Dynamics of Several Morphological Traits in Shagya Arabian Broodmares

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Abstract

The study aimed to present the dynamics of the height at withers, heart girth, and cannon girth of Shagya Arabian broodmares included in the Rădăuți stud's broodstock between 1989 and 2018. The purpose was to observe the population's evolution over time, considering that the breeding objectives included increasing the average values of these measurements, which were followed in ranking activities. The average height values ranged between 154.3±0.261 cm (2012) and 154.80±0.258 cm (2002 and 1994). The minimum average value of the thoracic girth was recorded in 1992 (176.2±0.885 cm), and the maximum was in 1989 (177.1±0.777 cm). The average values of the cannon girth registered the minimum in 1998 at 18.7±0.19 cm and the maximum in 1989 at 18.9±0.70 cm. Comparing the results with the breeding objectives (height at withers of 156 cm, heart circumference of 176 cm, and cannon girth of 19.5 cm), it was observed that only the heart girth had the targeted value. This highlights the importance of continuing the breeding process to achieve all the desired objectives.

Keywords: broodmares, cannon girth, heart girth, height, Shagya Arabian

1. Introduction

The Shagya Arabian is a globally acclaimed horse breed known for its diverse equestrian skills, including endurance, show jumping, recreational riding, and even hippotherapy. This assertion is supported by the total number of 720 registered horses in Romania alone, recorded in the national database (370 horses in the private sector and 350 horses in national stud farms) [1].

The breeding program for the Shagya Arabian horse breed in Romania, released in 2020, outlines the objectives of preserving the characteristics and attributes of the breed's founders, either entirely or to a greater extent, and aims to avoid an increase in inbreeding within the population. The program also emphasizes the need for a genetically stable population, considering the breed's "endangered" status [2].

The Rădăuți National Stud has been breeding one of the most significant stocks of Shagya Arabian horse breed in the world since the 18th Century. Initially, the goal was to create robust and energetic horses for the military. Therefore, when defining breeding objectives, this aspect was given top priority [3-6].

Given that the analyzed dimensions (height at the withers, thoracic circumference, and cannon girth) are also considered in ranking activities in National Studs, this study aims to examine the historical changes in these morphological aspects that characterize the broodmares at Rădăuți Stud Farm in Suceava County. Furthermore, it provides an opportunity to assess whether the breeding goals for mares, aiming to increase the height at the withers to 156 cm, chest girth to 178 cm, and cannon girth to 19.5 cm, have been achieved [7].

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2. Materials and methods

The horses' physical characteristics are assessed using measurements such as height at withers, thoracic circumference, and cannon girth. A National Commission evaluates these dimensions during ranking activities to determine which individuals are suitable for breeding, aligning with established breeding objectives. To ensure the accuracy of the results, the horses undergo a detailed examination, involving the observation of each body region and a comprehensive synthesis examination [8-11].

Data obtained from the stud's registers were analyzed by calculating descriptive statistics (mean, standard deviation, standard error of the mean, and coefficient of variation) for the entire stock within each year of the period. This analysis was conducted using GraphPad Prism 9.4.1 software. The results were then presented in tables and figures.

3. Results and discussions

Regarding the average height at withers of the Shagya Arabian broodmares in the breeding stock, calculated for each year of the period (as shown in Table 1), it was observed that the values ranged between 154.30±0.261 cm (in 2012) and 154.80±0.258 cm (in 2002 and 1994).

Table 1. The values of height at withers of broodmares (cm) for the entire period

Year	N	Mean	SEM	cv%	Min.	Max.
2018	68	154.6	0.227	1.21	151	158
2017	71	154.6	0.224	1.22	151	158
2016	43	154.3	0.286	1.21	151	158
2015	69	154.4	0.221	1.19	151	158
2014	63	154.5	0.234	1.20	151	158
2013	62	154.5	0.238	1.21	151	158
2012	50	154.3	0.261	1.19	151	158
2011	43	154.4	0.281	1.18	151	158
2010	40	154.5	0.293	1.19	151	158
2009	43	154.4	0.275	1.16	151	158
2008	36	154.5	0.317	1.23	151	158
2007	39	154.6	0.308	1.24	151	158
2006	41	154.6	0.299	1.24	151	158
2005	43	154.6	0.287	1.21	151	158
2004	48	154.7	0.259	1.16	151	158
2003	52	154.8	0.245	1.14	151	158
2002	49	154.8	0.258	1.16	151	158
2001	58	154.8	0.232	1.14	151	158
2000	62	154.8	0.219	1.11	151	158
1999	59	154.8	0.228	1.13	151	158
1998	63	154.7	0.217	1.11	151	158
1997	64	154.8	0.214	1.10	151	158
1996	60	154.8	0.225	1.12	151	158
1995	58	154.8	0.232	1.14	151	158
1994	49	154.8	0.258	1.16	151	158
1993	44	154.7	0.277	1.20	151	158
1992	41	154.4	0.292	1.21	151	158
1991	42	154.3	0.286	1.20	151	158
1990	46	154.4	0.287	1.26	151	159
1989	47	154.7	0.307	1.36	151	159

