EVALUATING REPRODUCTIVE PARAMETERS IN THE HUTSUL HORSE POPULATION

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Abstract

It is well known that in any stud farm, reproductive activity is one of the main concerns of specialists and that the continuation of valuable horse populations largely depends on the results of this activity. Regarding this aspect, the present study analyzed from a reproductive standpoint, over a 10-year period, a number of 14 Hutsul broodmares from the 2010 and 2011 generations, from the breeding nucleus of the Lucina Stud farm. The evaluated parameters were: age at first fertile mating (1,669.64 ± 194.92 days); age at first foaling (2,015.50 ± 195.91 days); gestation length (347.86 ± 1.13 days); service period (186.15 ± 35.02 days); and foaling interval (562.13 ± 41.92 days).

Key words: *horses, stud farm, broodmares, reproduction, performance.*

INTRODUCTION

The Hutsul horse is Romania's only native horse breed, originated in the Carpathian Mountains and renowned for its hardiness, agility, and endurance in rugged terrain. With ancient phylogenetic roots linked to primitive ancestors like the Tarpan, it historically served crucial economic and military roles. Today, the breed is defined by its compact, strong build and conserved across several traditional genealogical lines (such as Goral, Hroby, and Pietrosu) across Central and Eastern Europe.

The evaluation of reproductive performance in stud farms requires rigorous monitoring of fundamental technical indicators. Reproductive efficiency directly dictates the genetic progress, economic viability, and demographic continuity of valuable horse populations. In domestic mare (*Equus caballus*), reproductive parameters exhibit moderate physiological variability, being strongly influenced by genetic background, nutrition, environmental conditions, and breeding management [1-3].

In the present study, the fertility analysis of the Hutsul female breeding nucleus was conducted by tracking five key reproductive parameters:

- age at first fertile mating: defined as the period elapsed from birth to the date of the first conception that results in a term gestation. In mares, this parameter is usually reached between 12 and 18 months of age; however, the physiological and somatic maturity required for breeding is typically attained between 3 and 4 years of age (1,095–1,460 days), depending on breed precocity and farm management [1].
- age at first foaling: defined as the age at which a mare gives birth to her first viable foal. It is directly dependent on the age at first fertile mating and gestation length. In indigenous and primitive rustic breeds, such as the Hutsul, first foaling commonly occurs

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around 4 to 5 years of age (1,460–1,825 days), ensuring adequate skeletal and metabolic development of the mare prior to lactation [4].

- service period (SP): defined as the time interval (in days) between foaling and the subsequent fertile conception. In equine reproductive management, an optimal service period ranges from 20 to 60 days, allowing for proper uterine involution and early post-partum re-breeding (including foal-heat utilization or second-cycle breeding) [2].
- foaling interval (FI): defined as the elapsed time (in days) between two consecutive foalings (FI = Gestation Length + Service Period). The zootechnical ideal for equine breeding is a 12-month interval (approximately 365 days), which corresponds to the production of one foal per mare per year [2,3].

Monitoring these indicators over a 10-year period provides an objective assessment of reproductive precocity, post-partum uterine involution capacity, and overall reproductive efficiency in broodmares from the analyzed generations.

MATERIAL AND METHOD

The biological material comprised 14 Hutsul broodmares born in 2010 and 2011, which are currently or were previously active within the breeding nucleus of Lucina Stud Farm. A total of 8 females were introduced into the reproductive herd in 2013, and the remaining 6 females were admitted in 2014. To evaluate their morphological and reproductive performance, primary data were extracted from the Broodmares' Register.

The collected data were processed statistically to characterize the analyzed morphological and reproductive parameters. The statistical processing was performed using the following parameters:

- **Arithmetic Mean ($\bar{x}$):** Represents the central value of the analyzed trait around which individual sample measurements are distributed. The arithmetic mean was calculated using the formula:

$$\bar{x} = \frac{\sum x}{n},$$

where $\sum x$ is the sum of individual values, and *n* is the total number of observations.

- **Standard Deviation (s):** Serves as a measure of data dispersion relative to the arithmetic mean and expresses the degree of variability of the analyzed trait:
  - $s = \sqrt{s^2}$
- **Standard Error of the Mean ($\pm s_{\bar{x}}$):** Indicates the precision with which the sample mean estimates the true population mean, representing the error associated with the arithmetic mean. It was determined using the equation:

$$\pm s_{\bar{x}} = \pm \frac{s}{\sqrt{n}}$$

- **Coefficient of Variation (V%):** A relative indicator of variability that expresses the standard deviation as a percentage of the arithmetic mean, enabling comparisons between traits measured in different units:

$V\% = s/\bar{x} \times 100$.

