

Evaluation of the effect of abiotic factors on the weight development of young male breeding animals of the Ile de France breed in Bulgaria

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Abstract

Subject of the study were 123 purebred male lambs of the breed Ile de France. The animals were born in the period 2017–2020 and were raised on three farms in the northern part of Bulgaria. Monitored was the weight development of 123 male individuals from birth to 9 months. For this purpose, the following traits were measured: live weight at birth, at 30 days, at 70 days and at 9 months. The average daily gain of the animals realized in the studied periods was calculated. The data were obtained from the Pedigree book of the breed. The variance analysis was made on the basis of a multifactor linear-statistical model for each studied age. The studied factors inducing a specific variance were year of birth, lambing season and farm. It was found that the year of birth had a significant effect on the live weight trait of male lambs from the Ile de France breed up to 70 days of age. The farm factor had a significant effect on live weight after 30 days, and the lambing season had an effect on all ages studied. Depending on the farm, the realized gain by periods indicated a significant specific variance after 30 days of age, the 30–70 day season and the year for the three studied periods. The average live weight at birth was 5.193 kg, at 30 days – 15.766 kg, at 70 days – 30.739 kg and at 9 months – 68.910 kg. The average daily gain of male Ile de France lambs in the first month after birth was 0.362 kg, 0.387 kg up to 70 days and 0.192 kg between 70 days and 9 months of age. The obtained results for live weight and gain from birth to 9 months of age confirmed the good adaptation of the breed in Bulgaria and the opportunity for realization its potential for high growth intensity at an early age.

Key words: Ile de France sheep, live weight, average daily gain, year of birth, season, farm

Оценка на ефекта на абиотични фактори върху тегловното развитие на млади мъжки разплодни животни от породата Ил дьо Франс в България

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Резюме

Обект на проучването са 123 чистопородни мъжки приплоди от породата Ил дьо Франс. Животните са родени през периода 2017–2020 г. и се отглеждат в три ферми в северната част

на България. Проследено е тегловното развитие на 123 индивида от мъжки пол от раждането до 9-месечната им възраст. За целта са измерени: живото тегло при раждане, на 30 дни, на 70 дни и на 9 месеца. Изчислен е средният дневен прираст на животните, реализиран в проучваните периоди. Информацията е получена от Родословната книга на породата. Направен е анализ на варианса на базата на многофакторен линейно-статистически модел за всяка проучвана възраст. Изследваните фактори, индуциращи специфичен вариант са година на раждане, сезон на агнене и ферма. Установено е, че годината на раждане оказва достоверно влияние върху признака живо тегло на мъжки агнета от породата Ил дьо Франс до 70-дневна възраст. Факторът ферма влияе достоверно върху живото тегло след 30 дни, а сезонът на агнене на всички проучени възрасти. Реализираният прираст по периоди показва достоверен специфичен вариант в зависимост от фермата след 30-дневна възраст, сезонът 30–70 дни и годината за трите проучвани периода. Средното живо тегло при раждане е 5,193 kg, на 30 дни – 15,766 kg, на 70 дни – 30,739 kg, и на 9 месеца – 68,910 kg. Средният дневен прираст на мъжките агнета Ил дьо Франс през първия месец след раждането е 0,362 kg, 0,387 kg до 70 дни и 0,192 kg в периода от 70 дни до 9-месечна възраст. Получените резултати за средно живо тегло и среднодневен прираст от раждане до 9-месечна възраст потвърждават добрата адаптация на породата в България и възможността да реализира потенциала си за висок интензитет на растеж в ранна възраст.

