

EVALUATION OF THE EFFECT OF SOME ABIOTIC FACTORS ON THE WEIGHT DEVELOPMENT OF YOUNG FEMALE ANIMALS OF THE ILE DE FRANCE BREED IN BULGARIA

Evgeniya ACHKAKANOVA¹, Genoveva STAYKOVA^{2*}

¹Institute of Animal Science - Kostinbrod, Spirka Pochivka 2232, Kostinbrod, Bulgaria

²Agricultural Institute - Shumen, 3 Simeon Veliki Blvd, Shumen 9700, Bulgaria

*Corresponding author email: staikova666@abv.bg

Abstract

Subject of the study were 655 female lambs from the Ile de France breed, born in the period 2017-2020 in Bulgaria. Weight development was monitored. Live weight at birth, at 30, at 70 days and 9 months was measured. The gain for the studied periods was calculated. The analysis was made using a multifactor linear-statistical model for each studied age. The factors inducing a specific variance were year of birth, lambing season, and farm. The year had a significant effect on the live weight at all studied ages, except weight at birth. The season affected live weight at all levels, excluding weight at 30 days. The average daily gain indicated a reliable specific variance depending on the year of birth of all studied ages. The season affected the gain of 30 to 70 days only. The farm had a highly significant effect on the live weight and the gain at all ages. 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: average daily gain, farm, Ile de France sheep breed, live weight, season, year of birth.

INTRODUCTION

Interest in the sheep breeding meat industry in our country has significantly increased in recent years. The reason is the growing relative share of revenue from the sale of breeding animals and lambs for meat, compared to other revenues. This trend is observed in all areas of sheep breeding. The creation of the meat-producing sheep breed Ile de France began in 1920, and the first import in Bulgaria was realized in 1968. The Association for Breeding Ile de France Sheep in Bulgaria (ABILFB) conducts breeding activities with 6,200 purebred animals under selection control and about 1,600 crosses in 2020. According to France Génétique Elevage (2019), about 230,000 Ile de France sheep are bred in France, and the breed is bred in over 50 countries on all continents (INSEM OVIN, 2020). The specialized meat breed is characterized by intensive growth at an early age. The meat has excellent taste, marbled, without the characteristic specific odour of some other breeds raised in our country. Good growth abilities, meat-producing qualities and feed

consumption are in optimal combination at slaughter level from 35 kg to 40 kg, i.e. the breed specializes in the production of heavy-type lambs. The productivity and condition of the Ile de France sheep population in Bulgaria have been studied by Bulgarian authors (Achkakanova 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 explore the possibilities of crossing with our breeds and improving their meat-producing qualities, respectively and the economic effect of breeding (Dimitrov, 1988; Laleva et al., 2006; Marinova, 1976; Slavov, 2007). The tendency for expansion of the Ile de France population, as the main meat-producing breed in Bulgaria, motivates our research. Studies on the influence of environmental and genetic factors are needed, both in purebred herds and in crosses with improved meat production qualities.

The aim of the study was to establish the effect of some abiotic factors on weight development

of young female animals from the Ile de France breed in Bulgaria.

MATERIALS AND METHODS

Subject of the study were 655 female lambs from the Ile de France breed. The animals were born in the period 2017-2020 and were raised in three farms in North Bulgaria. Weight development from birth to 9 months of 655 female lambs 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 was measured with precision up to 0.1 kg. Average daily gain of animals, realized in the studied periods, was calculated. The data were obtained from the Pedigree Books, which were updated by breeders from the Association for Breeding Ile de France Sheep in Bulgaria. Data were obtained using standard methods and instructions provided in the Instruction for control of productive traits and grading, which is part of the selection program for the development of the breed in our country. The analysis of the variance is made on the basis of a multifactor linear-statistical model for each studied age, which has the following form:

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

In which:

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; 2 - autumn)

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

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

The differences between levels of the studied traits were established on the basis of the distribution values, calculated with the Student test (Hayter A., 1984):

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

In which:

$(y_i - y_j)$ - difference between average values for the levels of the studied trait

