

Dynamics of the selection traits milk yield and fertility in sheep from the Bulgarian Dairy Synthetic population

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Citation: Iliev, M., Staykova, G., & Tsonev, T. (2022). Dynamics of the selection traits milk yield and fertility in sheep from the Bulgarian dairy synthetic population. *Zhivotnovadni Nauki*, 59(2), 3-9 (Bg).

Abstract

The subject of the study were 254 ewes from the Bulgarian Dairy Synthetic population, owned by the Institute of Agriculture – Karnobat, born in the period 2013–2018. The aim of the study was to establish the dynamics of milk yield and fertility in sheep. The selection traits of milk yield of a standard 120-day period, duration of milking period and biological fertility by years of birth in animals of different ages have been studied and analyzed. The dynamic of milk productivity for 120 days was monitored from I to IV lactation, and biological fertility was monitored from I to IV lambing, until reaching 5.5 years. The data from the performed controls were processed by the method of variation statistics. It was established that the average milk yield for a standard 120-day period (108.6l), average daily milk yield (0.905 l) and duration of the milking period (140.6 days) were the highest during third lactation. Biological fertility of sheep increased from 134.2% to 154.1% during the time from the first to third lambing. The analyses of the obtained results indicate sufficient perspectives for increasing the potential and real productivity of sheep from the studied herd of Bulgarian Dairy Synthetic population.

Key words: Bulgarian dairy Synthetic sheep, selection traits, milk yield, fertility

Динамика на селекционните признаци млечност и плодовитост при овце от Синтетична популация българска млечна

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Резюме

Обект на изследването са 254 овце майки от Синтетична популация българска млечна, собственост на Института по земеделие – Карнобат, родени през периода 2013–2018 година. Целта на проучването е да се установи динамиката на млечността и плодовитостта при овцете. Про-

учени и анализирани са селекционните признаци дойна млечност за стандартен 120-дневен период, продължителност на доен период, средна дневна млечност за доен период и биологична плодовитост по години на раждане при животните на различна възраст. Динамиката на дойната млечност за 120 дни е проследена от I до IV лактация, а на биологичната плодовитост от I до IV агнене до достигане на 5,5-годишна възраст. Данните от проведените контроли са обработени по метода на вариационната статистика. Установено е, че средната млечност за 120-дневен стандартен доен период (108,6 l), средната дневна млечност (0,905 l) и продължителността на дойния период (140,6 дни) са най-високи на трета лактация. Биологичната плодовитост на овцете се увеличава от първо до трето агнене от 134,2% до 154,1%. Анализът на получените резултати показва добри перспективи за повишаване на потенциалната и реална продуктивност на овцете от проучваното стадо от Синтетична популация българска млечна.

Ключови думи: Синтетична популация българска млечна, селекционни признаци, млечност, плодовитост

Introduction

Bulgarian Dairy Synthetic population was created by applying a system of hybridization and was recognized in 2005 in Bulgaria. The scheme includes several Bulgarian and two introduced specialized dairy breeds – East Friesian and Awassi. The main selection traits in sheep from the of Bulgarian Dairy Synthetic population are milk yield and fertility, as the levels of their productivity determine the economic effect of animal husbandry. The dairy division occupies the largest relative share of the sheep breeding sector in the country, and the sheep from the Synthetic population are practically about 70% of the animals in the division (Stancheva et al., 2014). In addition to increasing productivity, other goals of the breeding activity are to improve the suitability for machine milking and to increase the plasticity of animals to climate change. Milk production is the main selection trait in dairy sheep. Subject of studies by Bulgarian and foreign scientists is the increase in milk productivity of sheep (Dzhorbineva and Mihailova, 2005; Iliev, 2007; Hinkovski et al., 2008; Stancheva et al., 2014; Slavova et al., 2015; Raycheva and Ivanova, 2015; Ivanova et al., 2015; Boykovski and Georgiev, 2019; Lyitskanov et al., 2013; Krupova et al., 2014). Fertility is the other important selection trait, which in the periodic changes in market realities gives a very significant impact on farm income. Studies on the