Ключови думи: Ил дьо Франс порода овце, живо тегло, среден дневен прираст, година на раждане, сезон, ферма

Introduction

The Ile de France breed is a French meat-producing sheep breed, successfully adapted in our country and it has acquired basic importance as a specialized meat breed in Bulgaria. According to France Génétique Elevage (2019), about 230000 sheep of this breed are raised in France. It is bred in over 50 countries on all continents (INSEM OVIN, 2020). The breed was created and recognized in its homeland in 1920, and the first import in Bulgaria was realized in 1968. The main goal of the research in our country is to establish the acclimatization and productive features of the breed and the possibilities for crossbreeding with the sheep bred in Bulgaria. According to the Ile de France Breeding Association in Bulgaria (AILFB), by 2020 6200 purebred animals and about 1600 crosses are bred in Bulgaria. The peculiarities, productivity and condition of the population of meat-producing sheep Ile de France in our country are the subject of research interest by Bulgarian authors (Achkanova et al., 2019, 2020; Dimitrov, 1978, 1991; Dimitrov et al., 1987, 2011; Ivanova, 2020; Ivanova et al.,

2017; Laleva, 1996; Laleva et al., 2020; Metodiev et al., 2008, 2010; Raycheva et al., 2005, 2010). Other authors study the possibilities for crossing with our breeds and improving their meat-producing qualities, respectively the economic effect of breeding (Dimitrov, 1988; Laleva et al., 2006; Marinova, 1976; Slavov, 2007). Interest in this breed has increased significantly in recent years. Changes in objective conditions and market realities have made meat production a major source of income in our sheep farms, but especially in meat farms, where compacted lambing is applicable – 3 times in two years in the most common cases or 5 times in 3 years. The male offspring are sold mainly for slaughter, and also about 70–80% of the female lambs. Even in the dairy sector, meat accounts for a larger share of revenue than milk. This leads to an expansion of the Ile de France purebred sheep population and an increase in crosses with improved meat yield. These circumstances determine the need for new research in order to periodically update the parameters of the main controlled traits in the Breeding Program for the Ile de France breed in Bulgaria. It is especially important for prac-

tice to establish the effect of non-genetic and genetic factors on productivity to achieve rapid economic and genetic progress.

The aim of the study is to ascertain the effect of some abiotic factors on the weight development of young male breeding animals of the Ile de France breed bred in Bulgaria.

Material and methods

The subject of the study are 123 purebred male offspring of the breed Ile de France. The animals were born in the period 2017–2020 and were bred on three farms in the northern part of Bulgaria. The weight development of 123 male individuals from birth to 9 months of age was monitored. For this purpose, the following were measured: live weight at birth, at 30 days, at 70 days and at 9 months. Live weight is measured to the nearest 0.1 kg. The average daily gain of the animals realized in the studied periods was calculated. The information was obtained from the Pedigree Book kept by the breeders of the Ile de France Breeding Association in Bulgaria (AILFB). The data were obtained according to the standard methods and instructions provided in the Instruction Codex for Control of Productive Traits and Complex Evaluation, part of the selection program for the development of the breed in our country. The analysis of the variant is made on the basis of a multifactor linear-statistical model for each studied age, which has the following form:

$$Y_{ijklm} = \mu + A_{ijkl} + B_{mn} + C_{opq} + e_{ijklmnopq}$$

Where:

μ – total average for all ages

A_{ijkl} – effect of the factor year of birth (fixed) - 4 levels (2017 - 2020)

B_{mn} – effect of the factor - season (fixed) - 2 levels (1- spring and 2 - autumn)

C_{opq} – effect of the factor - farm (fixed) - 3 levels (1 - 3)

$e_{ijklmnopq}$ – residual effects, $\approx N(0, \delta e^2)$

Differences between the levels of the studied factors were established on the basis of the de-

gree of distribution measured by Student (Hayter, A. 1984):

$$(y_i - y_j) / S \sqrt{(1 / n_i + 1 / n_j) / 2}$$

where: $(y_i - y_j)$ – differences between the mean values of the levels of the studied factor, S – square deviation, n_i and n_j – number of observations (individuals) for the respective levels.

