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Effect of selected factors on the reproductive performance of Sokolsky mares participating in the program for genetic resources protection

Wpływ wybranych czynników na wyniki rozrodu klaczy sokólskich uczestniczących w programie ochrony zasobów genetycznych

Summary. The study focused on the evaluation of breeding 150 Sokolsky mares under the genetic resources protection program and used for reproduction within the area governed by the Regional Horse Breeders Association in Bialystok. The analysis took into account the effect of age and origin after father on the values of particular indicators characterizing the reproductive performance of the studied mares. The following reproductive indicators were calculated: mating efficiency, fertility, non-heat percentage, proportion of dead births, and sterility, as well as the length of pregnancy and gestational interval. In total, 849 pregnancies and 700 gestational intervals were analyzed. The average mating efficiency of mares in the study period was 89.59%, fertility 84.53%, and the non-heat percentage 8.01%. Some variations could be observed in relation to miscarriages; the mean value of the indicator amounted to 1.47%. The share of dead births increased in subsequent years of mares' reproduction performance, reaching the level from 2.30% to 18.31%. A slight increase in the period of pregnancy in older mares and a prominent increase in the length of the gestational interval was reported. The gestational interval ranged from 107.33 days for below 6-year-old mares to 160.94 days at 14-year-old mares. Mares' origin after different father groups and mating with stallions from different genealogic lines also exerted some impact on the value of these indicators.

Key words: Sokolsky mare, program of genetic resources protection, reproduction indicators

INTRODUCTION

The horse breeding in practice can be full of problems. Due to a low prolificacy and slow rotation of generations [Bielański 1979], achieving satisfactory breeding progress is conditioned by various factors depending both on the animal's genotype, the farmers, and

the broadly understood environmental conditions. To reach optimum reproduction indicators is a fundamental requirement of breeding [Budzynski *et al*. 1995], which determines the positive economic result obtained from activities related to breeding of these animals. This applies both to small family farms, as well as specialized national centers. The appropriate rotation of generations determines the rapid breeding progress, which is expressed by a higher breeding value of the offspring as compared to parents. It can be concluded that proper reproduction in a herd can bring not only financial benefits, but also allows for its continued improvement. To repair the herd on the basis of animals characterized by a higher performance level is possible due to a skillful selection, proper choosing the pairs for mating at very effective reproduction. The effective reproduction is particularly important for endangered breeds, represented by a small number of their representatives. In this aspect, it allows for keeping, usually very valuable gene pool of animals with numerous qualities, especially in terms of their adaptability to local environmental conditions.

Taking into account the practical essence of the issue, these are the following goals of the study:

– evaluating the reproductive performance indicators of Sokolsky mares maintained within area governed by Regional Association of Horse Breeders in Białystok, and come within The Program of Genetic Resources Protection;

– evaluating the impact of mare's age, origin after different stud breeds, and stallions used for mating on mare's reproductive indicators.

MATERIAL AND METHODS

The study was conducted using 150 Sokolsky mares participating in the "Program for Protection of Genetic Resources of cold-blooded horses of Sokolsky type" within the area governed by the Regional Association of Horse Breeding (WZHK) in Bialystok. Horses were evaluated for reproduction performance results and tested mares were divided into following groups:

– referring to age – five groups (young ones below 6 years; from 7 to 8 years; from 9 to 10 years; from 11 to 13 years; and above 14 years old);

– referring to origin after the same father – 10 paternal groups represented by minimum four daughters (55 mares in total).

Mean age of studied mares was 10.21 years. The largest group (44 animals) was made up by mares between 9 and 10 years old. These mares came after 93 stallions.