Variability is categorized as low when V% ≤ 10% (homogeneous population), moderate when V% = 10-20 %, and high when V% > 20% (heterogeneous population).

Additionally, the minimum (Min) and maximum (Max) values were recorded for each parameter to highlight the range of variation of the analyzed traits.

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RESULTS

An analysis of the age at first fertile mating revealed values ranging from 1,436 days to 4,086 days, with an overall herd mean of 1,669.64 days (Fig. 1). Most broodmares achieved their first fertile mating at around 4–5 years of age, which aligns with standard reproductive management practices for the Hutsul breed (1,275 days). For the mares Goral XXI-9, Goral XX-13, and Hroby XXIV-24, this parameter was recorded only in years, as the exact mating date was missing from the studbook due to uncertain paternity of the offspring. The standard deviation was 729.34 days, with a standard error of the mean of ±194.92 days. The coefficient of variation (V% = 43.68%) indicates high variability within the analyzed group. This heterogeneity was primarily driven by mare Hroby XXIV-25, whose first fertile mating was recorded at a significantly older age compared to the rest of the herd.

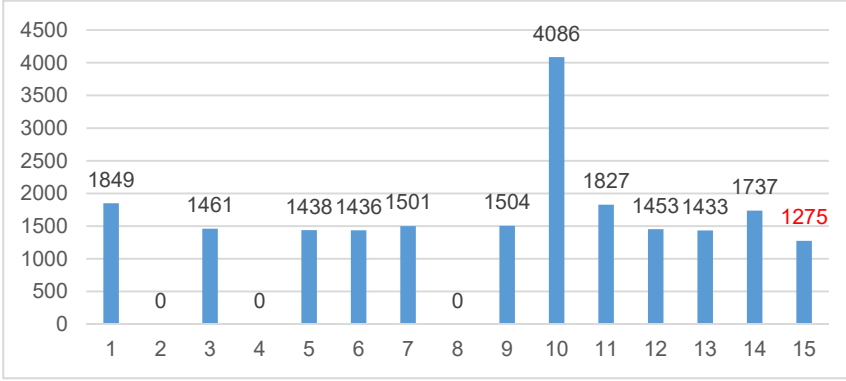


Fig. 1 Age at first fertile mating (days) in Hutsul broodmares (1-14) compared to literature (15)

Analysis of age at first foaling (Fig. 2) revealed values ranging from 1,409 to 4,443 days, with an overall herd mean of 2,015.50 days (5.52 years). The majority of broodmares produced their first foal between approximately 4 and 6 years of age, values closely aligning with those typically reported for the Hutsul breed. The standard deviation was 733.04 days, with a standard error of the mean of ±195.91 days. The coefficient of variation was 36.37%, indicating high variability within the analyzed herd. This heterogeneity is primarily driven by differences in the timing of first breeding exposure and the inclusion of extreme values—most notably mare Hroby XXIX-25, whose first foaling occurred at 12.16 years of age. A number of 9 gestation lengths from 14 broodmares were analyzed, excluding cases of abortion and instances where the mating date could not be determined. Gestation length ranged from 319 to 371 days, with a mean value of 347.86 days (Fig. 3). The standard deviation was 9.37 days, with a standard error of the mean of ±1.13 days, indicating a low dispersion of values around the mean. The coefficient of variation was 2.69%, highlighting very low variability and a highly homogeneous population. The values obtained are close to those reported in the literature, where the average gestation length for the Hutsul breed is approximately 340 days. Although the mean of the analyzed herd is slightly higher than the average values reported in the literature, it remains well within the normal physiological limits for equines. These results demonstrate the stability of this reproductive trait within the studied herd, a finding further confirmed by the very low coefficient of variation.

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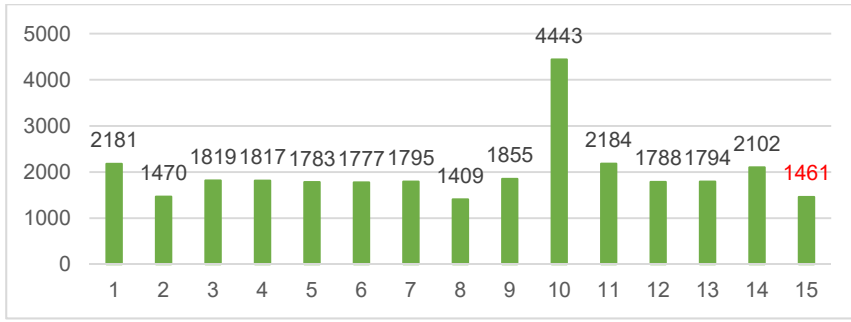


Fig. 2 The age at first foaling (days) in Hutsul broodmares (1-14) compared to literature (15)

