

CHRONOLOGICAL DYNAMICS OF SEVERAL REPRODUCTION PARAMETERS OF SHAGYA ARABIAN BROODMARES

C. Pânzaru¹, R.M. Radu-Rusu¹, M.A. Davidescu¹, M.G. Doliş^{1*}

¹Faculty of Food and Animal Sciences, Iasi University of Life Sciences, Romania

Abstract

A total of 1,110 cases of Shagya Arabian broodmare gestation, from the Rădăuți National Stud farm, were subject to analysis. The aim was to assess whether the 30-year breeding management provided optimal conditions for this breed to express its genetic potential. Consequently, it was necessary to assess the incidence of abortions, along with fertility percent. The results revealed that the average gestation length for each year within the study ranged from a minimum of 331.27 ± 0.30 days to a maximum of 340.48 ± 0.62 days. Abortion rates were found to vary between 0% and 12.90%, while fertility percentages fluctuated between 59.67% and 95.12%. To enhance these parameters, it is recommended primarily to improve the maintenance system for the mares, enhance the quality of their feeding, and consider adjustments to the breeding system. These measures are intended to reduce abortion rates, increase fertility percentages, and decrease foaling intervals.

Key words: Shagya Arabian, gestation, abortion, fertility

INTRODUCTION

The Shagya Arabian horse breed, initially created to meet the needs of the Austro-Hungarian cavalry for a sturdier and more powerful horse than its noble and elegant ancestor, the Purebred Arabian, later came to represent a symbol of pride in its native region. This program involved crossbreeding Purebred Arabian stallions imported from the Middle East with those born in Rădăuți, Romania and Bábolna, Hungary, individuals selected based on physical criteria. Only through applying correct reproductive techniques, which include rigorous selection, pair matching, and understanding the criteria used in breeding, a highly valuable result was achieved. [1]

The Shagya Arabian broodmares reared in stud farms start mating at approximately 42-48 months of age, depending on their physical development, health condition, and reproductive management. The age at first

foaling depends on the functioning of female's reproductive system, the balance between her neurological and hormonal systems, and the onset of gestation. [2]

The gestation represents the period between the last successful fertilization and parturition, during which the mares' organism provides the fetus with the nutrition, excretion, and breathing it needs to develop in utero. Its average length is around 340 days in mares, with a range between 310-412 days. [3]

The fertility, or the gestation rate, is one of the most important parameters considered in stud farms. It is calculated by comparing the number of pregnant mares to the number of inseminated ones, and its value should be between 80-90% in stud farms and 60-70% in other types of farms. [4]

As for the abortion rate in this species, the primary cause of non-infectious ones is multiple gestations, which occur in the 8th to

*Corresponding author: mariusdolis@uaiasi.ro

The manuscript was received: 01.10.2023

Accepted for publication: 31.10.2023

9th month due to placental insufficiency. Another common cause in this species is the twisting of the umbilical cord, which occurs because of its significant length (approximately 100 cm). Diagnosis is established by identifying edema or cord hemorrhage. Additionally, disturbances in circulation (indicated by subcutaneous swellings), mineralization of the placental blood vessels (observed under a microscope), a soft and edematous liver are signs of cord obstruction. [5]

Given the fact that Shagya Arabian breed is extremely valuable for various equestrian sports and that the primary supplier of high-quality biological material is the Rădăuți Stud farm, in Romania, it is necessary to analyze the reproductive management to determine if the principles of proper breeding and adequate maintenance are applied. These aspects are reflected in the fertility of the breeding herd, the number of annual abortions recorded, and the gestation length calculated for the whole population of broodmares registered each year. [6]

MATERIAL AND METHOD

The length of gestation is influenced by the age of the female (primiparous and older females tend to have a longer gestation period), the sex of the offspring (males have a longer gestation period than females), climate (a tropical climate shortens the gestation period compared to a cold one), and the maintenance conditions (the diet and care of the mares can shorten the gestation period). In cases where abortions are recorded in females without infectious or hormonal causes, daily progesterone supplementation (either orally or through injections) is administered to maintain the pregnancy until full term. Fertility is indeed one of the most important parameters to

consider in a stud farm, and it is calculated by comparing the number of pregnant mares to the number of females that were inseminated. In the case of horses raised in stud farms where the primary goal is reproduction, fertility should ideally reach percentages of 90% or higher. High fertility rates are indicative of the successful breeding program and the overall health and management of the breeding stock. [6]

Along with calculating the average gestation lengths recorded each year during the period, the analysis also involved looking into the number of abortions and the fertility percentage within the breeding core. The data were extracted from the stud farm's records and processed using Microsoft Excel and GraphPad Prism 8.4.2 (\bar{X} , $\pm S_{\bar{x}}$, s, V%, p significance test). This analysis allowed for an examination of the reproductive process over a significant 30-year period, which is essential for drawing pertinent conclusions regarding the reproduction in this unity.

