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Evaluation of Lipizzaner mares' fertility data in 10 Hungarian stud farms

Máté Kovács[1*] – Daniella Gyúró[2] – János Posta

[1]Doctoral School of Animal Science, University of Debrecen, 4032 Debrecen, Hungary
[2]Department of Animal Science, Institute of Animal Science, Biotechnology and Nature Conservation, Faculty of Agricultural and Food Sciences and Environmental Management, University of Debrecen, 4032 Debrecen, Hungary
[*]Correspondence: kovacs.mate@agr.unideb.hu

SUMMARY

Despite numerous studies on the genetic background and performance traits of the Lipizzan breed, fertility characteristics of Hungarian Lipizzan mares have not been systematically examined. This study evaluates the reproductive performance of 220 Lipizzaner mares from 10 Hungarian stud farms, born during the period of 1981 to 2019, using breeding records from 1998 to 2022. The mares were grouped into 25 mare families and 24 birth cohorts. Data on successful pregnancies and foalings were analyzed with respect to age, family affiliation, and breeding year. Results show that mares aged 8–12 years had the highest fertility rates, while a gradual decline was observed after 15 years. Breeding activity increased markedly after 2011, peaking in 2022 with the highest number of matings and foals born. Fertility varied considerably among mare families: some achieved consistently high reproductive success, while others showed low or zero foaling rates despite repeated matings. Hungarian mare families generally produced better fertility results, whereas Fogaras families displayed greater heterogeneity. The study emphasizes the importance of monitoring reproductive efficiency in small mare families, as unfavorable fertility trends may jeopardize their long-term viability. These findings contribute to improving breeding strategies and ensuring the preservation of genetic diversity in the Hungarian Lipizzaner population.

Keywords: *Lipizzan; mare fertility; foaling rate*

INTRODUCTION

The Lipizzan breed is closely connected to Hungary and Hungarian horse breeding culture through several links. Primarily, its historical background plays a key role, as one of the breed's founding populations was already bred in Mezőhegyes and by the former Hungarian aristocracy. Furthermore, during the second half of the previous century, the majority of significant successes in carriage driving sport were also associated with this breed. While numerous studies have focused on the genetic structure and performance traits of the Lipizzan (Rastija et al., 1991; Zechner et al., 2001a,b; Zohmann et al., 2001; Rastija et al., 2004), the fertility and reproductive characteristics of the Hungarian Lipizzan mare population have not yet been examined. In horses, reproductive indicators are influenced by multiple factors, including reproductive status, body condition, age, competition history, the rate of embryonic loss, infections, method of insemination, and even the effect of the year, all of which can be decisive for successful conception from both the stallion's and the mare's side. In addition, mare family affiliation may also be relevant, as practical breeding experience provides several examples of certain families increasing in numbers, while others approach extinction, or in extreme cases, disappear completely. However, no results addressing this aspect have been published in the international literature.

The identity of horse breeds is primarily determined by their distinct ancestry, historical background, conformation, and performance characteristics. In the case of breeds with similar conformation, pedigree information plays a crucial role in preserving breed identity (Mihók, 2008). Two fundamental breeding methods are commonly applied in horse breeding: line breeding and family breeding (Anker, 1998). In small, closed studbook populations, the preservation of mare families is of particular importance (Pataki, 1997). Due to their consistent inheritance patterns, mare families contribute to faster genetic progress. Furthermore, mitochondrial inheritance, which occurs exclusively through the maternal line, enhances the genetic significance of mares, as stallions are responsible for at most half of the genetic traits of their offspring (Mihók, 2008).

The reproductive performance of mares is affected by several factors. Based on reproductive status, pregnancy and foaling rates differ: lactating mares generally show lower values due to the negative effect of lactation, while maiden mares are more successful (Hutton and Meacham, 1968; Langlois and Blouin, 2004).

The mare's body condition, particularly her nutritional state after foaling, significantly influences ovarian function and the ovulatory cycle; an energy-deficient condition induces hormonal changes that negatively impact fertility (Huszenicza, 2003).

Age is also a key factor, as foaling rates decrease after 13–15 years of age, a finding supported by numerous studies (Ginther et al., 2004, 2008; Hemberg et al., 2004; Katila et al., 2010; Allen et al., 2007).

Competition history does not appear to have a negative effect on reproductive parameters; in fact, mares with a sport background often show higher productivity. Nevertheless, training condition and stress may affect hormonal balance and thereby fertility (Irvine and Alexander, 1998; Langlois and Blouin, 2004; Aurich and Aurich, 2008).

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Identifying mares that fail to conceive is crucial for breeding success. The most common cause of infertility is endometrial disease, which reduces reproductive capacity; therefore, endometrial biopsy is an essential diagnostic and therapeutic tool (Vincze et al., 2018).