Using breeding records kept in WZHK Bialystok, following indicators (%) characterizing the efficiency of breeding performance were calculated: mating efficiency – the ratio of pregnant to mated mares number, fertility – the ratio of live born foals to mated mares number; sterility – the ratio of mated to mated mares number; abortion – the ratio of aborting to mares being in foal number, dead birth - the ratio of dead born events to mated mares number, no heat – the ratio of mares not showing the estrus signs to all performed mares number during a given period. Moreover, the pregnancy duration expressed as the number of days from a successful mating to foaling and the gestational interval as a number of days from foaling to subsequent successful mating, was also determined. Analyses took into account the influence of the following factors on values

of particular indicators: subsequent season of mare's reproduction performance, mare's age, and affiliation to a given paternal group. Collected material was statistically processed by calculating the mean values of each indicator features and standard deviations, indicating the extreme values (Mn – minimum and Mx – maximum). The significance of differences between mean values in separate groups were estimated applying the Student t-test and multi-factorial analysis of variance.

RESULTS AND DISCUSSION

The study revealed high values of the basic reproductive indicators of Sokolsky mares. In 2007–2011, the average mating efficiency was at the level of 89.59%, fertility 84.53%, while sterility 10.41%. The average percentage of abortions and dead born events amounted to 1.47% and 3.79%, respectively (Table 1). Considerable difference was reported between values of studied indicators estimated for subsequent years. Some systematic decline in reproduction efficiency since 2007, when the mating efficiency and fertility were the highest, till 2011, when both indicators reached the lowest levels. Most probably, this tendency resulted from the fact that along with time, more and more the oldest mares having various problems with successful mating and pregnancy ended with live born gestation, appeared in the herd. Kulisa [2000] showed that the largest percentage of successful matings was observed at medium (86.6%) and primiparous mares (86.1%), while the lowest at older ones [Kulisa *et al*. 2000].

The twin pregnancy is a negative factor influencing on the reduced reproductive performance in herds, because a remarkable percentage of a fetal resorption, abortion, and dead born foals is associated. Foals born from such pregnancies are usually not of a significant value [Bielański and Tischner 1997, Wierzbowski and Kosiniak-Kamysz 1998].

The analyzes revealed the significant reduction in mating efficiency and fertility of assessed mares along with the subsequent season of their reproductive performance, while a significant increase in the percentage of sterility. Given the large sample size (50% of all evaluated mares), it can be assumed that the highest efficiency of mare's reproduction occurred during the first 7 seasons of their reproductive performance. Values of evaluated indicators decreased along with subsequent reproductive season. Although in 12^{th} and 13^{th} season, higher mating efficiency and fertility were recorded, but these two seasons are hardly representative due to the small number of mares mated at that time. A similar situation occurred in the case of 15^{th} season, when mating efficiency and fertility reached 100% (Table 2). Compared to other breeds, here evaluated group of Sokolsky mares was very promising. Based on the findings of other authors, it can be concluded that the mating efficiency of the thoroughbred mares ranges from 75–80%, while that of the Lesser Poland mares – 77.0%. The highest level of this indicator (94.8%) is however, observed for primitive breeds, e.g. Polish pony [Geringer and Hołówko 2000].

According to some authors, the percentage of sterile mares kept for reproductive purposes can vary within a large range, even from several to about 34% [Nowicka-Posłuszna and Zygmunt 2001]. Other authors determined the value of the indicator at 13.3% for Silesian mares to 13.3% [Gancarz *et al.* 2004]. Abortions in a herd is very negative factor, which reduces the effects of breeding. Our own study showed an average

Table 1. Indicators of reproduction performance of Sokolsky mares come within the Program of Genetic Resources Protection in 2007–2012
Tabela 1. Wskaźniki użytkowości rozpłodowej klaczy sokólskich objętych Programem Ochrony Zasobów Genetycznych w latach 2007–2012

Years Lata	Number of mares Liczba klaczy		Non-heat Brak rui		Mated mares Klacze kryte		Mating efficiency Źrebność		Fertility Płodność		Abortions Poronienia		Dead born Martwe urodzenia		Sterile Jałowienia	
	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%
2007	103	69,13	16	15,53	87	84,47	85	97,70	85	97,70	-	-	-	-	2	2,30
2008	123	82,55	16	13,01	107	86,99	99	92,52	96	89,72	-	-	3	2,80	8	7,48
2009	149	100,00	4	2,68	145	97,32	128	88,28	113	77,93	3	2,34	12	8,28	17	11,72
2010	148	99,33	9	6,08	139	93,92	122	87,77	111	79,86	4	3,28	7	5,04	17	12,23
2011	146	97,99	4	2,74	142	97,26	116	81,69	110	77,46	2	1,72	4	2,82	26	18,31
Mean for years Średnio w latach			9,8	8,01	124,00	91,99	110,00	89,59	103,00	84,53	1,80	1,47	5,20	3,79	14,00	10,41

