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Some effects on gestation length of traditional horse breeds in Hungary

Néhány tényező hatása a tradicionális lófajták vemhességi idejére Magyarországon

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Abstract

The national database of the use of stallions, supplied by the Department of Animal Registration and Breeding Organization of the Hungarian National Food Safety Authority was analyzed for the purpose of this research. 680 foaling data of 7 horse breeds was processed during the work. The factors effecting gestation length were examined by univariate analysis of variance (GLM). Breed, month of mating, method of fertilization, age of the mare, and sex of the foal were considered as fixed effects, and the sire was used as random effect in the study. The population genetic parameters of gestation length were also estimated. The overall mean value of gestation length was 334.1±2.62 days. Differences between the breeds were not significant. The effect of month of mating and effect of sex of foal on the gestation length were statistically proven ($P<0.01$). The mares fertilized in March and April had the longest gestation lengths 342.4 days, 341.4 days, respectively. In the cases of mares fertilized in later months of the year the gestation length was about 10 days shorter. Fillies had longer gestation length (335.6 days), than colts (333.5 days). Method of fertilization and age of the mare had no significant effect on the gestation length. The effects of sire on the gestation length were significant ($P<0.05$). The heritability (h^2) of gestation length was 0.18. Based on the analysis it can be presumed, that if the mares are kept in a suitable environment (professional nutrition, good health and breeding practices), well-balanced gestation parameters can be expected in the case of any genotypes.

Keywords: traditional Hungarian horse breeds, gestation length, effect of factors, heritability

Összefoglalás

A Szerzők a NÉBiH Állattenyésztési Igazgatóság Tenyésztés Szervezési és Teljesítményvizsgálati Osztályától kapott országos ménhasználati adatbázist dolgozták fel. A munka során hét lófajta összesen 680 ellési adatát értékelték. A vemhességi időt befolyásoló tényezők hatásának vizsgálatát többtényezős varianciaanalízissel (GLM) végezték. A munka során fix hatásnak tekintették a fajtát, a fedeztetés hónapját, a termékenyítés módját, a kanca életkorát, valamint a megszületett csikó ivarát. A modellbe véletlen hatásként az apát is beépítették. A vemhességi idő tulajdonság populációgenetikai paramétereit is megbecsülték. A vemhességi idő főátlaga 334,5±2,62 nap volt. A fajták közti különbségeket nem találták statisztikailag igazolhatónak. A fedeztetés hónapjának, valamint a csikó ivarának a hatása statisztikailag igazolhatóan ($P<0,01$, ill. $P<0,05$) befolyásolta a vemhességi időt. A leghosszabb vemhességi idővel (342,4 nap, ill. 341,4 nap) a márciusban és áprilisban termékenyített kancák rendelkeztek. Az év későbbi hónapjaiban termékenyített kancák vemhességi ideje ennél mintegy 10 nappal rövidebb volt. Kancacsikó születése esetén a vemhességi idő (335,6 nap) hosszabb volt, mint a méncsikóknál (333,5 nap). A termékenyítés módja, valamint a kanca életkora nem gyakorolt szignifikáns hatást a vemhességi időre. Az apa hatása a vemhességi idő tulajdonságra statisztikailag igazolhatónak ($P<0,05$) bizonyult. A vemhességi idő örökölhetősége (h^2) 0,18 volt. A vizsgálatok alapján feltételezhető, hogy ha egy kancának megfelelő környezet (szakszerű takarmányozás, az állomány jó egészségi állapota és a helyes szaporítási gyakorlat stb.) biztosítható, akkor gyakorlatilag bármilyen genotípusú állománnyal megfelelő vemhességi mutatókra számíthatunk.

Kulcsszavak: tradicionális magyar lófajták, vemhességi idő, tényezők hatása, örökölhetőség

Introduction

The gestation length of horse species is quite long compared to other farm animals. The gestation of warm blooded mares holds an average of 336 days (48 week, or 11 months). Foaling occurs most commonly between the 326th and 350th days after fertilization (Bucsy, 1992).