MATERIALS AND METHODS

The aim of our study was to evaluate the reproductive performance of the Hungarian Lipizzan mare population, with particular emphasis on differences among mare families and factors influencing fertility. The dataset was derived from the breeding records of 220 mares of the breed, as registered in the OLIR database. The mares included in the analysis were born during the period of 1981 to 2019, covering a 38 year period. Data were collected from 10 stud farms: State Stud Farm Szilvásvárad (80 mares), Acsa 2001 Mg. Term. és Fejl. Kft. (23 mares), Gábor Baksa (13 mares), Tamás Mihály Banka (9 mares), István Zoltán Forgács (14 mares), Norbert Hati (10 mares), Károly Hódi (14 mares), Municipality of Szabadkígyós (18 mares), Attila Szántó (18 mares), and Jánosné Szigeti (15 mares).

During data collection, we considered the years in which the mares were covered, and whether a foal was born in the following year. For the purposes of breeding year analysis, data from Lipizzan mares mated during the period of 1998 to 2022 were used.

The mares under investigation were grouped according to mare family and year of birth. Based on this classification, they could be assigned to 24 mare families and 24 birth groups.

RESULTS AND DISCUSSION

The studied population was divided into four age groups:

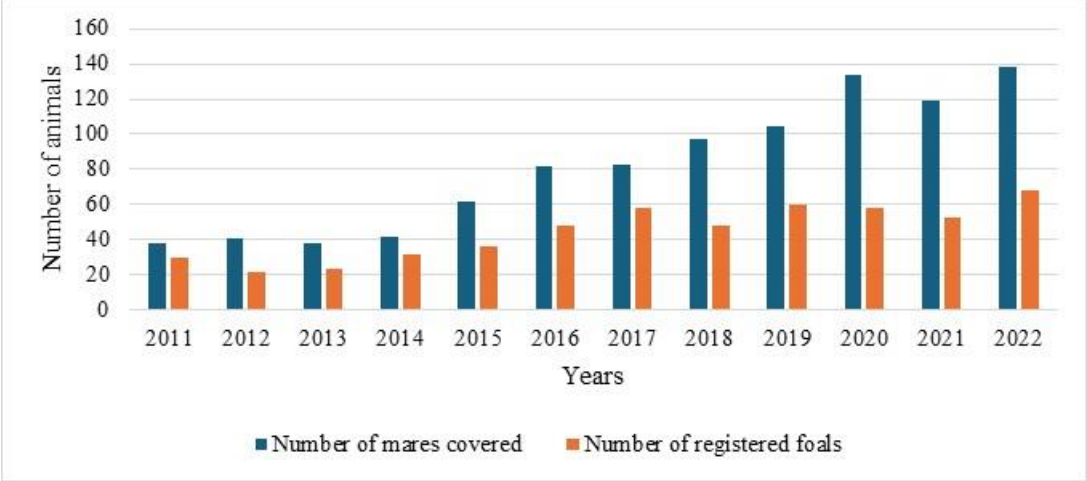
- Young mares (3–7 years): 42 mares, generally exhibiting a low number of coverings but a high conception rate.
- Middle-aged mares (8–12 years): 65 mares, typically showing the highest reproductive performance.
- Aged mares (13–18 years): 51 mares, with variable reproductive outcomes.
- Old mares (>18 years): 24 mares, mostly displaying declining fertility, although some exceptional cases were observed.

The results are consistent with the literature (Allen et al., 2007; Katila et al., 2010), which indicates that mares aged 8–12 years showed the highest fertility, while fertility gradually declines in those over 15 years of age.

Development of Breeding Years

At the beginning of the study period (1998–2010), an average of 20–25 mares were bred annually. After 2011, a sudden increase occurred, which was more favorable for statistical evaluation; therefore, the results from the preceding years were not included in the analysis. The highest number of mares were bred in 2022, and the highest number of foals was also born in 2022. The reproductive efficiency was highest for mares bred in 2011 (38 mares, 30 foals, 78.9% foaling rate) and lowest in 2020 (132 mares, 58 foals, 43.9%). The number of breedings and the number of foals registered are illustrated in *Figure 1*. The columns in the figure represent the number of foals born in a given year in relation to the number of mares covered in the previous year.

Figure 1. **Number of breeding events and registered foals**



Relationships Between Mare Family and Fertility

During the study period, the reproductive performance of several classical, Hungarian, Fogaras, Croatian, and Slovenian mare families was analyzed. Among the mare families examined, the highest number of individuals belonged to the Presciana (29 mares), No. 7 (19 mares), and No. 15 (14 mares) Hungarian families. Several mares achieved a 100%

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foaling rate, producing at least one foal in every breeding year. Conversely, some mares exhibited extremely low reproductive performance, and in extreme cases, failed to produce any offspring despite multiple breeding years. Typically, the highest number of foals per mare was achieved after 8–14 years of breeding. Lower reproductive rates were often associated with fewer breeding years, although exceptions occurred where mares had many breeding years but few foals. Hungarian mare families generally showed higher individual numbers and more breeding years, likely due to their domestic origin. Fogaras mare families exhibited greater heterogeneity in both reproductive performance and the number of breeding years. In several mare families, foaling rates of 0% or close to 0% were observed. Classical, Croatian, and the Slovenian Thais family showed heterogeneous results, but generally displayed good fertility rates. Among the studied individuals, several mares demonstrated outstanding performance, such as Conversano XXIV-60 from the No. 7 Hungarian family, and Maestoso XXXIV-10 from the No. 10 Hungarian family, which maintained excellent fertility despite a high number of breeding years. Conversely, some mares produced no offspring at all, which, in small-sized mare families, could lead to the long-term disappearance of these families.