Results and discussion

The year of birth had a significant effect ($P < 0.001$) on the trait live weight of male lambs of the Ile de France breed up to 70 days of age (Table 1). The farm factor significantly ($P < 0.001$) affected live weight after 30 days, and the lambing season – at all studied ages ($P < 0.05$, $P < 0.01$, $P < 0.001$). The values of the F criterion for the farm effect of the last two ages reach 21.024 and 22.069. The coefficients of variation of the studied trait range from 21.90% at birth to 8.88%. The high level of variation in birth weight is logical in a breed with high fertility, due to the significant differences between offspring with different types of birth. The coefficients of determination of the model used range from 0.462 to 0.797 at different ages, which shows that a significant part of the variation is due to the sources of variability included in the model. Dimitrov (1978) proves a significant influence of the factor year of birth to weaning, which is in unison and is confirmed by our study after more than 40 years. In the same study, no significant differences were found in the weight development of breeding lambs obtained from imported sheep and from purebred animals raised in our country. Dimitrov et al. (1982) studied the main productive traits of sheep in the herd at the Agricultural Institute – Stara Zagora and also showed a significant influence of the year in terms of live weight at birth. Achkakanova et al. (2020) found a significant effect of the farm factor, combined with the genetic factor on the weight development of male and female offspring up to 70 days of age. The authors do not find a significant effect of the year and month of birth in the studied sample, but believe that the grouping of months by seasons changes the specific effects. There-

fore, when calculating breeding values, the interaction between the individual factors must be taken into account and the farm, year and month must be included in the linear models.

The realized daily gain by periods shows a reliable specific variant depending on the farm after 30 days of age ($P < 0.001$), the season 30–70 days ($P < 0.01$) and the year for the three stud-

ied periods ($P < 0.05$, $P < 0.001$) (Table 2). The variation of the studied trait is about 15% until weaning, after which the possibility of expressing one's own potential leads to higher variability of growth – 23.24%. The coefficients of determination of the used model range from 0.586 to 0.778 at different ages and this shows a good representativeness of the obtained results.

Table 1. Analysis of variance of the trait live weight of male lambs

Factors	df	F	P	R	CV%
1 day					
Year of birth	3	8.016	***		
Season	1	10.092	**	0.462	21.90
Farm	2	0.203	n. s.		
30 days					
Year of birth	3	6.198	***		
Season	1	2.771	*	0.516	11.34
Farm	2	1.536	n. s.		
70 days					
Year of birth	3	15.158	***		
Season	1	12.780	***	0.775	8.88
Farm	2	21.024	***		
9 months					
Year of birth	3	0.802	n. s.		
Season	1	4.867	*	0.797	12.98
Farm	2	22.069	***		

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

df – degree of freedom

Table 2. Analysis of variance of the trait average daily gain of male lambs

Factors	df	F	P	R	CV%
1 day–30 days					
Year of birth	3	15.090	***		
Season	1	0.146	n. s.	0.586	15.50
Farm	2	0.761	n. s.		
30 days–70 days					
Year of birth	3	27.120	***		
Season	1	8.258	**	0.778	15.26
Farm	2	22.257	***		
70 days–9 months					
Year of birth	3	3.503	*		
Season	1	1.504	n. s.	0.761	23.24
Farm	2	11.311	***		

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

df – degree of freedom

The results in Table 3 show that the animals born in 2017 and 2019 had lower values for the trait at birth compared to the average for the studied selected group ($P < 0.05$, $P < 0.01$, $P < 0.001$). After a month, and for the second and the next age, they present with positive LS-assessments for live weight, compared to their peers. This is probably due to a positive maternal effect, because at 9 months these male lambs again lag behind the average level of the trait. Those born in 2018 give negative LS-assessments for live weight up to 70 days. The offspring from 2020 show superiority in birth weight, after which they have a negative deviation from the average of up to 70 days and at 9 months are again presented with positive LS-assessments compared to their peers. Male lambs born in the spring definitely dominate in live weight at all studied ages, compared to the offspring born in the autumn ($P < 0.05$, $P < 0.001$). The analysis of farm data shows the strong influence of this factor in the period after weaning. The results of the analysis of the variant, where the values of the F criterion in the period from weaning to the end of the study are high, are confirmed. At a slightly lower birth weight, the offspring from Farm 1 significantly outperform their peers at the following ages ($P < 0.05$, $P < 0.01$, $P < 0.001$). The exact opposite trend is observed in the data for Farm 3. Farm 2 is characterized by negative LS-assessments for live weight at all study ages. The average live weight at birth is 5.193 kg, at 30 days – 15.766 kg, at 70 days – 30.739 kg and at 9 months – 68.910 kg. The results obtained by us for the average weight of male offspring at 30 days correspond to those established in France – 14.400 kg, and at 70 days – 31.500 kg. In total for both sexes the average live weight at 70 days is 28.900 kg. The information is published in the Yearbook of the National Institute of Animal Husbandry in France, which conducts its research in collaboration with INRAE (French National Institute for Agriculture, Food and Environment). Dimitrov (1978) found lower values of the studied trait at birth and at 1 month for lambs from imported mothers, and for sheep raised in our country the results are close to ours. Raycheva et al. (2005) published average values for live weight – at birth