Broad information in scientific literature (Table 1) is available on the gestation length of different horse breeds. These papers present mainly the gestation length of a single breed, but studies dealing with more breeds or other comprehensive works are quite scarce.

The length of gestation is largely genetically determined. However, there is widespread information on the gestation length of horses being influenced by different factors such as feeding level, type, age of the mare, month of mating, year, breed or sex of the foal (Rollins and Howell, 1951; Flade and Frederich, 1963; Nett et al., 1973; Rossdale et al., 1984; Hevia et al., 1994; Davies-Morel et al., 2002; Satué et al., 2011 etc.). It was observed, that gestation length of cold blooded mares can be 12 to 14 days shorter, especially, when they work regularly. The gestation length of mares is usually longer at first foaling, in the cases of old mares and if the foaling is in winter time. The gestation length of mares fertilized between December and May

was about 10 days longer than of those which were mated between June and November (Bucsy, 1992).

Pérez et al. (2003) studied the gestation length of Spanish mares. According to their results, the gestation length was 339.0±9.55 days on average. The gestation length was 2.17 days shorter if the mares were pregnant with fillies, than that was observed in the cases of a pregnancy with colts. Concerning those mares, which were fertilized in June and July, they found about 10 days shorter gestation length, than those were mated in February and March.

Table 1. Gestation length of mares of different horse breeds in literature
1. táblázat. A különböző fajtájú lovak vemhességi ideje a szakirodalomban

Breed	Gestation length (day)	Author
Andalusian	343.6	Pozo-Lora (1954)
Andalusian	336.8	Valera et al. (2006)
Arabian	343.0	Pozo-Lora (1954)
Arabian	340.3	Valera et al. (2006)
Arabian	336.4	Howell and Rollins (1951)
Carthusian Spanishbred	322-359	Pérez et al. (1997)
Criollo	335.6	Winter et al. (2007)
Freiberger	307-361	Giger et al. (1997)
Frisian	337.7	Bos and van der Mey (1980)
Haflinger	341.3	Bos and van der Mey (1980)
Lipizzaner	334.3	Heidler et al. (2004)
Quarter horse	333-343	Pool-Andreson et al. (1994)
Quarter horse	336.6-349.2	Thorson et al. (2010)
Quarter horse	340.7-342.4	Guay et al. (2002)
Salernitano	340.9	Salerno and Montemurro (1966)
Shetland Pony	337.2	Bos and van der Mey (1980)
Shetland Pony	324.0-334.4	First and Alm (1977)
Standardbred	302-383	Marteniuk et al. (1998)
Thoroughbred	305-365	Hintz et al. (1979)
Thoroughbred	319-364	Hintz et al. (1992)
Thoroughbred	315-360	Kurtz Filho et al. (1997)
Thoroughbred	344.1	Davies-Morel et al. (2002)

In the work of Valera et al. (2006) the gestation lengths of Andalusian and Arabian mares were 336.8 and 340.3 days, respectively. The effect of age of the mare, sex of the foal, month of mating and breed were significant on gestation length. The gestation length of animals which foaled a filly was 2 days longer, than the colt foaled ones. The heritability of gestation length was found to be h^2=0.21.

According to Davis-Morel et al. (2002) the gestation length of colt foaled Thoroughbred mares was significantly longer (346.2 days), than the filly foaled ones (342.4 days). The month of mating had a statistically proven influence on gestation length, but they were not able to detect any effect of the age of the mare, the age of the stallion or the stud.

In the sources of literature the heritability value of gestation length was estimated between 0.19 and 0.38 (Rodero and Pozo Lora, 1960; Matassino, 1962; Salerno and Montemurro, 1966; Sato et al., 1973; Valera et al., 2006; Langlois and Blouin, 2012).

In the above context, the aim of our study was to determine the gestation length of traditional horse breeds in Hungary by using a national database. In our work we wanted to reveal the effect of factors influencing gestation length, and the population genetic parameters of this trait.