S - Standard deviation

n_i, n_j - Number of observation (animals) for corresponding levels

RESULTS AND DISCUSSIONS

The year of birth had a significant effect ($P < 0.001$) on the live weight trait of Ile de France female lambs at all studied ages, except weight at birth (Table 1). This factor is a complex abiotic factor and source of specific variance on live weight. The year of birth indicates the influence of all components of the environment in the specific year that affect the weight development lambs after birth. The lambing season also affected all ages ($P < 0.05$, $P < 0.01$, $P < 0.001$), excluding weight at 30 days. The farm had a highly significant effect ($P < 0.001$) on live weight and the average daily gain at all ages of the studied selection animals. The values of the F criterion for the effect of the year vary from 21,350 to 50,496, for the factor season up to 48,431 and for the farm it reached 371,613 at 70 days. The coefficients of variation of the studied trait range from 22.12% at birth to 8.36%, gradually decreasing with age. 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 used model varied from 0.420 to 0.849 at different ages, which indicates that a significant part of the variation is due to the sources of variability included in the model. Achkakanova et al. (2020) found a significant effect from the factor farm, combined with genetic factors, on the weight development of male and female animals up to 70 days. The authors believe that when calculating breeding values, the interaction between the individual factors should be taken into account and the farm, year and month of lambing should be included in the linear models. Dimitrov (1978a) did not establish significant differences in the weight development of lambs for breeding, obtained from imported sheep and purebred animals raised in our country. The author proved a significant influence of the factor year of birth to weaning, which was confirmed by our study (Dimitrov, 1978b). Dimitrov et al. (1982) showed a significant effect of the factor year on live weight at birth.

Table 2 shows a significant specific variance of the realized gain by periods depending on the year and the farm for the three studied periods

($P < 0.001$) and the season 30-70 days ($P < 0.001$).

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

Factors	df	F	P	R ²	CV%
1 day					
Year of birth	3	1,989	n.s.	0.420	22.12
Season	1	6,359	*		
Farm	2	31,041	***		
30 days					
Year of birth	3	34,253	***	0.579	12.19
Season	1	0.033	n.s.		
Farm	2	67,211	***		
70 days					
Year of birth	3	50,496	***	0.849	10.60
Season	1	48,431	***		
Farm	2	371,613	***		
9 months					
Year of birth	3	21,350	***	0.516	8.36
Season	1	7,617	**		
Farm	2	35,281	***		

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

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

Factors	df	F	P	R ²	CV%
1 day - 30 days					
Year of birth	3	42,958	***	0.514	16.35
Season	1	1,609	n.s.		
Farm	2	46,000	***		
30 days - 70 days					
Year of birth	3	102,560	***	0.815	22.58
Season	1	52,342	***		
Farm	2	220,888	***		
70 days - 9 months					
Year of birth	3	14,913	***	0.508	16.89
Season	1	2,569	n.s.		
Farm	2	27,047	***		

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

The values of the F criterion for the effect of the year reached 102,560, and for the farm up to 220,888 for the second period of the studied gain. The variation of the studied trait is from

16.35% to 22.58%. The coefficients of determination of the used model ranged from 0.508 to 0.815 at different ages and this indicated a good representativeness of the results. Achkakanova and Staykova (2019b) found that the farm and the year of birth have a significant impact on the realized gain by periods, except for the year after 9 months.

The results in Table 3 show that animals born in 2019 have higher live weight values compared to other groups of all studied ages ($P < 0.05$, $P < 0.01$, $P < 0.001$). It is noteworthy that the superiority increases with age. For those born in 2020, a positive LS-assessment was observed at birth ($P < 0.05$, $P < 0.01$, $P < 0.001$), but at following ages the average weight progressively decreased compared to their peers. Those born in 2017 and 2018 showed negative LS- assessments at birth, but were 30 days ahead of their peers in live weight ($P < 0.05$, $P < 0.01$, $P < 0.001$), which was probably due to a positive maternal effect. At following ages, they had different deviations from the average weight. Female lambs born in the spring definitely dominated in live weight at all studied ages, compared to the autumn offspring ($P < 0.05$, $P < 0.001$). The analysis of farm data indicated the strong influence of this factor at all ages. The results of the analysis of the variance, where the values of the F criterion are high, were confirmed. Female offspring from Farm 1 were significantly ahead of their peers at all ages ($P < 0.001$). The lambs from Farm 2 showed a positive deviation at birth, but then lagged behind the average for the studied selection of animals, together with the animals from Farm 3. They were characterized by negative LS-assessments for live weight at all ages. The average live weight of female lambs at birth was 4,660 kg, at 30 days - 14,890 kg, at 70 days - 27,861 kg and at 9 months - 56,341 kg (Table 3).