(4.370 kg), at 30 days (11.826 kg) and at 70 days (20.750 kg). Laleva et al. (2006) published data on the average birth weight of 3.570 kg, and at other ages they are close to those of Raycheva et al. (2005). Dimitrov et al. (1982) and Ivanova and Raicheva (2017) reported a higher mean birth weight of male lambs born as singles, but the values of the following ages were lower in both types of birth. Laleva et al. (2020) publish lower values for average live weight from birth to 70 days for the herd in ZI – Stara Zagora, while the values for animals from IJN – Kostinbrod are close to our results at birth (5.005 kg), but at the following ages are lower than in our study. Achkakanova et al. (2020) report close to our data on live weight of male lambs of the same age up to 70 days.

Our results are close in value to those cited in the report of the Ile de France Breeding Association in Bulgaria (AILFB) for 2020 for the entire population bred in our country. The fact that they are similar to the realized live weights and growth of the young animals of the breed in France shows that the adaptation under our conditions is successful and the productive potential of the sheep of the breed Ile de France can be fully realized.

Table 4 gives data on higher daily gain of male lambs born in 2017 in the first month, after which they lag behind the average for the studied sample ($P < 0.01$, $P < 0.001$). Those born in 2018 and 2020 present negative LS-scores for average daily gain up to 70 days ($P < 0.01$, $P < 0.001$), and at 9 months they outperform their peers from other groups, but without statistical certainty of the differences. Lambs born in 2019 are presented with different deviations from the average in different periods. Animals born in the spring give lower growth in the first month, but then outperform their peers by 9 months. The male offspring from Farm 1 significantly achieved higher average daily gain for all studied periods, compared to the lambs from the other two farms ($P < 0.01$, $P < 0.001$). The results of the analysis of the variant were confirmed, where the values of the F criterion for the effect of the farm on the trait after weaning are high. The average daily gain of male Ile

Table 3. LS-estimates (LSC) of the: year of birth, season and farm effects on the live weight of male lambs at different age

Age	1 day			30 days			70 days			9 months		
	n	LSC	SE	n	LSC	SE	n	LSC	SE	n	LSC	SE
Year of birth												
2017	25	-0.824 A	0.228	25	1.399 ab	0.357	25	-1.008 a	0.559	25	-1.023	1.819
2018	28	-0.121 I	0.251	28	-0.926 a	0.394	28	-1.817 A	0.617	25	0.512	2.028
2019	43	-0.217 B	0.302	43	0.361 I	0.473	43	3.446 aAB	0.741	40	-3.049 a	2.403
2020	27	1.162 AIB	0.367	27	-0.834 bi	0.575	27	-0.623 B	0.901	26	3.561 a	2.923
Season												
I	61	0.566 C	0.178	61	0.468	0.279	61	1.418 m	0.437	58	3.122 A	1.415
II	62	-0.566 C	0.178	62	-0.468	0.279	62	-1.418 m	0.437	58	-3.122 A	1.415
Farm												
№ 1	46	-0.055	0.288	46	0.699 m	0.452	46	4.012 CI	0.707	45	13.462 Ba	2.288
№ 2	54	-0.081	0.207	54	-0.505 m	0.324	54	-2.962 C	0.508	51	-9.706 B	1.667
№ 3	23	0.136	0.241	23	-0.194	0.378	23	-1.050 I	0.592	20	-3.756 a	1.949
μ	123	5.193 \pm 0.125		123	15.766 \pm 0.197		123	30.739 \pm 0.306		116	68.910 \pm 1.023	

μ – overall LS mean;

Significance of differences within columns – when symbols identical: A to Z – $P < 0.001$; a to k – $P < 0.01$; I to z – $P < 0.05$