Material and Methods

The research was based on the data of utilization of stallions, supplied by the Department of Animal Registration and Breeding Organization of the Hungarian National Food Safety Authority. The examinations were extended to the mares fertilized during 2009 (foaled in 2010). After excluding the incomplete data lines, 680 foaling data of 7 horse breeds (Furioso - North Star, Hungarian Cold Blooded Horse, Hungarian Sport Horse, Kisberi, Lipizzaner, Nonius and Shagya) was at our disposal. The gestation length was calculated as the difference between the last mating date and the foaling date.

The effects of factors on the gestation length were examined by univariate analysis of variance (General Linear Model - GLM). During our research the breed, month of fertilization (from February to September), method of fertilization (natural mating or artificial insemination), age of the mare (3-17 years old) and sex of the foal (colts and fillies) were considered as fixed effects. The sire was included in the model as random effect (the results are demonstrated in a tabular form only in the cases of those 20 stallions, which had the most progeny). The used model was written as follows:

$$\hat{y}_{ijklmn} = \mu + S_i + B_j + M_k + T_l + A_m + I_n + e_{ijklmn}$$

(where $\hat{y}_{ijklmn}$ is the gestation length of a mare, which was fertilized with „i" sire, from „j" breed, in „k" month, with „l" method; at „m" age, and foaled „n" sex of foal; μ is the overall mean value; S_i is the effect of sire; B_j is the effect of breed; M_k is the effect of month of fertilization; T_l is the effect of method of fertilization; A_m is the effect of age of the mare; I_n is the effect of sex of the foal; e_{ijklmn} is the residual)

In those cases, where the F-test showed significant difference, Tukey-test (for different number of elements) was used to reveal the differences between levels of factors.

The genetic variance (among progeny groups, V_g), environmental variance (within progeny groups, V_e), phenotypic variance (V_p), and heritability value (h^2) of gestation length were estimated during research (with GLM, Variance components, ANOVA type III method). The method of calculation from the data of ANOVA table was as follows (the k_1 factor was calculated degree of freedom of sire and number of animals):

$$V_g = [(MS_{sire} - MS_{environment}) / k_1] \times 4$$

$$V_e = MS_{environment}$$

$$V_p = V_g + V_e$$

$$h^2 = V_g / V_p$$

The method of calculation in detail was described in details in our previous work (Bene et al., 2009), so hereby we omit its presentation.

Preparation of data was done with the help of Microsoft Excel 2003 and Word 2003 programs. SPSS 9.0 (1998) statistical software was used for the univariate analysis of variance and the estimation of population genetic parameters.

Results and Discussion

The gestation lengths of mares from different breeds are shown in Table 2. The overall mean value of gestation length was 334.5±2.62 days. The longest gestation length (336.2 days) was found in the Kisberi, the shortest (333.3 days) in the Shagya breeds, but the differences between the breeds (effect of breed) were not significant (P=0.667). Our results in absolute values are similar to the literature data (Hintz et al., 1979, 1992; Valera et al., 2006; Bos and van der Mey, 1980; Thorson et al., 2010 etc.). In contrast, we found slightly smaller gestation lengths in Lipizzaner breed, than Heidler et al. (2004).

Table 2. The gestation length of different horse breeds
2. táblázat. A különböző lófajták vemhességi ideje

Breed	Number of foaling	Average gestation length (day)	SE	Distance from overall mean (day)	P
Furioso - North Star	47	334.3	1.89	-0.2	<NS (0.667)
Hungarian Cold Blooded Horse	122	335.2	1.35	+0.7	
Hungarian Sport Horse	146	333.6	1.64	-0.9	
Kisberi	123	336.2	1.34	+1.7	
Lipizzaner	60	334.0	1.27	-0.6	
Nonius	146	335.1	1.27	+0.5	
Shagya	36	333.3	2.12	-1.2	
Overall mean	680	334.5	2.62	0.00	

The effects of different factors (month of mating, fertilization method, age of mare and sex of foal) are shown in Table 3. The month of mating was statistically proven (P<0.01) to influence the gestation length. The mares fertilized in March and April had the longest gestation lengths (342.4 days and 341.4 days, respectively). In the case of mares, which were fertilized in later months of the year, the gestation length was about 10 days shorter. Our results are similar to the data published by Davis-Morel et al. (2002), Perez et al. (2003) and Valera et al. (2006).