Table 2. List of reproductive performance indicators for Sokolsky mares taking into account the number of performance seasons calculated in reference to all evaluated mares
Tabela 2. Zestawienie wskaźników użytkowości rozpłodowej klaczy sokólskich z uwzględnieniem liczby sezonów użytkowania rozpłodowego, wyliczonych w odniesieniu do wszystkich ocenianych klaczy

Season Sezon	Number of mares Liczba klaczy		Non-heat Brak rui		Mated mares Klacze kryte		Mating efficiency Źrebność		Fertility Płodność		Abortions Poronienia		Dead born Martwe urodzenia		Sterile Jałowienia	
	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%	mares klacze	%
1	150	100,00	-	-	150	100,00	148	98,67	146	97,33	2	1,33	-	-	2	1,33
2	150	100,00	23	15,33	127	84,67	121	80,67	118	78,67	2	1,33	1	0,67	6	4,00
3	150	100,00	10	6,67	140	93,33	127	84,67	127	84,67	-	-	-	-	13	8,67
4	137	91,33	16	11,68	121	88,32	114	83,21	114	83,21	-	-	-	-	7	5,11
5	113	75,33	5	4,42	108	95,58	97	85,84	95	84,07	2	1,77	-	-	11	9,73
6	92	61,33	8	8,70	84	91,30	74	80,43	73	79,35	1	1,09	1	1,09	10	10,87
7	75	50,00	8	10,67	67	89,33	61	81,33	59	78,67	2	2,67	-	-	6	8,00
8	51	34,00	4	7,84	47	92,16	42	82,35	40	78,43	2	3,92	-	-	5	9,80
9	40	26,67	5	12,50	35	87,50	29	72,50	28	70,00	1	2,50	-	-	6	15,00
10	30	20,00	2	6,67	28	93,33	24	80,00	24	80,00	-	-	-	-	4	13,33
11	23	15,33	-	-	23	100,00	15	65,22	15	65,22	-	-	-	-	8	34,78
12	16	10,67	-	-	16	100,00	13	81,25	13	81,25	-	-	-	-	3	18,75
13	12	8,00	2	16,67	10	83,33	10	83,33	10	83,33	-	-	-	-	-	-
14	6	4,00	1	16,67	5	83,33	4	66,67	4	66,67	-	-	-	-	1	16,67
15	3	2,00	-	-	3	100,00	3	100,00	3	100,00	-	-	-	-	-	-

level of abortions for Sokolsky mares (1.47%). It was rather low value and very beneficial in the context of reproductive efficiency in the herd. Oleksiak and Galas estimated the abortion indicator in noble semi-blood and pure-blood Arabian horse breeds for 4.60–6.16% [Oleksiak and Galas 2000].

Our own study carried out using Sokolsky mares also showed some significant individual differences for the duration of pregnancy and gestational interval. In the assessed group of Sokolsky mares, the average pregnancy lasted for 335.23 ± 8.35 days with variations from 272 to 351 days. The gestational interval fluctuated in a wide range, from 4 up to 1000 days, with an average of 96.26 ±167.31 days. Frequently, however, it amounted to 1–50 days (60.42% of the analyzed gestational intervals) and 51–100 days (15.86% of the analyzed gestational intervals) (Table 3).