Close to our results for the average live weight of female lambs, individuals of this breed at 30 days were established in France - 13,900 kg, and at 70 days - 27,200 kg. The information was published in the Yearbook of the National Institute of Animal Husbandry in France, which conducted its research in collaboration with INRAe - Bilan du Contrôle de Performances Ovins Allaitants - Campagne 2019, Institut de l'Élevage/IDELE/INRAe, Races de France. For

twins, the results were lower by 14.4% and 10.3% at the same ages, respectively. In total, for both sexes, the data for 2018 show an average weight of 14.500 kg at 30 days and 28,900 kg at 70 days (Résultats du contrôle de performances 2018, Institut de l'Élevage & Races de France). Raycheva et al. (2005) published average values for live weight - at birth (4,370 kg), which is close to our result. For following ages the values were lower - at 30 days (11,826 kg) and at 70 days (20,750 kg). Laleva et al. (2006) published data on an average weight at birth (3,570 kg), and at other ages they were close to those of Raycheva et al. (2005). Laleva et al. (2020) published a study with lower values for average live weight from birth to 70 days for the herd in Agricultural institute - Stara Zagora, while the values for animals from Institute of Animal Sciences - Kostinbrod were closer to our results at birth (5.005 kg), but for following ages were lower

than our study. Achkakanova and Staykova (2019a) found an average live weight of 70,939 kg at 2 years of age, compared to female Ile de France lambs at 9 months in our study which reached 79.42% of the weight of adult animals. This is indicative of the high growth rate at a young age and precocity of the breed, which is a sufficient condition for early conception after this age. Achkakanova et al. (2020) reported close to our live weight data of female lambs of the same age up to 70 days. Our results are close to those in the report of the Association for Breeding of the Ile de France sheep in Bulgaria for 2019 for the entire population bred in our country. These results are similar to the realized live weight and gain of the young animals of the breed in France, which proves that the adaptation under our conditions is successful and the full productive potential of the Ile de France sheep can be realized.

Table 3. LS-estimates (LSC) of the: year of birth, season and farm effects on the live weight of female 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	313	-0.016	0.066	313	1.182ABC	0.121	313	-1.079 aA	0.188	312	1.125 aA	0.313
2018	91	-0.251 l	0.106	91	0.228AD	0.194	91	0.345aBb	0.304	82	-0.139 Bb	0.527
2019	190	0.014 m	0.081	190	0.041BE	0.149	190	2.343ABC	0.233	173	2.943aBC	0.394
2020	61	0.253 lm	0.143	61	-1.452CDE	0.262	61	-1.609 bC	0.409	60	-3.928AbC	0.696
Season												
I	245	0.138 n	0.055	245	0.018	0.101	245	1.095 D	0.157	231	0.743 c	0.269
II	410	-0.138 n	0.055	410	-0.018	0.101	410	-1.095 D	0.157	396	-0.743 c	0.269
Farm												
№ 1	211	0.384 A	0.082	211	1.714 FG	0.149	211	6.315 EF	0.234	200	3.385 DE	0.404
№ 2	219	0.135 B	0.063	219	-0.630 FH	0.115	219	-2.392EH	0.180	208	-1.733 D	0.305
№ 3	225	-0.519AB	0.066	225	-1.084 GH	0.121	225	-3.924FH	0.189	219	-1.652 E	0.319
μ	655	4,660 ± 0.054		655	14,890 ± 0.099		655	27,861 ± 0.156		627	56,341 ± 0.261	

μ - overall LS mean;

Significance of differences within columns - when symbols identical:

A to Z - P<0.001; a to k - P<0.01; l to z - P<0.05

The results in Table 4 show a higher average daily gain of female lambs born in 2018 to 70 days and 2019 at all ages (P<0.05, P<0.001). Those born in 2020 are presented with negative LS-assessments for the three periods, and the offspring from 2017 gave different deviations from the average in the different periods. Animals born in different seasons are presented with insignificant and without statistically significant differences. Between 30 and 70 days, female offspring born in the spring achieved significantly higher gain (P<0.001).