In case of fillies the gestation length (335.6 days) was statistically proven (P<0.05) longer, than colts (333.5 days). Our obtained data similar to the data of Davis Morel et al. (2002), Perez et al. (2003), and Valera et al. (2006). They found that the effect of sex of the foal was significant. However, it should be added, that while Perez et al. (2003) and Davis Morel et al. (2002) found longer gestation lengths in the cases of pregnancies with colts, in the works of Valera et al. (2006) the filly foaling mares had longer gestation lengths.

None of the methods of fertilization (P=0.271) or the age of the mare (P=0.076) had a significant effect on the gestation length. The gestation lengths of mares at first foaling - 3 years old - (328.7 days) and young mares (average 332 days) were shorter, than older animals. In our opinion, this tendency corresponds to the existing information (Bucsy, 1992; Valera et al., 2006 etc.), even if we could not statistically prove the difference.

Table 3. The effects of different factors on gestation length trait
3. táblázat. A különböző tényezők hatása a vemhességi időre

Factors	Number of foaling	Average gestation length (day)	SE	Distance from overall mean (day)	P
Month of mating					
- February	16	^{abc}337.6	4.07	+3.1	<0.01 (0.000)
- March	55	^{a}342.4	2.80	+7.8	
- April	167	^{a}341.4	2.77	+6.9	
- May	217	^{b}336.9	2.72	+2.3	
- June	142	^{c}332.7	2.77	-1.8	
- July	52	^{c}332.7	3.10	-1.8	
- August	20	^{cd}330.6	3.81	-4.0	
- September≤	11	^{d}322.1	4.64	-12.5	
Fertilization method					
- Natural mating	582	338.1	1.18	+3.6	NS (0.271)
- Artificial insemination	98	331.0	5.76	-3.6	
Age of mare (year)					
- 3	6	328.7	5.76	-5.9	NS (0.076)
- 4	45	333.4	3.18	-1.1	
- 5	71	331.7	2.95	-2.8	
- 6	69	336.3	2.97	+1.7	
- 7	76	332.0	2.91	-2.5	
- 8	60	332.8	3.01	-1.8	
- 9	62	335.6	2.91	+1.0	
- 10	45	333.7	3.15	-0.8	
- 11	45	336.2	3.19	+1.7	
- 12	47	334.5	3.17	+0.0	
- 13	34	341.1	3.36	+6.5	
- 14	29	333.1	3.50	-1.5	
- 15	23	336.6	3.55	+2.1	
- 16	16	337.5	4.00	+3.0	
- 17≤	52	334.9	3.06	+0.4	
Sex of foal					
- Colts	330	^{a}333.5	2.67	-1.1	<0.05 (0.024)
- Fillies	350	^{b}335.6	2.66	+1.1	
Overall mean	680	334.5	2.62	0.00	

treatments without the same superscript differ significantly (P<0.05)

The effect of sire on gestation length is presented in Table 4. The effect of the sire on gestation length was considered significant (P<0.05). The shortest gestation length

(average: 326.4 days) was found in the case of one Shagya stallion, named "2987 Kohelian Nagyvezér". Gestation length of his foals compared to the overall mean value of the population was 8.1 days shorter. The longest gestation length (average: 341.6 days) was observed in the cases of those mares, which were fertilized by the Nonius stallion “3816 Nonius XVII-36” (distance from overall mean +7.1 days). The difference between the two extremes was 15.2 days, which can be regarded as considerable.

