Bulgarian Journal of Agricultural Science, 18 (No 2) 2012, 272-277
Agricultural Academy

LONGEVITY OF SHAGYA BROODMARES

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Abstract

SABEVA, I. and A. APOSTOLOV, 2012. Longevity of Shagya broodmares. *Bulg. J. Agric. Sci.,* 18: 272-277

The objective of the research was to be established the sources of specific variance and the heritability of the productive life of Shagya broodmares. The data for the length of productive life of 95 broodmares acted at the National stud Kabiuk after 1975 was an object of statistical processing. They were representatives of 8 lines 7 genealogical families and originated from 15 stallions and 63 mares. The analyses of the variance were done by mixed lineal models in which not only the genetic and environmental sources of variation were included, but also the factors: rate of gene plasma from Arabian breed, inbreeding, basic body indices, the exterior estimates and the generational remoteness from the families' founders.

The factors inbreeding, grading, massiveness, the exterior estimates and the generational remoteness of mares from the families' founders had decisive influence on the phenotypic variance of the productive life of Shagya broodmares. Typically for all long – term selected breeds of horses, fathers were the main source of genetic variance. With the longest productive life were the mares with F_x from 1.60 to 3.12 %. Estimates over the population average had the Arabian crossbreeds with grading above 50.00%. The superiority of the mares with massiveness above 114% was statistically proven.

Average to high heritability of the trait was established (h^2 = 0.34).

Key words: shagya, productive life, heritability, type traits

Introduction

In scientific literature, the length of productive life in horses is studied in two main aspects. The first one is about performance duration and the second one – about the reproductive activity of sires and broodmares. Wallin et al. (2000) have established statistically proved differences between breeds, sex and type of using. Because of lower risk from accidents and stress, the average length of life in half-bred broodmares was between 18.3 and 18.6 years old and it is about 4 years more than the average for competing horses. Burns et al. (2006) have established that the prevalent influence of greater number of environmental and external risk factors as reason for the low inheritance of the productive racing life (h^2=0.12). Richard and Bouin (2011) have also established that the above-mentioned influences as reasons for the low inheritance of the competitive jumping horses (h^2=0.10) with 22% censored data set.

The publications with relation to the duration of economic use of broodmares are not many and the presented results are not identical. According to Budzynski et al. (1994), Polish Arabian mares were used for breeding at the rate of 11.29 breeding seasons. The authors have established low inheritable determination of the breeding seasons' number (h^2=0.10). The female Champions and the Reserve Champions from the same breed were used in breeding significantly longer in comparison with the others (Budzynski et al., 2000). Average high heritability (h^2=0.45) of the length of productive life and statistically significant effects of the genealogical lines, breeds, grading and the individual coefficients of inbreeding have been established for the East-Bulgarian mares. They were used on the average of 11.4 years, as the mares with grading above 67 % and coefficient of complex inbreeding to 1.56 % considerably exceeded the average for the population (Sabeva, 1997). The results from the analyses of Budzynski et al. (2001) have shown that the low levels of inbreeding were not influenced on the traits' variety which have characterized the life reproductive efficiency in Arabian mares, except for the conception rate (R_{xy}=0.262).Chmiel and Sobczuk (2006 a, b) reported about influence of the mother line on variance of the reproductive life in mares from the same breed. Mantovani et al. (2007) have stated for length of productive life of 6.6 years for Italian Heavy Draught mares and inheritance 0.07 with 32.5 % censored data set.

During the recent years, the duration of the economic use was an object for detailed researches in all kinds of agricultural animals. The results from the researches conducted with sows and cows have shown that the length of productive life had significant genetic variance. The high correlative relationships between longevity and the traits characterizing type, conformation and productivity have shown the possibilities for conducting of an indirect selection (Grindflek and Sehested, 1996; Yazdi et al., 2000; Diaz et al., 2002; Rodriguez-Zas et al., 2003; Strapak et al., 2005; Tarres et al., 2006; Apostolov et al., 2011).

The aim of the study was to determine the sources of specific variance and the inheritance of the productive life with Shagya broodmares.