The individual numbers belonging to each mare family are contained in *Table 1*.

Table 1. **Distribution of covered mares across mare families**

Name of the mare family	Number of mares	Name of the mare family	Number of mares
No. 1 Hungarian mare family	10	No. 1 Fogaras mare family	1
Presciana (No. 2 Hungarian mare family)	33	No. 2 Fogaras mare family	11
No. 7 Hungarian mare family	19	No. 5 Fogaras mare family	2
No. 10 Hungarian mare family	3	No. 6 Fogaras mare family	12
No. 15 Hungarian mare family	14	No. 8 Fogaras mare family	6
No. 16 Hungarian mare family	3	No. 9 Fogaras mare family	2
No. 18 Hungarian mare family	14	No. 10 Fogaras mare family	11
No. 20 Hungarian mare family	2	No. 16 Fogaras mare family	1
No. 22 Hungarian mare family	4	No. 19 Fogaras mare family	2
No. 23 Hungarian mare family	11	Krabbe	1
No. 26 Hungarian mare family	11	Thais	3
Almerina (No. 32 Hungarian mare family)	3	Sardinia	3

The reproductive performance of the examined Hungarian and Fogaras mare families showed considerable variation. In the Hungarian family 1, 10 mares produced 26 foals from 55 breeding years, corresponding to an average reproductive rate of 47.27%. The best result was achieved by Favory Helga (71.43%), while two mares remained without offspring. In family 2 (Presciana), 29 mares were covered over 195 breeding years; the highest number of foals was produced by Neapolitano XXV-5 (13 foals), although the average reproductive rate was only 36.15%. In family 7, two mares, Incitato XIV-24 and Conversano XXVII-18, stood out with 11 foals each, while the reproductive rates ranged widely, from 100% to as low as 14.29%.

Among the smaller Hungarian families, family 10 proved remarkable, with Maestoso XXXIV-10 producing a foal from every breeding (100%), while Pluto Piroska achieved 57.14%. In family 15, Incitato XVI-25 was the most productive (13 foals, 92.86%), although two mares showed 0% fertility. In family 16, Neapolitano Donna led with 61.54%, whereas in family 18, Maestoso XXXII-12 produced 11 offspring, alongside two mares achieving 100% and three mares 0%. The smaller families (20, 22, 23, 26, and 32) displayed strong variation, with some mares reaching 100% reproductive rates, while others remained completely barren.

The Fogaras families also showed pronounced differences. In family 2, Conversano Niki produced the most foals (9), did not produce any foals. In family 6, Incitato Durcás led with 9 foals, while two mares achieved 100% and one was entirely infertile. In family 8, Neapolitano Dáma excelled with 71.43%, whereas in family 9, Neapolitano Nyalka (62.5%) showed higher reproductive rates than Szindi (53.33%). In the Fogaras family 10, Neapolitano Nelli was the most fertile (9 foals), while Favory Fatima was the only mare to achieve 100%. The smaller families (1, 5, 16, and 19) generally showed medium results, with reproductive rates between 25% and 62.5%.

Among the classical and Croatian families, the Krabbe family's only examined mare (Siglavy Capriola Sába) had a reproductive rate of 0%. In the Thais family, Favory XXIX-10 stood out with 100%, while Siglavy Capriola XIV-14 also performed above average (62.5%). In the Sardinia family, the best result was shown by Betalka XXXV (57.14%), while the other mares produced foals in 50% of breeding years.

Overall, several mares achieved a reproductive rate of 100%, but these usually occurred with relatively few breedings. In the larger families (e.g., Hungarian families 2, 7, and 15, and Fogaras families 2 and 10), reproductive rates varied widely, demonstrating substantial individual differences within the population. The best-performing mares were those that

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produced a foal from every breeding, whereas poor results were primarily associated with persistent infertility or low conception rates. The findings confirm that significant reproductive variability exists among Lipizzan mare families, which should be considered carefully in breeding programs.

CONCLUSIONS

This study evaluated the reproductive performance of the Hungarian Lipizzan mare population during the period of 1981 to 2019, analyzing the breeding data of 220 mares. Mares were grouped according to 25 mare families and 24 age cohorts, with data collected from ten different studs. Age-based analysis indicated that mares aged 8–12 years exhibited the highest fertility, while mares over 15 years showed decreased reproductive performance. The number of breedings increased significantly after 2011, with the highest number of breedings and foals recorded in 2022. Fertility results varied among mare families: some achieved 100% foaling rates, whereas others showed low performance. Hungarian mare families generally had higher numbers of breedings and better fertility, while Fogaras families exhibited greater variability. The study highlights that small-sized mare families require special attention to maintain genetic diversity, as unfavorable reproductive performance could lead to the long-term disappearance of certain families.

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