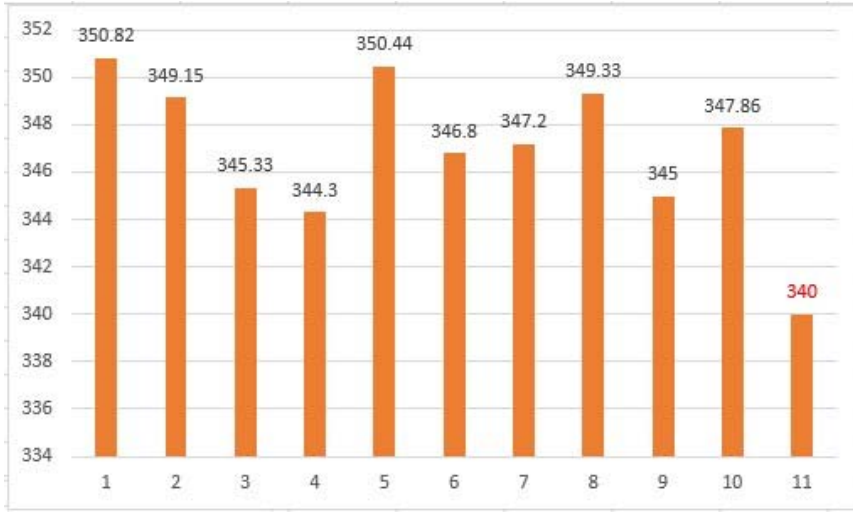


Fig. 3 The gestation length (days) in Hutsul broodmares (1-9) compared to average value (10) and literature (11)

Statistical analysis of the service period revealed an average duration of 186.15 days, with individual values ranging from 12.60 to 438 days (Fig. 4). The standard deviation of 131.02 days and a coefficient of variation of 70.38% highlight very high variability and a heterogeneous population. The elevated mean value and wide range of variation must be interpreted in relation to the reproductive history of the analyzed mares. Examination of the studbook revealed that the majority of mares experienced one or two consecutive breeding seasons in which they were either not covered or recorded as barren. In these instances, the interval to the subsequent fertile mating was considerably prolonged, thereby elevating the mean service period and contributing to the high heterogeneity of the herd. Consequently, the high values observed cannot be attributed strictly to inherent reproductive characteristics, as they were also significantly influenced by reproductive management practices and the continuity of mare utilization in breeding.

A notable case is that of the mare Hroby XXIV-25, which recorded her first pregnancy at the most advanced age among the analyzed specimens. Following her introduction to breeding, the mare exhibited consistent reproductive activity, characterized by a regular succession of

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breeding seasons and a short service period. This observation highlights that an advanced age at first gestation was not associated with reduced subsequent reproductive efficiency. Similarly, the mare Pietrosu XI-48 achieved a mean service period duration of 13.5 days, being recorded as barren only during her first breeding year, with subsequent reproductive cycles proceeding normally.

At the opposite extreme was the mare Ouşor IX-113, which recorded only two gestations during her reproductive career, separated by an interval of 438 days.

Regarding the foaling interval (the interval between two consecutive foalings), the mean value was 562.13 days, with limits ranging from 342.5 to 830 days (Fig. 5). The minimum value was recorded again in the case of the mare Hroby XXIV-25, followed by the mare Pietrosu XI-48 with 366 days. The maximum value of 830 days was observed in the mare Goral XX-16. The standard deviation was 156.85 days, with a standard error of the mean of ±41.92 days. The coefficient of variation was 27.9%, indicating a heterogeneous population.

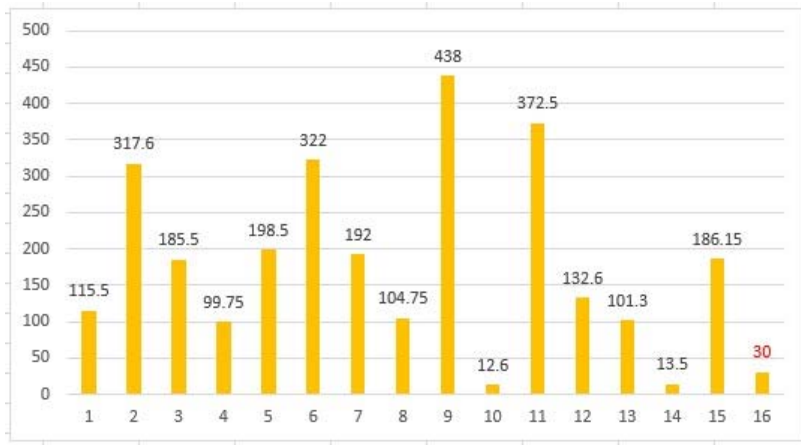


Fig. 4 The average length (days) of service period parameter compared to population mean (15) and literature (16)