Material and Methods

The data for the length of productive life of 95 broodmares acted at the National stud Kabiuk after 1975 was an object of statistical processing. They were representatives of 8 lines 7 genealogical families and originated from 15 stallions and 63 mares. The productive life, measured in years, was defined as difference between month and year of the stud entrance and month and year of leaving the breeding herd. Mixed lineal models did the analyses of variance. The components of the additive variance were calculated by the covariance between the half-sibs by father (model 1) and separately by the covariance between the half-sibs by mother (model 2). Not only the genetic and environmental sources of variation were included in the structure of the operative models but also the factors grading, inbreeding, basic body indices, the exterior estimates and the generational remoteness from the families' founders. The rate of the genetic plasma from Arabian breed in the genotype of the mares was defined up to fourth and sixth pedigree generation. The individual inbreeding coefficients were calculated by Wright's formula (1921) including to sixth generation of pedigree. The body indices were presented as percent proportions of the cannon girth to height at withers for the bone development; of the chest girth to height at withers for the massiveness and of the chest width to chest depth for the chest development. The exterior estimates were done using ten score system.

Horses were arranged to 5 categories according to the inbreeding value: $F_x = 0.00$, $F_x \leq 0.78$, $0.82 \leq F_x \leq 1.56$, $1.60 \leq F_x \leq 3.12$, $3.16 \leq F_x \leq F_x$ 4.45 %; to 3 with relation to the grading: to 43.75%, from 50.00 to 68.75% and from 75.00 to 87.50%; and to 3 for each one of the studied indices.

Results and Discussion

Shagya broodmares were used for breeding on the average of 8.62 years (Table 1). High variation coefficient (50.09 %) is result from the big variation width of the trait, which values ranged from 2 to 20 years. According the parameters of the common statistics presented in Table 1 the mares were extremely well equalized regarding the body development and possessed the typical breed proportions. Bigger variety from 12.66 % was established for the traits characterizing the exterior.

A modified scale of measurements using the way of root extraction (Tables 2 and 3) did the analyses of variance and the estimates of the factors. The substitution ensured independence of the dispersion from the average and reduced to the geometric distribution of data to the normal (Falconer, 1989). The tested models differed by the way of using the influence of the factors grading, inbreeding, body indices and exterior estimates. In model 1 these sources of variation were regressions and in model 2 were fixed factors with the respective sublevels. During the investigated period, the regression effects of inbreeding, massiveness and exterior estimates were statistically proved. The group effects of the mares' lineal and family belonging as well as the differences between chest index values did not induce significant phenotypic variance in present investigation. Significant influence of the generations was established only in the decomposition of the total variance by the covariance between the mothers' half-sibs (model 2). This type of calculation leads to increasing the level of significance of the differences between fathers and of the regression effect of the exterior estimates. The results from the analyses show that the variation of productive life is influenced largely from non-additive type gene relationships.

In Table 3 are given the BLUE of the statistically proved sources of variation. With the lon-

Table 1
Average arithmetical, standard deviations and variance coefficients of the included traits in the analyses

Traits	x	s.d.	CV
Productive life	8.62	4.31	50.09
√ productive life	2.94	0.71	24.49
Massiveness	114.07	2.76	2.42
Bone system development	12.27	0.29	2.37
Chest index	60.43	3.39	5.61
Exterior estimation	7.54	0.95	12.66

Table 2
ANOVA of the examined traits

Sourses of variability	df	Productive life	
		model 1 F - тест	model 2 F - тест
Line (F)	7	n.s.	-
Family (F)	6	n.s.	-
Generation (F)	5	n.s.	*
Month of bird (F)	8	n.s.	-
Inbreeding (C/F)	1/4	* (C)	* (F)
Grading at IV generation of pedigree (C/F)	1/2	n.s. (C)	*(F)
Grading at VI generation of pedigree (C/F)	1	n.s. (C)	n.s.
Massivenes (F)	2	*	n.s.
Bone system development (C/F)	1/3	n.s. (C)	n.s. (F)
Chest index (C/F)	1/2	n.s. (C)	n.s. (F).
Exterior estimation (C)	1	*	**
Sire (R/F)	14	(R)	*
Mother (R)	62	-	(R)
Year of birth (ABS)			
R^2		0.56	0.61

* – $P \leq 0.05$, ** – $P \leq 0.01$; Factors: F - fixed, R - random, C - covariate, ABS - absorbed.

gest productive life were the mares with F_x from 1.60 to 3.12 %. The positive regression effect of the inbreeding is due to the systematically using of complex inbreeding, as a form of moderate and distant relationship. Estimates over the population average had the broodmares with grading above 50.00%, with significant superiority of the group 50.00% – 68.75% over the other two categories. The improved exterior and the better-expressed Eastern type of the crossbreds with Arabian breed were reasons for their longer longevity. They give way on massiveness to the typical Shagya