RESULTS

To assess the reproductive performance of the Shagya Arabian broodmares reared in Rădăuți Stud farm during the period 1989-2018, gestation length, fertility percentage, and abortion rate were calculated. Therefore, a number of 1,110 cases were analyzed for the results to be relevant.

In Table 1, the situation of the gestation length for the broodmares (days) is represented. It can be observed that the minimum value was registered in the year 2004 (331.27 ± 0.30 days), while the maximum was in 2008 (340.48 ± 0.62 days); the average value for this parameter over the entire studied period was 337.12 ± 0.572 days, which is in between the ranges mentioned in the literature (310-412 days).

Table 1 The average gestation length of Shagya Arabian broodmares

The studied year	N	\bar{X}	\pm StDev	$\pm s_{\bar{x}}$	V%	Min.	Max.
2018	57	338.21	6.10	0.73	1.80	323	358
2017	53	337.92	5.86	0.69	1.73	323	358
2016	39	338.14	4.88	0.74	1.44	328	354
2015	37	338.50	5.40	0.65	1.59	328	358
2014	50	339.30	5.23	0.65	1.54	329	358
2013	39	338.57	4.88	0.61	1.44	329	357
2012	36	338.47	3.66	0.51	1.08	333	354
2011	32	339.96	3.67	0.56	1.08	336	354
2010	24	339.68	3.61	0.57	1.06	336	354
2009	25	339.32	4.23	0.64	1.24	329	354
2008	21	340.48	3.73	0.62	1.09	336	354
2007	19	339.66	3.89	0.62	1.14	329	354
2006	22	336.06	3.72	0.58	1.10	329	354
2005	25	333.23	2.07	0.31	0.62	329	337
2004	33	331.27	2.10	0.30	0.63	328	339
2003	39	337.10	2.52	0.35	0.75	331	342
2002	31	338.12	1.88	0.26	0.55	332	342
2001	46	336.16	3.42	0.44	1.01	330	347
2000	39	338.67	3.73	0.47	1.10	326	352
1999	48	337.78	2.56	0.33	0.75	327	345
1998	53	335.83	3.91	0.49	1.16	328	348
1997	50	339.04	2.29	0.28	0.67	329	346
1996	51	338.45	2.45	0.31	0.72	329	346
1995	41	338.56	2.45	0.32	0.72	329	346
1994	38	337.91	2.83	0.40	0.83	329	346
1993	30	335.58	5.12	0.77	1.52	321	346
1992	31	332.62	8.32	1.30	2.50	304	357
1991	31	331.88	4.72	0.72	1.42	323	345
1990	37	334.22	6.29	0.92	1.88	318	348
1989	33	333.17	7.15	1.04	2.14	317	354

N= number of gestations analyzed; \pm StDev = standard deviation; $\pm s_{\bar{x}}$ = standard error; V% = variation coefficient; Min. = minimum value of gestation length (days); Max. = maximum value of gestation length (days); Alpha=0,05.

For all the analyzed years, the coefficient of variation ranged from 0.55% to 2.50%, indicating a very low influence of individuality within each studied core regarding gestation duration, a characteristic that can be considered very homogeneous. However, by using the variance analysis algorithm, unifactorial variance, significant differences were observed between the mean values of gestation duration in 2.30% of cases, distinctly significant differences in 4.37%

of the year-to-year comparisons, and particularly very significant differences in 24.49% of the analyzed situations. In all other comparisons made, the differences were non-significant.

The dynamic representation of gestation length is illustrated in Figure 1, where it is observed that the maximum value was recorded in 2008 (340 days). This aspect, in correlation with the low number of pregnant broodmares, can be explained by the relocation of this horse population to

Brebeni, Olt County, in 1998, when a reduction in the total number of females was initiated. Probably, along with the changes

in environmental conditions and how the mares' bodies responded to them, physiological changes also occurred.

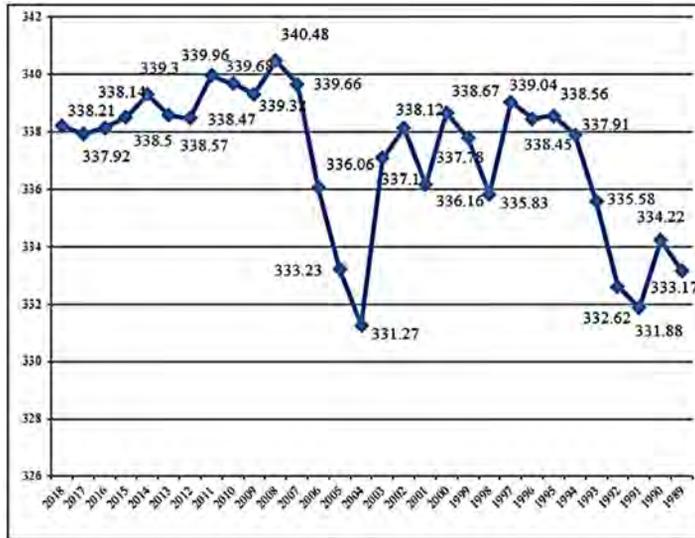


Fig. 1 The dynamics of gestation length from 1989 to 2018 (days)