Female lambs from Farm 1 achieved significantly higher gain to 70 days compared to animals from the other two farms (P<0.001). In Farm 2 and Farm 3, the opposite trend was observed. After 70 days, they showed a slightly higher value of the average gain (P<0.05, P<0.01, P<0.001). The average daily gain of Ile de France female lambs in the first month after birth was 0.341 kg, 0.325 kg up to 70 days and 0.143 kg between 70 days and 9 months. Close to our results were those published in the Yearbook of the National Institute of Animal

Husbandry in France, which conducted its research together with INRAe. The Ile de France sheep in their homeland have achieved 0.354 kg average daily gain from 30 to 70 days in 2018 and 0.358 kg in 2019 (Bilan du Contrôle de Performances Ovins Allaitants - Campagne 2019, Institut de l'Elevage/IDELE), INRAe, Races de France). Dimitrov et al. (1987) published lower values of the trait up to 30 days (0.266 kg) for lambs from imported purebred mothers, but during the second period they observed more intensive gain with an increase of 0.313 kg. Ivanova and Raicheva (2017) published data on the average daily gain

of Ile de France female lambs from different lineage from 0.208 kg to 0.299 kg, noting that individuals gain more by the 30th day, and twins increase the intensity of growth after 30 to 70 days. Laleva et al. (2020) also reported slightly lower growth values of lambs from the two herds of research institutes at Agricultural Academy, but concluded that offspring could be weaned earlier for meat production.

The analysis of our results confirms the fact that the breed is well adapted in Bulgaria and has retained its potential for high growth intensity at an early age, with a very good average daily gain for lambs.

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

Term	1 day-30 days			30 days-70 days			70 days-9 months		
	n	LSC	SE	n	LSC	SE	n	LSC	SE
Year of birth									
2017	313	0.039 IAB	0.004	313	-0.056 ABC	0.004	312	0.011 alA	0.002
2018	91	0.016 I	0.006	91	0.003 AD	0.007	82	-0.002 a	0.003
2019	190	0.001 A	0.004	190	0.058 BDE	0.005	173	0.003 IB	0.002
2020	61	-0.057 B	0.008	61	-0.004 CE	0.009	60	-0.012 AB	0.004
Season of birth									
I	245	-0.004	0.003	245	0.027 F	0.004	231	-0.002	0.001
II	410	0.004	0.003	410	-0.027 F	0.004	396	0.002	0.001
Farm									
№ 1	211	0.044 CD	0.005	211	0.115 GH	0.006	200	-0.014 CD	0.002
№ 2	219	-0.026 C	0.004	219	-0.044 Ga	0.004	208	0.003 Cm	0.001
№ 3	225	-0.019 D	0.004	225	-0.071 Ha	0.005	219	0.011 Dm	0.002
μ	655	0.341 ± 0.003		655	0.325 ± 0.004		627	0.143 ± 0.001	

μ - overall LS mean;

Significance of differences within columns - when symbols identical:

A to Z - P<0.001; a to k - P<0.01; l to z - P<0.05

CONCLUSIONS

Year of birth had a significant effect on the live weight trait in female Ile de France lambs in all studied ages, with the exception of weight at birth. Season of lambing also affected all ages, excluding weight at 30 days.

The realized gain by periods indicates a significant specific variance depending on the year of birth for all studied ages. The season influenced gain only at 30 to 70 days.

The farm had a highly significant effect on live weight and average daily gain for the selected animals in all ages.

The results for average live weight and average daily gain from birth to 9 months confirmed that the good adaptation of the breed in Bulgaria and the possibility for realization of

its potential for high growth intensity at an early age.

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REFERENCES

- Achkakanova, E., & Staykova, G. (2019a). Evaluation of the Main Productive Traits of Ile-de-France Sheep in Bulgaria. *Bulgarian Journal of Agricultural Science*, 25 Suppl.1, 69-72.
- Achkakanova, E., & Staykova, G. (2019b). Effect of Different Sources of Specific Variance on Live Weight and Daily Gain of Ile-de-France Sheep in