Table 3. Frequency of particular gestational intervals duration at Sokolsky mares come within the Program of Genetic Resources Protection
Tabela 3. Frekwencja poszczególnych długości okresów międzyciążowych u klaczy sokólskich objętych Programem Ochrony Zasobów Genetycznych

No Lp.	Gestational interval length Długość okresu międzyciążowego	n	%
1	1–50	434	62,00
2	51–100	100	14,29
3	101–150	43	6,14
4	151–200	11	1,57
5	201–250	16	2,29
6	251–300	9	1,29
7	301–350	25	3,57
8	351–400	22	3,14
9	401–450	17	2,43
10	451–500	8	1,14
11	501–1000	11	1,57
12	1001–2200	4	0,57

Results achieved by other authors indicate prominent prolongation of both the estrus and pregnancy duration at older mares [Chmiel *et al*. 2000, Walkowicz 2001].

According to Kosiniak-Kamysz and Wierzbowski, pregnancy in mares takes an average of 338–340 days (with fluctuations about 310–370 days) [Kosiniak-Kamysz and Wierzbowski 2003/2004]. Hence, the average length of pregnancy observed in the present study for Sokolsky mares may be considered compatible with the standards applicable to this horse breed. The own study showed significant individual impact of a stallion on gestation length and duration of the gestational interval of the mated mare.

The average duration of pregnancy was the longest at the daughters of 1986 Buchar sire (337.02 ±195.11 days), while the shortest at the female offspring of 1221 Bobr stallion (313.11 ±151.16 days). The observed differences were not statistically significant. Much greater variation related to the length of gestational interval, which ranged from only 22.06 ±3.02 days at daughters of 9590 Gmach stallion to 222.41 ±3.96 days for daughters of 1485 Salniak sire (Table 4).

Table 4. Average pregnancy and gestational interval duration of Sokolsky mares after the most numerously represented paternal groups (minimum 3 representatives) and the standard deviation
Tabela 4. Średnia długość ciąży i okresu międzyciążowego klaczy sokólskich pochodzących z najliczniej reprezentowanych grup ojcowskich (minimum 3 przedstawicielki) oraz odchylenie standardowe

No Lp.	Name of sire Nazwa ogiera	Pregnancy duration (days) Długość ciąży (dni)		Gestational interval duration (days) Długość okresu międzyciążowego (dni)	
		X	S	X	S
1	1221 BOBR n = 4	311,11	142,16	128,90	46,75
2	1986 BUCHAR n = 8	336,49	196,43	122,56	2,91
3	1503/2000 GEST n = 3	332,42	154,92	185,18	3,70
4	9590 GMACH n = 3	335,34	70,07	23,09	2,51
5	1059 GUSTLIK n = 3	338,75	182,86	119,63	1,15
6	810 HETMAN n = 3	338,34	98,65	53,80	3,39
7	1257/97 PULOWER n = 5	334,09	36,23	19,76	3,35
8	1485 SALNIAK n = 3	335,30	232,23	224,93	4,51
9	1738 SEKTOR n = 4	251,92	103,93	167,95	75,76
10	1008 SENIOR n = 5	335,06	81,59	78,02	3,13
11	1475/2000 SETNY n = 3	334,64	71,20	25,49	2,56
12	316 SPLENDOR n = 4	331,56	51,56	54,65	14,24

The analyzes showed that the pregnancy duration slightly increased at analyzed mares within the range from 323.89 ±3.23 days for mares aged 7–8 years to 335.76 ±4.54 days in 9–10 year-old mares. A similar trend was observed in relation to the length of gestational interval, which ranged from 84.26 ±41.32 for 7–8 year-old mares to 162.15 ±43.21 days at mares above 14 years of age. The observed differences however, were not statistically significant.

CONCLUSIONS

1. General indicators of reproductive performance of studied mares were at high levels. Average mating efficiency amounted to 89.59%, while fertility to 84.53%.

2. It has been shown that in subsequent reproductive seasons, mating efficiency and fertility of mares decreased reaching the value within the range 65.22 – 100%; length of the reproductive performance ranged from 1 to 15 seasons; some decline in the number of mares in consecutive seasons was prominent.