N=the number of broodmares per year; mean=the average values of the height at withers; SEM=standard error of the mean; cv%=the coefficient of variation; Min.=minimum value; Max.=maximum value

The coefficient of variation (cv%) ranged from 1.1% to 1.36%, indicating a high level of homogeneity in this measurement. According to the regulations, the standard measurements for mares at the age of 4 years are as follows: an average height at the withers of 156 cm (with allowable limits ranging from 154 cm to 158 cm), an average heart girth of 176 cm (with limits ranging from 174 cm to 180 cm), and an average cannon girth of 19 cm (with a maximum allowable limit of 20 cm) [11, 12].

The dynamics of average height at withers for broodmares between 1989 and 2018 are depicted in Figure 1. The observed minimum and maximum values are in close proximity, ranging from 154.3 cm to 154.8 cm.

What's even more significant is the declining trend that follows a period of stability from 1998 to 2003. This decline may be attributed to the fact that the population returned to the Rădăuți stud in 1998 after a period spent in the South of the country (Brebeni, Olt County), where the differences in climate could have had an impact on the horses' body dimensions. Comparing the obtained results (the average height of the entire population for the studied period was 157.59 cm) with those mentioned by other authors, we can draw the following conclusions: The average population height increased overall compared to the findings reported by other authors, where the average height was 158.41 cm [5].

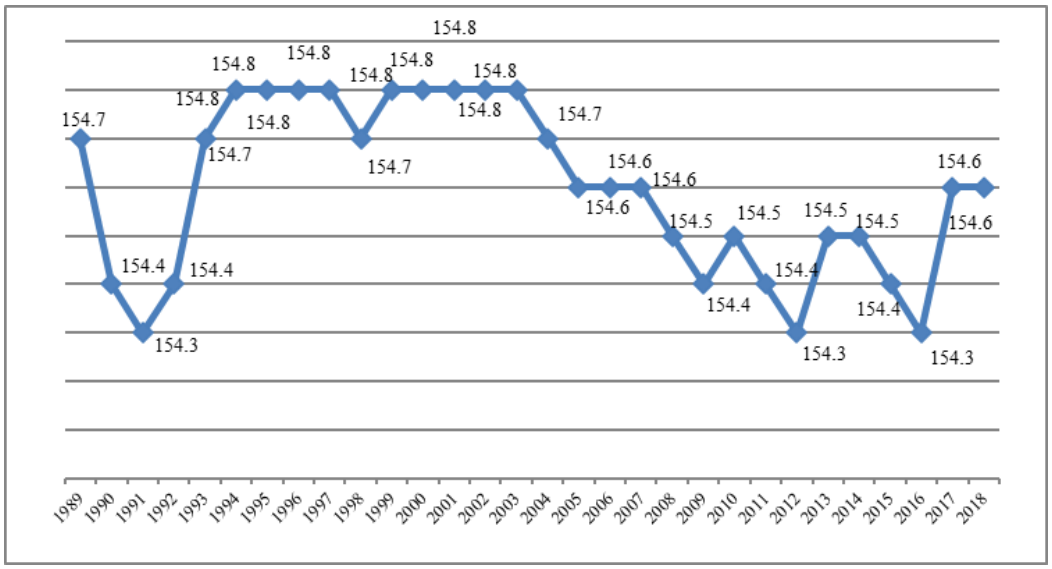

Figure 1. The dynamics of average values of height at withers, for broodmares (cm)

Table 2 reveals that the average values of heart girth ranged between 176.2±0.885 cm (in 1992) and 177.1±0.787 cm (in 1989). The coefficient of variation (cv%) suggests that this trait is also homogeneous, with values ranging from 2.93% to 3.21%.

These results align closely with findings in the literature, such as 177.90±0.57 cm [13]. It's worth mentioning that the maximum observed value was 188 cm, indicating that the breeding objective is feasible, even though it wasn't fully met during the studied period.