The fertility in the studied population ranged between 59.67% (in 2015) and 95.12% (in 2016). A significant difference is observed between the populations in these two years: in 2015, there were 69 mares in the breeding herd, of which 62 were inseminated, and only 37 remained pregnant, whereas in 2016, the number decreased to 43 mares, with 41 inseminated

and 39 becoming pregnant. The conclusion can be drawn that mares with a lower fertility percentage were removed from the breeding herd, leading to its improvement in the following year. This decision was correct, as in the subsequent years, the parameter showed high values (81.53% in 2017 and 89.06% in 2018). (table 2)

Table 2 The fertility percent of Shagya Arabian broodmares (%)

The studied year	L (heads)	M (heads)	N (heads)	F (%)
0	1	2	3	4
2018	68	64	57	89.06
2017	71	65	53	81.53
2016	43	41	39	95.12
2015	69	62	37	59.67
2014	63	62	50	83.33
2013	62	62	39	62.90
2012	50	50	36	72.00
2011	43	43	32	74.42
2010	40	38	24	63.15
2009	43	40	25	62.50
2008	36	33	21	63.63
2007	39	29	19	65.51
2006	41	26	22	84.61

0	1	2	3	4
2005	43	32	25	78.12
2004	48	44	33	75.00
2003	52	47	39	82.97
2002	49	40	31	77.50
2001	58	51	46	90.19
2000	62	48	39	81.25
1999	59	53	48	90.56
1998	63	60	53	88.33
1997	64	59	50	84.74
1996	60	56	51	91.07
1995	58	49	41	83.67
1994	49	45	38	84.44
1993	44	39	30	76.92
1992	41	36	31	86.11
1991	42	38	31	81.57
1990	46	41	37	90.24
1989	47	41	33	80.48

L= the number of broodmares in the herd; M= the number of inseminated broodmares;
 N= the number of pregnant broodmares; F= fertility percent.

The dynamics of the fertility percent is illustrated in figure 2, where it can be observed that between 1989-2005, this parameter was relatively constant and at high values, then it declined until it got to the lowest point in 2015 (59,67%). But then in 2016 it reached the maximum value of 95.12% (the great difference of total number of broodmares between these two years indicate that in 2016 only the females

with great fertility were maintained in the reproduction herd – in 2015 a number of 69 heads was registered, while in 2016 only 43 were bred). These variations can be attributed to the influence of various factors involved in the reproductive activity, such as the maintenance and nutrition of the females, the exercise schedule, and even health issues affecting them or the stallions used for breeding, among other factors.

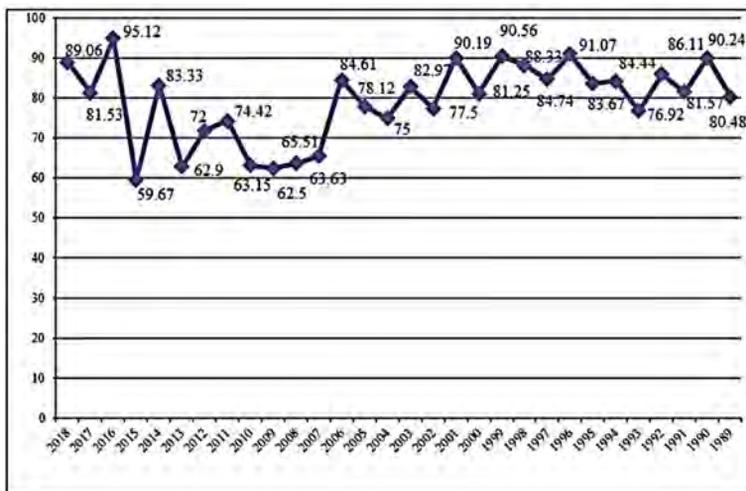


Fig. 1 The dynamics of fertility percent from 1989 to 2018 (%)



Table 3 shows that the minimum abortion rate was 0% in 33.33% of the 30 years studied, and the maximum rate was identified in the year 2002 (12.90%). This variation can be justified by the fact that in 2002, there was a change in management, which likely led to changes in the

maintenance conditions for the broodmares. This, in turn, might have necessitated a period of adaptation to the new management practices. Sometimes, this adjustment period can be extended, especially if it is influenced by other factors contributing to the occurrence of abortions.