3. The pregnancy and gestational interval duration prolonged with mare's age.

4. It was found that the daughters of different sires were characterized by considerable variation referring to their pregnancy and gestational interval duration.

REFERENCES

Bielański W., 1979. Rozród zwierząt. PWRiL Warszawa.
Bielański A., Tischner M., 1997. Biotechnologia rozrodu zwierząt udomowionych. Drukrol Kraków.
Chmiel K., Sobczuk D., Gajewska A., 2000. Wpływ wieku klaczy czystej krwi arabskiej na długość ich rui i ciąży. Annales UMCS, sec. EE, Zootechnica, 18 (19), 141–143.
Gancarz J., Budzyński M., Budzyńska M., Zamoyska A., 2004. Wskaźniki reprodukcyjne klaczy zarodowych na terenie województwa podkarpackiego. Annales UMCS, sec. EE, Zootechnica, 22 (26), 195–199.
Geringer H., Hołówko U., 2000. Analiza rozrodu klaczy pełnej krwi angielskiej stadnin dolnośląskich w latach 1976–1995. Zesz. Nauk. PTZ 50 (28), 67–72.
Kosiniak-Kamysz K., Wierzbowski S., 2003/2004. Rozród koni. Drukrol Kraków.
Kulisa M., Łuszczyński J., Pieszka M., Więć K., 2000. Wpływ wieku klaczy matki na wartość potomstwa. Zesz. Nauk. PTZ, 50 (29), 271–282.
Nowicka-Posłuszna A., Zygmunt B., 2001. Ocena wskaźników rozpłodowych klaczy użytkowanych w Stadninach Koni Pępowo, Posadowo i Racot w latach 1995–2000 z uwzględnieniem ich modelu rodowodowego (cz. I). Rocz. Nauk. Zoot., Supl., 14, 309–317.
Oleksiak S., Galas A., 2000. Ocena wyników użytkowania rozpłodowego klaczy czystej krwi arabskiej w latach 1982–1991. Zesz. Nauk. PTZ 50 (31), 295–305.
Walkowicz E., 2001. Charakterystyka wybranych wskaźników rozrodu klaczy śląskich w hodowli państwowej. Zesz. Nauk. PTZ, 50, 255–262.
Wierzbowski S., Kosiniak-Kamysz K., 1998. Kierowany rozród koni. Drukrol, Kraków.

Streszczenie. Badania dotyczyły oceny wyników rozrodu 150 klaczy sokólskich objętych programem ochrony zasobów genetycznych i użytkowanych rozpłodowo na terenie działalności Wojewódzkiego Związku Hodowców Koni w Białymstoku. W analizach uwzględniono wpływ wieku i pochodzenia po ojcu na wartość poszczególnych wskaźników charakteryzujących użytkowość rozpłodową badanych klaczy. Wyliczono dla nich wskaźniki reprodukcji, takie jak: źrebność, płodność, procent braku rui, martwych urodzeń i jałowień oraz długość ciąży i okresu międzyciążowego. Przeanalizowano 849 ciąże i 700 okresów międzyciążowych. Średnia źrebność klaczy w okresie lat objętych oceną wyniosła 89,59%, płodność 84,53%, zaś procent braku rui 8,01%. Tendencję zróżnicowaną można było zaobserwować w przypadku poronień. Średnia tego wskaźnika wyniosła 1,47%. Procent jałowień rósł wraz z kolejnym rokiem użytkowania rozpłodowego klaczy, przyjmując wartość od 2,30% do 18,31%. Wykazano nieznaczne wydłużenie się okresu ciąży u klaczy starszych oraz wyraźny wzrost długości okresu międzyciążowego. Okres międzyciążowy wahał się od 107,33 dni u klaczy do 6 roku życia do 160,94 dni u klaczy powyżej 14 roku życia. Wpływ na wartość powyższych wskaźników miało również pochodzenie klaczy z różnych grup ojcowskich oraz krycie ich ogierami należącymi do różnych linii genealogicznych.

Słowa kluczowe: klacze sokólskie, program ochrony zasobów genetycznych, wskaźniki reprodukcji