci. Pap. Rep.* 22 (3), 281–288.
- Kondracki S., 2010. Znaczenie inseminacji w hodowli i produkcji świń [Significance of insemination in breeding and swine production]. V Sympozjum Naukowe „Zastosowanie osiągnięć naukowych z zakresu genetyki, rozrodu, żywienia oraz jakości tusz i mięsa w nowoczesnej produkcji świń”, Bydgoszcz 14–15 października 2010. AT-R Bydgoszcz [in Polish].
- Milewska W., Falkowski J., 2004. Effects of season on selected semen traits in purebred and crossbred boars. *Anim. Sci. Pap. Rep.* 22 (3), 289–295.
- Owsianny J., Fiałkowska B., Kawęcka M., Czarnecki R., Matysiak B., 2004. Porównanie cech wartości rozrodczej knurów linii 990 urodzonych w sezonie wiosennym i jesiennym [Comparison of reproductive values traits in 990 Line boars born in spring and autumn]. *Zesz. Nauk. Prz. Hod.* 72 (2), 77–83 [in Polish].

- Pokrywka K., Ruda M., 2004. Wpływ sezonu eksploatacji na wybrane wskaźniki ilościowe i jakościowe nasienia knurów rozpoczynających użytkowanie w różnym wieku [The effect of performance season on the chosen quantitative and qualitative indices of boar semen depending on the age of the first ejaculate collection]. Zesz. Nauk. Prz. Hod. 72 (2), 85–93 [in Polish].
- Pokrywka K., Ruda M., Tereskiewicz K., 2009. Jakość ejakulatów knurów czystorasowych urodzonych w różnych porach roku [The quality of ejaculates of purebred boars born different seasons of the year]. Acta Sci. Pol., Zootech. 8 (4), 33–40 [in Polish].
- Smital J., 2009. Effects influencing boar semen. Anim. Rep. Sci. 110, 335–346
- Szostak B., 2003. Wpływ genotypu, wieku knura i sezonu eksploatacji na wybrane cechy ejakulatów [The effect of genotype, age of boar and season of use the selected qualities of ejaculates]. Zesz. Nauk. Prz. Hod. 68 (2), 147–155 [in Polish].
- Szostak B., Sarzyńska J., 2008. Effect of boar breed and chosen crossing variants on the development of basic traits of boar semen. Ann. UMCS, Sectio EE, XXVI (4), 10–16.
- Szostak B., Przykaza Ł., 2010. Wpływ rasy i wieku młodych knurów na wybrane cechy ich nasienia [The influence of breed and age of young boars the selected traits of their semen]. Acta Sci. Pol., Zootech. 9 (3), 93–100 [in Polish].
- Wysokińska A., Kondracki S., Kowalewski A., Adamiak A., Muczyńska E., 2009. Effect of seasonal factor on the ejaculate properties of crossbred duroc x pietrain and pietrain x duroc boars as well as purebred duroc and pietrain boars. Bull. Vet. Inst. Puławy 53, 677–685.

WPLYW SEZONU URODZENIA KNURÓW RAS DUROC I PIETRAIN ORAZ ICH MIESZAŃCÓW NA CECHY NASIENIA

Streszczenie. Celem badań była ocena jakości ejakulatów knurów ras duroc, pietrain i ich mieszańców urodzonych w różnych porach roku. Materiał do badań stanowiły wyniki użytkowania rozplodowego 143 knurów rasy duroc, pietrain i mieszańców (duroc x pietrain i pietrain x duroc). Ocenie poddano łącznie 20 442 ejakulatory knurów użytkowanych w latach 1997–2009 w Małopolskim Centrum Biotechniki, Stacja Eksploatacji Knurów w Czerminie. Ejakulatory oceniano na podstawie: objętości frakcji plemnikowej, odsetka plemników o ruchu postępowym, koncentracji plemników, ogólnej liczby plemników o ruchu postępowym, liczby dawek inseminacyjnych uzyskanych z jednego ejakulatu. Parametry ejakulatów knurów ocenianych ras analizowano statystycznie w porach roku urodzenia knura: wiosna (od 22 marca do 21 czerwca), lato (od 22 czerwca do 21 września), jesień (od 22 września do 21 grudnia), zima (od 22 grudnia do 21 marca). W badaniach wykazano istotny wpływ sezonu urodzenia knurów ocenianych ras i mieszańców na cechy jakościowe nasienia. Najwyższym potencjałem reprodukcyjnym wyrażonym liczbą dawek inseminacyjnych charakteryzowały się knury rasy duroc i pietrain urodzone latem. W przypadku mieszańców tych ras w obu wariantach krzyżowania najkorzystniejszymi parametrami nasienia charakteryzowały się samce urodzone w sezonie zimowym.

Słowa kluczowe: cechy nasienia, knur, mieszaniec, rasa, sezon urodzenia

Accepted for print – Zaakceptowano do druku: 14.07.2011