Table 4. LS-estimates (LSC) of the: year of birth, season and farm effects on the trait average daily gain of male lambs within different growth terms

Term	1 day–30 days			30days–70 days			70days–9 months		
	n	LSC	SE	n	LSC	SE	n	LSC	SE
Year of birth									
2017	25	0.066 abA	0.011	25	-0.056 A	0.012	25	-0.001	0.008
2018	28	-0.010 a	0.012	28	-0.032 B	0.013	25	0.012	0.009
2019	43	-0.006 bB	0.015	43	0.091 ABC	0.016	40	-0.033	0.012
2020	27	-0.050 AB	0.018	27	-0.004 C	0.019	26	0.021	0.014
Season of birth									
I	61	-0.003	0.008	61	0.027 I	0.009	58	0.009	0.007
II	62	0.003	0.008	62	-0.027 I	0.009	58	-0.009	0.007
Farm									
№ 1	46	0.017	0.014	46	0.087 Da	0.015	45	0.047 Aa	0.011
№ 2	54	-0.007	0.010	54	-0.065 D	0.011	51	-0.034 A	0.008
№ 3	23	-0.010	0.011	23	-0.022 a	0.013	20	-0.013 a	0.009
μ	123	0.362 \pm 0.006		123	0.387 \pm 0.007		116	0.192 \pm 0.005	

μ – overall LS mean;

Significance of differences within columns – when symbols identical: A to Z – $P < 0.001$; a to k – $P < 0.01$; I to z – $P < 0.05$

de France lambs in the first month after birth was 0.362 kg, 0.387 kg up to 70 days and 0.192 kg between 70 days and 9 months of age. Our results are again similar to those published in the Yearbook of the National Institute of Animal Husbandry in France, which conducts its research in collaboration with INRAE (French National Institute for Agriculture, Food and Environment). Male lambs Ile de France in their homeland have achieved 0.372 kg average daily gain from 30 to 70 days of age, the average for the entire selected group is 354 grams. Dimitrov (1988) published data on high intensity of 366–407g average daily growth in individual fattening from 30 to 90 days of male lambs Ile de France in Bulgaria, which is in line with our results. Examining the weight development of imported and born in our country offspring of both sexes Dimitrov (1978) gives data on lower average daily growth of lambs Ile de France up to 1 month and 70 days (0.279 kg and 0.251 kg). Dimitrov et al. (1987) published lower values of the trait up to 30 days (0.266 kg) for lambs from imported purebred mothers, but in the second period observed more intensive growth with an increase of 0.313 kg. Ivanova and Raicheva (2017) published data on the average daily gain of male lambs Ile de France with different linear affiliation from 0.240 kg to 0.261 kg, noting that singles gain more up to 30 days, and twins increase the intensity of growth after 30 up to 70 days. Laleva et al. (2020) also provide data on slightly lower growth intensity of lambs from the two institute herds, but confirm the fact that the breed has a good average daily gain of offspring and can be weaned earlier for meat. The analysis shows that adapting to our conditions, the breed has retained its potential for high growth intensity at an early age.

Conclusions

The year of birth had a significant effect ($P < 0.001$) on the trait live weight of male lambs of the Ile de France breed up to 70 days of age. The factor – farm significantly ($P < 0.001$) affected live weight after 30 days, and the lambing

season – at all studied ages ($P < 0.05$, $P < 0.01$, $P < 0.001$).

The realized gain by periods shows a reliable specific variant depending on the farm after 30 days of age ($P < 0.001$), the season 30–70 days ($P < 0.01$) and the year for the three studied periods ($P < 0.05$, $P < 0.001$).

The average live weight at birth is 5.193 kg, at 30 days – 15.766 kg, at 70 days – 30.739 kg and at 9 months – 68.910 kg. The average daily gain of male Ile de France lambs in the first month after birth was 0.362 kg, 0.387 kg up to 70 days and 0.192 kg between 70 days and 9 months of age.

The obtained results for live weight and gain from birth to 9 months of age confirmed the good adaptation of the breed in Bulgaria and the opportunity for realization its potential for high growth intensity at an early age.

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