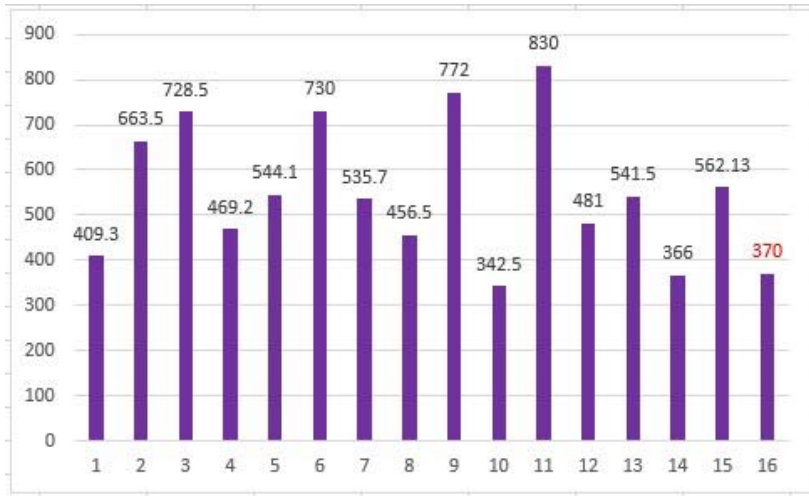


Fig. 5 The average length (days) of foaling interval compared to population mean (15) and literature (16)

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DISCUSSIONS

The age at first fertile mating for the majority of broodmares aligned fully with standard recommendations for the Hutsul breed, reflecting suitable reproductive management within the analyzed herd [4]. Although the overall mean and variability were inflated by an isolated late-entry case (mare Hroby XXIV-25), the core breeding cohort exhibited consistent timing for first fertile mating.

The age at first foaling for the analyzed Hutsul broodmares fell predominantly within the expected range for the breed, demonstrating appropriate reproductive practices and timely introduction to breeding within the stud farm [5]. Although the overall mean and sample variance were skewed by individual late-entry outliers-most notably mare Hroby XXIX-25-the core herd demonstrated satisfactory reproductive efficiency at the onset of their maternal career.

Regarding the gestation length in the evaluated Hutsul broodmare population it was observed that it exhibited high physiological stability and consistency across consecutive pregnancies, remaining strictly within normal limits for equines [6]. Although the mean gestation duration was slightly longer than classical breed references, the remarkably low coefficient of variation underscores strong herd homogeneity and uniform reproductive management within the stud farm.

The service period duration within the analyzed Hutsul herd demonstrated high overall variability, reflecting management decisions and breeding schedule continuity rather than intrinsic physiological dysfunction [7,8]. Although extended breeding pauses and barren seasons elevated the population mean, individual case trajectories-such as the high post-entry efficiency of mare Hroby XXIV-25-confirm that underlying reproductive capacity remained intact across the broodmare population.

The foaling interval among the evaluated Hutsul broodmares showed substantial dispersion around the mean, driven primarily by non-consecutive breeding years rather than physiological impairment. Although extended intervals in specific mares elevated the population average beyond the ideal annual cycle, individual performances-most notably the optimal values achieved by mares Hroby XXIV-25 and Pietrosu XI-48-demonstrate the inherent potential of the breed for regular annual foaling under continuous reproductive management [9].

CONCLUSIONS

As a result of this study on Hutsul broodmares from Lucina stud farm, the following conclusions can be stated:

- age at first fertile mating: the majority of broodmares achieved their first fertile mating at around 4–5 years of age (mean = 1,669.64 days), aligning with standard breed recommendations and demonstrating appropriate initial breeding management. High group variability (CV = 43.68%) was primarily driven by isolated late-entry specimens rather than systemic management delays.
- age at first foaling: the mean age at first foaling was 5.52 years (2,015.50 days), confirming proper physical development prior to maternal utilization. Although individual late-entry outliers (such as mare Hroby XXIX-25) elevated the overall mean and sample variance, the core herd exhibited satisfactory reproductive timing at the start of their maternal career.
- gestation length: gestation duration demonstrated exceptional physiological stability and high population homogeneity (mean = 347.86 days; CV = 2.69%), remaining strictly within normal limits for equines and confirming uniform environmental and management conditions.

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- service period: the elevated average duration (186.15 days) and high variability (CV = 70.38%) were predominantly governed by reproductive management practices-specifically non-consecutive breeding seasons and voluntary breeding pauses-rather than intrinsic physiological subfertility.
- foaling interval: the mean value of foaling interval (562.13 days) reflects intermittent breeding schedules within the herd, whereas minimum values (~365 days) confirm the biological potential of Hutsul broodmares for regular annual foaling under continuous reproductive management.

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