The fluctuations in the average values of heart girth for broodmares between 1989 and 2018 are depicted in Figure 2. The observed minimum and maximum values fall within close limits, ranging from 176.2 cm to 177.1 cm. These values are very close to the breeding objective but, once again, they were not exactly fulfilled during the studied period.

Table 2. The values of heart girth of broodmares (cm)

Year	N	Mean	SEM	cv%	Min.	Max.
2018	68	176.8	0.629	2.93	167	186
2017	71	177.0	0.625	2.97	167	186
2016	43	176.7	0.815	3.02	167	186
2015	69	176.8	0.649	3.04	167	186
2014	63	176.7	0.698	3.13	167	186
2013	62	176.7	0.707	3.15	167	186
2012	50	176.6	0.771	3.09	167	186
2011	43	176.9	0.807	2.95	167	186
2010	40	176.8	0.841	3.00	167	186
2009	43	176.6	0.797	2.96	167	186
2008	36	176.5	0.905	3.07	167	186
2007	39	176.9	0.890	3.14	167	186
2006	41	176.8	0.865	3.13	167	186
2005	43	176.7	0.841	3.12	167	186
2004	48	176.4	0.780	3.06	167	186
2003	52	176.5	0.784	3.11	167	186
2002	49	176.5	0.784	3.11	167	186
2001	58	176.3	0.718	3.10	167	186
2000	62	176.4	0.681	3.04	167	186
1999	59	176.3	0.708	3.08	167	186
1998	63	176.5	0.671	3.01	167	186
1997	64	176.5	0.661	2.99	167	186
1996	60	176.4	0.701	3.07	167	186
1995	58	176.3	0.718	3.10	167	186
1994	49	176.5	0.784	3.11	167	186
1993	44	176.6	0.813	3.08	167	186
1992	41	176.2	0.885	3.21	167	186
1991	42	176.5	0.861	3.16	167	186
1990	46	176.9	0.788	3.02	167	188
1989	47	177.1	0.787	3.04	167	188

N=the number of broodmares per year; Mean=the average values of the heart girth; SEM=standard error of mean; cv%=the coefficient of variation; Min.=minimum value; Max.=maximum value

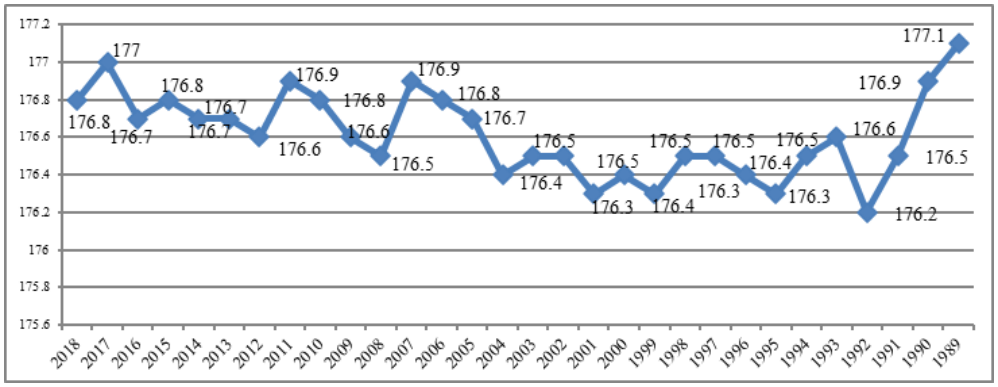

Figure 2. The dynamics of average values of heart girth for broodmares (cm)

Table 3 presents the values for cannon girth in broodmares. The minimum observed value was 18.7±0.19 cm (in 1998), and the maximum value was 18.9±0.70 cm (in 1989). The coefficient of variation ranged from 1.02% to 3.71%, indicating a high degree of homogeneity in this trait.

Comparing these values with the data from other studies, it's worth mentioning that average values of 17.54±0.62 cm at 3 years old (Kosťuková et al., 2013) [13] and values ranging from 18.82±0.21 cm to 19.43±0.12 cm at 4 years old were reported [7, 14].