Table 3 The abortion rate of Shagya Arabian broodmares

Year	Pregnant mares (heads)	Abortions (heads)	Abortions (%)
2018	57	2	3.50
2017	53	4	7.54
2016	39	0	0
2015	37	4	10.81
2014	50	1	2.00
2013	39	1	2.56
2012	36	4	11.11
2011	32	3	9.37
2010	24	2	8.33
2009	25	0	0
2008	21	0	0
2007	19	0	0
2006	22	0	0
2005	25	2	8.00
2004	33	0	0
2003	39	3	7.69
2002	31	4	12.90
2001	46	2	4.34
2000	39	1	2.56
1999	48	0	0
1998	53	2	3.77
1997	50	0	0
1996	51	0	0
1995	41	3	7.31
1994	38	1	2.63
1993	30	0	0
1992	31	3	9.67
1991	31	2	6.45
1990	37	3	8.10
1989	33	1	3.03

DISCUSSIONS

Considering that the average value of gestation length over the entire studied period was 337.12 ± 0.572 days and that the literature mentions a range of 310-412 days [7], it can be affirmed that the broodmares analyzed over the course of 30 years fall

within the acceptable limits for their species. Furthermore, for half-blooded mares, a more restricted range is mentioned (337-339 days), and the results obtained during the study period fall within the range specified by the author mentioned earlier. [7]

According to specialized studies, fertility should fall within the range of 80-90% in stud farms [8]. In the studied period, fertility exceeded the 80% threshold in only 4 out of the 30 years analyzed. In 73.33% of these years, it was above 60%, a value more typical of other types of horse farms. This suggests that the management of the breeding activity met the requirements of the species. However, in the years when the values were not high, certain aspects like feeding and maintenance may not have been optimal. Therefore, paying due attention to the nutrition, maintenance, training, selection, health status of the mares, as well as the breeding stallions, are fundamental elements in achieving the desired performance and increasing the percentages of these parameters.

CONCLUSIONS

The study led to the following conclusions:

- analysis of the average gestation length, for each year of the studied period, indicated the fact that the minimum value was registered in 2004 (331.27 ± 0.30 days), and the maximum in 2008 (340.48 ± 0.62 days); the character is very homogeneous ($V\%=0.55-2.50\%$).
- the fertility percent recorded limits between 59.67% (2015) and 95.12% (2016), the birth rate percent had a minimum value of 46.15% and maximum of 90.69%, with an average of 67.60%.
- the percentage of abortions revealed limits between 0-12.90% (admitted values for this species).

The following recommendations can be drawn:

- better feeding and selection management to improve the fertility percent.
- better maintenance for broodmare to avoid mechanical abortions.

REFERENCES

1. Ivancia, M.; Pânzaru, C.; Nicolae CG; Doliş, MG; Raţu, R. Study regarding the morphology of public mount stallions population from Tuluceşti stud farm. University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Animal Production, Engineering and Management, Scientific papers, Series D, Animal Science, **2019**, *62*, No. 1, 162-167, WOS: 000484814600024.
2. Doliş, MG; Pânzaru, C.; Doliş, GM; Maftai, M; Raţu, RN. Contributions to studies regarding the morphological and reproduction characters of Shagya Arabians horse breed, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Animal Production, Engineering and Management, Scientific papers, Series D, Animal Science, **2021**, *64* (2), 45-50, WOS:000737352500004.
3. Doliş, MG; Usturoi, MG; Simeanu, D; Pânzaru, C. Study regarding the reproduction activity of Shagya Arabian broodmares from Rădăuţi stud farm: Oradea, Annals of the University of Oradea, Fascicle: Ecotoxicology, Animal Husbandry and Food Science and Technology, **2020**, *19/B*, 141-150.
4. Dumitrescu, I. Horse reproduction, **1986**, 77-78. *Ceres Publ.*, Bucharest.
5. Doliş, MG; Radu-Rusu, R.; Nacu, G.; Doliş, GM; Maciuc, V; Pânzaru, C. Study regarding some reproductive parameters of broodmares from Rădăuţi stud farm: University of Agricultural Sciences and Veterinary Medicine, Iaşi, Scientific papers – Animal Science Series, **2021**, *75* (26).
6. Heck, L.; Clauss, M.; Sanchez-Villagra, M. R. Gestation length variation in domesticated horses and its relation to breed and body size diversity, *Zurich, Mammalian Biology* **84**, **2017**, 44-51.
7. Dumitrescu, I. Horse reproduction. **1986**, 77-80. *Ceres Publ.*, Bucharest.
8. Velea, C.; Târnoveanu, I; Marcu, N.; Bud, I. Horse rearing, **1980**, 66-69. *Dacia Publ.*, Cluj Napoca.