The heritability (h^2) of gestation length was found to be 0.18 (Table 5). This result is similar to most of the values found in the literature (Salerno and Montemurro, 1966; Sato et al., 1973; Valera et al., 2006; Langlois and Blouin, 2012 etc.).

Table 4. The effect of sire on gestation length trait
4. táblázat. Az apa hatása a vemhességi időre

Identity number and name of sire	Breed of sire*	N	Average gestation length (day)	SE	Distance from overall mean (day)	P
4990 Nonius 32-40	NO	15	339.5	4.09	+4.9	<0.05 (0.030)
3992 Fernando Zsebtolvaj	KB	14	333.1	4.44	-1.5	
3844 Bicsérd-129 Csibész	HC	13	338.3	4.50	+3.7	
4763 Nonius IV-38	NO	12	330.2	4.61	-4.4	
4988 Sellye-288 Fantom	HC	12	340.7	4.66	+6.2	
2700 Bugac Szikrázó-13	KB	11	341.5	4.78	+7.0	
2987 Koheilan Nagyvezér	SH	11	326.4	4.71	-8.1	
3166 Fernando Farsang	KB	11	334.9	4.71	+0.4	
3811 Octavio	HS	11	339.2	3.81	+4.7	
4853 Timpex Cent	HS	11	337.2	4.73	+2.6	
3376 Hadfi Hadnagy	KB	10	339.2	4.84	+4.7	
4416 Siglavy Capriola Sziga	LI	10	338.8	4.80	+4.3	
4417 Siglavy Capriola Tangó	LI	10	329.1	4.81	-5.4	
4453 Csörötnek Nonius-3	NO	9	337.3	5.08	+2.8	
4762 Nonius XLIX-2	NO	9	337.6	4.97	+3.1	
3191 Catalin VII-9	FN	8	330.2	5.19	-4.4	
3816 Nonius XVII-36	NO	8	341.6	5.15	+7.1	
4123 Furioso XVIII-3	FN	8	335.3	5.15	+0.8	
4294 Bocfölde-10 Dollár	HC	8	333.4	5.12	-1.1	
4319 Maxim Mars	KB	8	335.9	5.26	+1.3	
Overall mean			334.5	2.62	0.00	

*NO = Nonius; KB = Kisberi; HC = Hungarian Cold Blooded Horse; SH = Shagya; HS = Hungarian Sport Horse; LI = Lipizzaner; FN = Furioso - North Star

Table 5. The population genetic parameters of gestation length trait
5. táblázat. A vemhességi idő tulajdonság populációgenetikai paraméterei

Population genetic parameters	Value
Variance among progeny groups (genetic) (V_g)	27.388
Variance within progeny groups (environmental) (V_e)	121.186
Phenotypic variance (V_p)	148.574
Heritability (h^2)	0.184

Conclusions

The results based on the evaluation of 680 mating and foaling data of 7 traditional horse breeds in Hungary are partly similar to the previous information available in international sources.

The gestation length of traditional Hungarian horse breeds was similar to that in foreign breeds. Compared to the available data the Lipizzaner breed had slightly shorter gestation lengths in our findings.

According to our research, the month of mating influenced the gestation length the most. The mares fertilized earlier in the year had about 10 days longer gestation length, than those which were mated in summer. Most of the literature sources reported on a similar trend.

Similar to the existing information, the effect of the sex of the foal was statistically justifiable on the gestation length. But neither the age of the mare nor the method of fertilization had any significant impact.

Substantial and statistically reliable differences were found between the sires. This is of no great importance in practice, but according to our results it appears, that the length of gestation can be successfully influenced with the selection of a suitable sire.

The heritability of gestation length (h^2=0.18) is proved to be low, so the trait is mainly formed by the environment. Based on the analysis it can be presumed, that if the mares are kept in a suitable environment (professional nutrition, good health and breeding practices), well-balanced gestation parameters can be expected in the case of any genotypes.

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