levels of biological fertility and the factors that influence the trait are conducted by Boykowski et al. (2005); Iliev (2008); Panayotov and Simeonov (2008); Hinkovski et al. (2008); Dimova et al. (2010); Slavova et al. (2015); Raycheva and Ivanova (2015); Nedelkov et al. (2015) and others. In the flock of the Bulgarian Dairy Synthetic population of the Institute of Agriculture – Karnobat, most of the genotypes are heredity combinations of five breeds. In the beginning, sheep from the Karnobat fine fleece breed were bred with male breeders from the Agricultural Institute – Shumen, the Agricultural Institute – Stara Zagora and the Experimental Station – Razgrad. At a later stage, purebred rams of the East Friesian breed, imported from Germany, were used. Periodic productivity studies are needed to identify trends and effectively guide the selection process to achieve genetic progress.

The aim of the study was to establish the dynamics of milk yield for 120 days and the biological fertility of sheep from the Bulgarian Dairy Synthetic population.

Material and methods

Subject of the study were 254 ewes from the Bulgarian Dairy Synthetic Population (BDSP), owned by the Institute of Agriculture – Karnobat, born in the period 2013–2018. The selection traits of milk yield for a standard 120-day peri-

od, duration of the milking period, average daily milk yield for the milking period and biological fertility by years of birth in animals of different ages were studied and analyzed. The dynamics of milk yield for 120 days was followed from I to IV lactation, and of biological fertility from I to IV lambing until reaching 5.5 years. The necessary primary information for the study was taken from the pedigree genealogy books kept at the Institute of Agriculture – Karnobat. Milk yield for milking period was determined by the AC method of ICAR, according to the Instruction for control of productive qualities and evaluation of sheep (2003) and Regulations for breeding with sheep from the Bulgarian Dairy Synthetic population in the scope of the Association for breeding the Bulgarian Dairy Synthetic sheep breed. The flock was under selection control in the Association for Breeding of Bulgarian Dairy Sheep Breed. Biological fertility was defined as a ratio between the number of all lambs (live births, stillbirths and abortions) and the number of lambs. The data from the performed controls were processed by the method of variation statistics.

Results and discussion

The data for milk productivity for 120 days and the duration of the milking period are shown in Table 1. The results indicate that the milk pro-

ductivity for 120 days was the highest at third lactation – 108.6 l and the duration of the milking period lasted on average 140.63 days. The largest variation of the trait (32.03%) was observed during the first lactation. Lower than our results found Stancheva et al. (2014) for 120 days of milk productivity in the first and second lactation – 95.41 l and 94.41 l, with 101.9 l and 107.7 l in our study. Ivanova et al. (2015) gave data for 80.02 l of milk for 120 days of first lactation, with a duration of 142 days. Our results show a duration of the lactation period from 136.9 to 140.6 days, with a more significant variation of the fourth lactation. The average daily milk productivity in the studied herd increased on II, III and IV lactations compared to I lactation as follows: I lactation – 0.849 l; II lactation – 0.897 l; III lactation – 0.905 l; IV lactation – 0.887 l. The dynamics in the values was insignificant, the coefficients of variation were low and the differences were without statistical significance. Slavova et al. (2015) found close to our results – 0.843 l average daily milk productivity for the milking period of the first lactation, 0.929 l of the second, 0.974 l of the third and 0.997 l of the fourth lactation in sheep from the Bulgarian Dairy Synthetic population, bred at the Agricultural Institute – Stara Zagora.

An increase in the milk productivity for 120 days was established from I to II lactation for all studied animals (Table 2). In the third and fourth lactations there was no significant dynamics in

Table 1. Milk productivity per 120 days, duration of the milking period and average daily milk yield

Таблица 1. Дойна млечност за 120 дни, продължителност на дойния период и средна дневна млечност

Parity / Поредност на лактация	Milk productivity per 120 days, l / Дойна млечност за 120 дни, l			Duration of the milking period, days / Продължителност на дойния период, дни			Average daily milk yield, l / Средна дневна млечност, l		
	n	$\bar{x} \pm S_x$	C	n	$\bar{x} \pm S_x$	C	n	$\bar{x} \pm S_x$	C
I lactation / I lactation	254	101.9 ± 1.17	32.03	254	139.2 ± 0.96	10.95	254	0.849 ± 1.28	7.71
II lactation / II lactation	188	107.7 ± 1.22	26.06	188	136.9 ± 1.01	10.06	188	0.897 ± 1.94	8.16
III lactation / III lactation	121	108.6 ± 1.53	26.14	121	140.6 ± 1.15	8.99	121	0.905 ± 2.61	8.29
IV lactation / IV lactation	77	106.5 ± 1.94	26.18	77	138.2 ± 1.90	12.09	77	0.887 ± 3.04	8.14