- Bulgaria. *Journal of Mountain Agriculture on the Balkans*, 22(2), 37-49.
- Achkakanova, E., Minkova, T., & Nikolov, V. (2020). Growth of Lambs of the Ile-de-France Breed from Birth to Weaning and Factors Affecting it. *Scientific Papers. Series D. Animal Science*, LXIII (1), 13-18.
- Dimitrov, I. (1978a). Characteristics of Selection Signs of the Ile-de-France Breed, Bred in Bulgaria, I. Fertility, Weight Development and Meat Properties of Lambs, *Animal Sciences*, 4, 58-67, (BG).
- Dimitrov, I. (1978b). Characteristics of Selection Signs of the Ile-de-France Breed, Bred in Bulgaria, II. Live Weight and Wool-Yielding, *Animal Sciences*, 5, 41-48 (BG).
- Dimitrov, I., Georgieva, E., & Ivanov, I. (1982). Phenotypic Parameters of Basic Productivity Qualities of Sheep from the Ile-de-France Breed, Bred in the Institute of Cattle and Sheep Breeding - Stara Zagora. *Animal sciences*, 3, 20-26 (Bg).
- Dimitrov, I., & Kaleva, S. (1987). Analysis of Live Weight and Fertility Signs of the Ile-de-France Breed, *Animal Sciences*, 10, 3-9 (BG).
- Dimitrov, I. (1988). Development of a Specialized Synthetic Line and Use of the Ile-de-France Breed for Improving the Meat Properties of Lambs. Dissertation, Sofia, Bulgaria.
- Dimitrov, I. (1991). Introduction of Indices in Sheep Selection by Fertility and by Breeding for Meat, *Animal Sciences*, 1-4, 36-39 (BG).
- Dimitrov, I., Stankov, I., Slavov, R., & Achkakanova – Dimitrova, E. (2011). Selection Program for Breeding the Ile-de-France, Stara Zagora.
- Ivanova, T. (2020). Effect of the inclusion of palm oil in the diet of female lambs. *Zhivotnovadni Nauki*, 57(6), 39-41 (BG).
- Ivanova, T., & Raicheva, E. (2017). Analysis of the Live Weight and the Gain of Lambs from the Flock of Ile de France Breed According to Genealogical Lines. *Journal of Animal Science*, 2, 3-9 (BG).
- Laleva, S. (1996). Reproductive Ability of Sheep from Different Productivity Directions, Dissertation, Sofia, Bulgaria, 166.
- Laleva, S., Slavova, P., Popova, J., Boykovska, G., & Krastanov, Z. (2006). Study of Fertility and Live Weight in Lambs from the Breeds Mouton Sharole, Ile de France, Thracian Fine-Fleece Breed and her Crosses. International Science Conference – Stara Zagora, II, Veterinary Medicine, Livestock Breeding, 384-387.
- Laleva, S., Slavova, P., Ivanova, T., Kalaydzhev, G., Popova, J., Ivanov, N., & Metodiev, N. (2020). Phenotypic characteristics of breeding traits in Ile de France sheep. *Zhivotnovadni Nauki*, 57(3), 23-30 (BG).
- Marinova, P. (1976). Study on the Variability of the Main Breeding Characteristics of Sheep and Goats with Ile de France Breeds, Dissertation, Sofia.
- Metodiev, N., & Raicheva, E. (2008). Study on Fertility of Sheep Breed Ile de France. Proceedings of the Scientific Conference “Traditions and Modernity in Veterinary Medicine”, University of Forestry, Sofia, 48-54 (Bg).
- Metodiev, N., Todorov, N., & Raicheva, E. (2010). Sexual Activity and Use of Non-Hormonal Methods for Synchronization of Fertility and Increasing Litter Size of Ewes from the Ile de France Breed. *Journal of Animal Science*, 3, 15-23 (BG).
- Raicheva, E., & Ivanova, T. (2005). Effect of Lambing, Type of Birth and Sex on the Live Weight and the Gain of Ile de France Lambs. *Journal of Animal Science*, 5, 222-226 (BG).
- Raicheva, E., & Ivanova, T. (2010). Live Weight and Gain at Sheep from Ile de France Breed According to Some Factors. *Journal of Animal Science*, 5, 10-15 (BG).
- Slavov, R. (2007). Opportunities for Improvement of Sheep from the North-Eastern Bulgarian Fine-Fleece Breed - Dobrudjan Type. PhD Dissertation, Stara Zagora.
- ***Bilan du Contrôle de Performances Ovins Allaitants - Campagne (2019). Institut de l’Elevage/IDELE/INRAe, Races de France.
- ***France Génétique Elevage (2019). <http://en.francegenetique-elevage.org/>
- INSEM OVIN. 2020. <https://www.insemovin.com//>