Table 3. The values of cannon girth of broodmares (cm)

Year	N	Mean	SEM	cv%	Min.	Max.
2018	68	18.8	0.051	2.25	18	20.5
2017	71	18.8	0.049	2.21	18	20.5
2016	43	18.8	0.068	2.39	18	20.5
2015	69	18.8	0.057	2.54	18	20.5
2014	63	18.7	0.061	2.60	18	20.5
2013	62	18.8	0.061	2.56	18	20.5
2012	50	18.8	0.071	2.67	18	20.5
2011	43	18.8	0.069	2.40	18	20.5
2010	40	18.8	0.072	2.44	18	20.5
2009	43	18.8	0.068	2.38	18	20.5
2008	36	18.8	0.077	2.48	18	20.5
2007	39	18.8	0.072	2.39	18	20.5
2006	41	18.8	0.071	2.44	18	20.5
2005	43	18.8	0.068	2.40	18	20.5
2004	48	18.7	0.062	2.32	18	20.5
2003	52	18.7	0.060	2.32	18	20.5
2002	49	18.7	0.061	2.30	18	20.5
2001	58	18.7	0.056	2.29	18	20.5
2000	62	18.7	0.056	2.35	18	20.5
1999	59	18.7	0.057	2.34	18	20.5
1998	63	18.7	0.055	1.02	18	20.5
1997	64	18.7	0.054	2.32	18	20.5
1996	60	18.7	0.057	2.38	18	20.5
1995	58	18.7	0.056	2.29	18	20.5
1994	49	18.7	0.061	2.30	18	20.5
1993	44	18.7	0.066	2.38	18	20.5
1992	41	18.7	0.078	2.67	17.5	20.5
1991	42	18.7	0.076	2.64	17.5	20.5
1990	46	18.8	0.095	3.41	17.5	20.5
1989	47	18.9	0.102	3.71	17.5	20.5

N=the number of broodmares per year; X=the average values of the cannon girth; SEM=standard error of mean; cv%=the coefficient of variation; Min.=minimum value; Max.=maximum value.

Figure 3 illustrates the average values obtained for each year, demonstrating that the cannon girth falls within a narrow range (18.7-18.9 cm). It's obvious that the breeding objective of increasing this parameter to 19.5 cm was not met during the studied period. However, it's noteworthy that the maximum observed value was 20.5 cm, indicating that achieving the mentioned objective is possible through careful pairing and selective breeding.

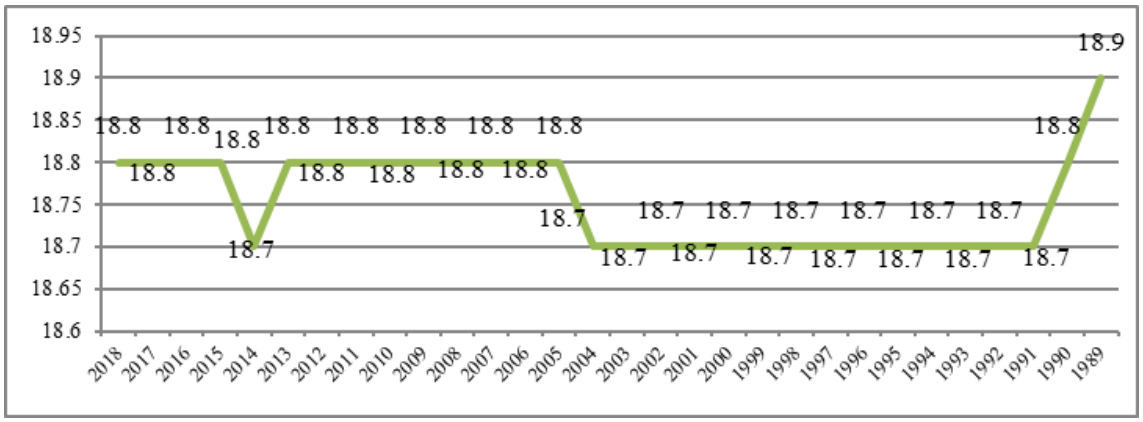

Figure 3. The dynamics of average values for broodmares (cm)

4. Conclusions

The study's conclusions are as follows:
The average values of height ranged from 154.3±0.261 cm in 2012 to 154.80±0.258 cm in 2002 and 1994. This indicates that this characteristic is highly homogeneous (cv%=1.1-1.36%). However, the breeding objective of increasing the height to 156 cm was not achieved, even though the average values fell within the specified limits.
The minimum average value for thoracic circumference was recorded in 1992 at 176.2±0.885 cm, while the maximum was in 1989 at 177.1±0.777 cm. This demonstrates the homogeneity of this parameter (cv%=2.93-3.21%), and it reached the desired 176 cm in line with breeding objectives.
The average values of cannon circumference ranged from a minimum of 18.7±0.19 cm in 1998 to a maximum of 18.9±0.70 cm in 1989. This character is highly homogeneous (cv%=1.02-3.71%). However, the breeding objective of achieving a value of 19.5 cm was not met during the breeding process.

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