Table 2. Milk productivity per 120 days and duration of the milking period by year of birth**Таблица 2.** Дойна млечност за 120 дни и продължителност на доения период по години на раждане

Lactation / Лактация	2013		2014		2015		2016		2017		2018	
	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$
120-day milk productivity, l / Дойна млечност за 120 дни, l												
I lactation / I лактация	54	100.24 ± 2.53	43	104.03 ± 2.83*	36	105.11 ± 3.10**	39	102.85 ± 2.97*	46	99.88 ± 2.74**	36	99.69 ± 3.10**
II lactation / II лактация	51	110.12 ± 2.35**	39	107.63 ± 2.68	33	109.67 ± 2.92**	35	104.89 ± 2.83**	30	102.75 ± 3.06**	-	-
III lactation / III лактация	42	109.62 ± 2.60	34	107.86 ± 2.89	29	109.18 ± 3.13	16	106.34 ± 4.21	-	-	-	-
IV lactation / IV лактация	39	106.98 ± 3.7	21	105.66 ± 3.72	17	105.46 ± 4.14	-	-	-	-	-	-
Duration of milking period, days / Продължителност на доен период, дни												
I lactation / I лактация	54	141.50 ± 2.07	43	140.59 ± 2.32	36	138.89 ± 2.54	39	141.97 ± 2.44*	46	136.08 ± 2.25**	36	135.41 ± 2.54***
II lactation / II лактация	51	139.85 ± 1.93*	39	138.23 ± 2.20	33	140.39 ± 2.40***	35	135.00 ± 2.33	30	128.62 ± 2.51***	-	-
III lactation / III лактация	42	141.97 ± 1.95	34	139.53 ± 2.17	29	141.86 ± 2.35	16	137.15 ± 3.16**	-	-	-	-
IV lactation / IV лактация	39	140.51 ± 2.68	21	138.62 ± 3.65	17	132.53 ± 4.05**	-	-	-	-	-	-

* - $p < 0.05$; ** - $p < 0.01$; *** - $p < 0.001$

the values for those born in the respective year. The average milk productivity of the first lactation ranged from 99.69 l (for those born in 2018) to 105.11 l (born in 2015), followed by those born in 2014 and 2016 ($p < 0.01$ and $p < 0.05$). In the second lactation, the highest milk productivity for 120 days was for those born in 2013 – 110.12 l, followed by a slightly lower value for those born in 2015 ($p < 0.01$). In the third lactation, the average milk yield for 120 days was the highest for those born in 2013 – 109.62 l, followed by those born in 2015, but without statistical significance of the differences between the groups. In the fourth lactation, the milk productivity was highest again in animals born in 2013 – 106.98 l, followed by those born in 2014 and 2015, without established significance of the differences. The observed variation by years of birth did not give grounds for a certain trend in the dynamics of the average milk productivity for 120 days. The obtained results for the studied flock were higher than the average milk productivity for 120 days – 96 l, indicated in the breeding program of the Association for Breeding the Bulgarian Dairy Synthetic Population for the previous 10 years.

The duration of the respective lactations varied in the following range: I lactation lasted on average from 135.41 days to 141.97 days; II – from 128.62 days to 140.39 days; III – from 137.15 days to 141.97 days; IV – from 132.53 days to 140.51 days ($p < 0.05$, $p < 0.01$, $p < 0.001$) (Table 2). There was a tendency to reduce the duration of lactation between the first and second, with the exception of animals born in 2015. There was a slight prolongation of the third lactation for all groups studied and again a reduction in the duration of the fourth lactation. The variation between lactations had different directions. Slavova et al. (2015) found greater variation in the duration of the lactation period, respectively of the first lactation from 114.00 days to 138.64 days; on the second – from 117.79 days to 159.08 days; on the third – from 106.38 days to 143.76 days; on the IV – from 110.67 days to 129.43 days.