Table 3
BLUE of the examined factors

Factors levels	n	constant	Fd - test
Inbreeding			
1. autobreeding	32	-0.523	1 - 3***, 4***, 5***
2. to 0.78 %	17	-0.303	2 - 4***, 5*
3. 0.82 % - 1.56 %	21	-0.109	3 - 4***
4. 1.60 % - 3.12 %	16	0.771	4 - 5****
5. 3.16 % - 4.45 %	9	0.165	
regression effect	95	0.421*	
Grading IVth generation of pedigree*			
1. to 43.75 %	35	-0.623	
2. 50.00 % - 68.75 %	45	0.413	1 - 2***, 3***
3. 75.00 % - 87.50 %	15	0.211	
regression effect	95	0.065	
Massiveness*			
1. to 112.00 %	26	0.113	
2. 112.00 % - 114.00 %	30	-0.517	1 - 2***, 3*
3. 114.00 % and up	45	0.405	2 - 3***
regression effect	95	-0.027	
Chest index			
1. to 60.00 %	43	0.022	
2. 60.00 % - 63.00 %	29	0.098	1 - 3***
3. 63.00 % and up	23	-0.120	
regression effect	95	0,005	
Grading VIth generation of pedigree			
regression effect	95	0.008	
Exterior estimation			
regression effect	95	0.297*	
Generation*			
1. seventh	4	0.787	1 - 2***, 4**, 5***, 6***
2.eight	14	-0.233	2 - 3***, 4***, 5***, 6***
3. ninth	34	0.399	3 - 4*, 5***, 6***
4. tenth	28	0.099	4 - 6***
5. eleventh	12	-0.213	5 - 6***
6. twelfth	34	-0.838	

Levels of significance: * – P ≤ 0.05, ** – P≤ 0.01, *** – P≤ 0.001.

which resulted in positive constant of the massiveness category to 112% (BLUE = 0.113). The superiority of the mares with massiveness above 114% over the remaining was statistically proven. Broodmares from seventh, ninth and tenth generation had productive life over the average for the herd. Broodmares from the last two generations had shortest period of productive life, as all differences between sublevels of the factor were proven with significance $P \leq 0.001$. As a conclusion for the entire set of data, 29.70% of broodmares had productive life to 5 years, 30.69% - to 12 years and 30.69% - up to 12 years. Decreased length of productive life over the last two generations and the too high percent of broodmares left the herd before being progeny tested ware due to the stud herd restriction at the end of 1990s.

Depending on the calculation method the inheritance of the duration of productive life ranged from 0.14 (Becker, 1968) to 0.34 (by the equation of model 1). The value of the additive variance in Shagya broodmares was the lowest compared with the same in East Bulgarian ($h^2 = 0.45$) and Arabian breeds ($h^2 = 0.44$), raised in the same stud (Sabeva 1997, Sabeva and Apostolov 2011). There were some reasons led to higher value of inheritance calculated by the mixed models methodology. Higher inheritable determination of the trait might be expected in long-term selected breeds with consolidated inheritance and with statistically proved fathers' effect. The scale of measurements the trait was modified which according to Falconer (1989) led the geometric distribution of data set to the normal, increased the influence of non-additive gene relationships and ensured independence of the dispersion from the average, i.e. the range of the average variance was précised. Besides, the management systems and selection in the old studs were relatively constant in time, which led to decreased influence of the risky environmental factors. The present research was based on uncensored data set. The investigations of Guo et al. (2001), Burns et al. (2005) and others showed that heritability decreased with the increasing of the part of uncensored data and the obtained estimations were biased. Having in mind the above mentioned, we could accept that the productive life of Shagya broodmares had average to high inheritable determination and in the presence of high genetic correlations with some of the selected traits might be an object of an indirect selection.

Conclusions

The factors inbreeding, grading, massiveness, the exterior estimates and the generational remoteness of mares from the families' founders had significant influence upon the phenotypic variance of the productive life of Shagya broodmares. Typically for all long – term selected breeds of horses, fathers were the main source of genetic variance.

Average to high inheritable determination of the trait was established.

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Received November, 2, 2011; accepted for printing February, 2, 2012.