A very important selection trait in sheep breeding is biological fertility (Table 3). Following the average values in the order of lambing, we

Table 3. Biological fertility of ewes depending by year of birth

Таблица 3. Биологична плодovitост на овцете майки в зависимост от годината на раждане

Lambing / Агнене	2013		2014		2015		2016		2017		2018		Общо / Total	
	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$	n	$\bar{x} \pm S_x$
I lambing / I агнене	54	134.3 ± 0.06	43	$126.4 \pm 0.07^{**}$	36	128.1 ± 0.08	39	$149.1 \pm 0.08^{***}$	46	$141.3 \pm 0.07^{**}$	36	128.4 ± 0.08	254	134.2 ± 0.03
II lambing / II агнене	51	129.1 ± 0.07	39	138.3 ± 0.08	33	139.4 ± 0.09	35	$146.2 \pm 0.08^{***}$	30	$120.4 \pm 0.09^{***}$	25	$144.1 \pm 0.10^{*}$	213	135.4 ± 0.03
III lambing / III агнене	42	$140.3 \pm 0.09^{**}$	34	$168.1 \pm 0.10^{**}$	29	148.2 ± 0.11	16	156.0 ± 0.15	29	$169.1 \pm 0.11^{**}$	-	-	150	154.1 ± 0.05
IV lambing / IV агнене	39	136.4 ± 0.08	21	152.3 ± 0.11	17	$129.4 \pm 0.13^{*}$	10	150.2 ± 0.16	-	-	-	-	87	141.4 ± 0.06

* – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$

found that it increases from the first to the third lambing from 134.25% to 154.1% and followed a slight decrease to 141.4% of the fourth lambing. Slavova et al. (2015) found slightly lower values for the biological fertility of sheep from BDSP, which increased from the first to the third lambing from 126.2% to 140.2%, and then decreased to 136.0%. Stancheva et al. (2014) also indicated a variation of the trait from 124% to 152%. Raycheva and Ivanova (2015) found close to our results for biological fertility (BDSP) from 130% to 145% in breeding lines. Ivanova et al. (2015) gave data for 120% fertility of the same flock in sheep at 2.5 years. A large number of genetic and non-genetic factors are known in literature that influence the phenotypic performance of the trait. On average, for the dairy sheep population controlled by Association for breeding Bulgarian Dairy Synthetic sheep, the fertility was much lower (112.6%) than our results for a period of 10 years of breeding activity.

Depending on the year of birth, the fertility results of sheep varied widely. On the first lambing, the animals born in 2016 had the highest fertility – 149.1%, followed by those born in 2017 ($p < 0.05$, $p < 0.01$, $p < 0.001$). In the second lambing the number of born offspring was higher again in those born in 2016 – 146.2%, followed by those born in 2018 ($p < 0.05$, $p < 0.001$). In the third lambing with significantly higher biological fertility were those born in 2017 – 169.1%, followed by those born in 2014 ($p < 0.01$). In the fourth lambing the highest fertility was in ewes born in 2014 – 152.3%. The reproductive results in Table 3 show that in the first two lambing campaigns the highest biological fertility was shown by the animals born in 2016, and on the third and fourth lambing the sheep born in 2014 performed better. The dynamics of the average values between the first and second lambing, considered by years of birth, respectively of production, was different. However, between the second and third lambing, there was a steady trend of increasing the number of offspring at all studied levels. The opposite trend was observed when comparing the results of the third and fourth lambing again for the whole studied sample.

Conclusions

The average milk yield for a 120-day standard milking period (108.6 l), the average daily milk yield (0.905 l) and the duration of the milking period (140.6 days) were highest at third lactation.

The biological fertility of sheep increased from the first to the third lambing from 134.2% to 154.1%.

The obtained results for milk yield and biological fertility of the studied flock were higher than the average values of sheep from the Bulgarian Dairy Synthetic population, controlled by the Association for Breeding of Bulgarian Dairy Synthetic Sheep Breed.

The analysis showed good perspectives for increasing the potential and real productivity of the sheep from the studied flock from the Bulgarian Dairy Synthetic population.

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