Economical Assessment and Effect of Factors on The Absolute Live Weight Gain in Lambs from the Northeast Bulgarian Merino Breed and it's Crosses with Australian Merino and Ile-De-France

R. Slavov **I. Georgiev**

Faculty of Agriculture, Trakia University, 6000 Stara Zagora, Bulgaria.

A scientific economical experiment with 42 lambs from three genotypes has been performed: 14 from the Northeast Bulgarian Merino (NEBM) breed, 14 crosses of NEBM with ¼ blood of Australian Merino breed – internal breeding and 14 crosses with ¼ blood of Ile-de-France breed – internal breeding.

In the beginning of the trial, the lambs were equalized with regard to their age, gender, birth type, age of weaning and age of dams. The fattening lasted up to the 130th day of age. The lambs were fed freely with concentrate feed, alfalfa hay and corn silage. The control of live body weight was performed at 14-day intervals and spent forages were weighed on a daily basis.

The absolute live weight gain, the cost of 1 kg live weight gain and the net income from the weight gain of the three groups of lambs were estimated at the ages of 100 and 130 days. The factorial effect of feed type on the absolute live weight gain by groups and by ages was also studied.

The lambs with ¼ blood of Ile-de-France (internal breeding) were superior than the other 2 genotypes with regard to the absolute weight gain, the cost and the net income of 1 kg weight gain. They exhibited the highest biological maximum and economical optimum of the absolute weight gain at the background of a balanced absolute and relative effect of forages. A very strong factorial effect of forages on the absolute weight gain levels was determined.

Keywords: Northeast Bulgarian Merino, Australian Merino, Ile-de France, fattening, weight gain , factorial effect

Kuzey Doğu Bulgar Merinosu ve Onların Avustralya Merinosu ve Ile-De France Melezi Kuzularinin Net Canlı Ağırlık Kazancı Üzerine Etkili Faktörler ve Ekonomik Analizi

Yapılan çalışmada üç farklı genotipden kuzular kullanılmıştır. Bunların 14 tanesi Kuzey Doğu Bulgar Merinosu (NEBM) , 14 tanesi ise (3/4) Kuzey Doğu Bulgar Merinosu ve (1/4) Avustralya Merinosu, 14 tanesini ise (3/4) Kuzey Doğu Bulgar Merinosu ve (1/4) il-de France ırkı olmak üzere 42 baş hayvan kullanılmıştır.

Denemenin başlangıcında, denemeden kullanılan kuzuların homojenliğini sağlamak için aynı yaş, cinsiyet, aynı doğum şekli, aynı süttek kesim yaşı ve aynı ana yaşı olucak şekilde kuzular seçilmiştir. Denemeye 130 günlük yaşa kadar devam edilmiştir. Kuzulara serbest olarak konsantre yem, alfa alfa kuru otu ve mısır silajı verilmiştir. Canlı ağırlık kontrolleri ise 14 günlük aralılar ile yapılmıştır. Net canlı ağırlık kazancı, 1 kg canlı ağırlık kazancının maliyeti, ağırlık kazancından net gelir her üç genotipdeki kuzular için 100 ve 130 günlük yaş için tahmin edilmiştir.

Yapılan çalışmanın sonucunda (3/4) Kuzey Doğu Bulgar Merinosu ve (1/4) il-de France melezi kuzuların diğer iki genotipe göre net canlı ağırlık artışı, 1 kg ağırlık artışı için net gelir en üstün ve maliyet en düşük bulunmuştur.

Anahtar kelimeler: Kuzey Doğu Bulgar Merinosu, Avustralya Merinosu, Ile-de France Koyunu, yağlanma, canlı ağırlık kazancı , faktöriyel etkiler.

Introduction

The process of breed improvement regarding Bulgarian Merino sheep breeding is related to perfection of wool and meat production of sheep.

With regard to the better physico-mechanical and technological traits of wool in Bulgarian Merino sheep breeds, a crossing with Australian Merino has been attempted. The results from the studies of numerous authors evidenced that the positive impact of the improver breed was mainly related to wool length, the yield and amount of pure wool and to its whiteness (Boikovski , S , 1993, 1994-1995, Boikovski et all, 2002; Slavov and Dimitrov, 2001; Slavova, 2000; Tshenkov et al., 1995; Lazarov and Iliev, 1997).

The world tendencies for increasing of consumption and higher prices of meat from young animals resulted in its higher relative share within the entire structure of the income in sheep breeding farms (Bennett, 1990).

The fattening and meat production traits of Merino lambs have been investigated by Boikovski et al. (1982); Dimitrov and Stankov (1984); Silva and Portugal (1991, 2001), Muhin (1991); Morbidini et al. (1989).

The unfavourable trends in the price of merino wool on both international and internal markets encourage the investigation of possibilities for increasing the meat production of Merino sheep, including via improving crossing with the Ile-de-France sheep breed (Slavov et al., 2005).

The crossing of NEBM with Australian Merino and Ile-de-France is by now in advanced stage, and a big number of crosses from internal breeding have been obtained. Apart the purely biological aspects of meat production, the crosses need the performance of economical assessment as well, accompanied with detection of the level of factorial effects upon it. Economical evaluation and analysis of the impact strength of various factors upon productivity and economical traits in sheep from various production types have been performed by Popova et al. (2006), Slavova et al. (2005, 2006), Georgiev (1990).Momchilov ,H.(2005). The authors concluded that feed had the highest level of influence, followed by the labour and other material costs.

The purpose of the present study was to perform an economical assessment and to investigate the level of factorial effect of feeds on the absolute live weight gain in fattening lambs from the Northeast Bulgarian Merino breed and its crosses with either Australian Merino or Ile-de-France breeds.

Material and Methods

A scientific economical experiment with 42 lambs from three genotypes has been performed in 2005: 14 from the Northeast Bulgarian Merino (NEBM) breed, 14 crosses of NEBM with ¼ blood of Australian Merino breed – internal breeding (¼ AM IntB) and 14 crosses with ¼ blood of Ile-de-France breed – internal breeding (¼ IF IntB). In the beginning of the trial, the lambs were equalized with regard to their age (43–45 days), gender (equal number male and female), birth type (equal number single and twin births), age of weaning (32-36 days), age and parity of dams (3 years, second parity). The lambs were placed under equal conditions and subjected to intensive fattening up to the 130th day of age. They were fed ad-libitum with a starter feed for fattening lambs, alfalfa hay and corn silage. The control of live body weight was performed at 14-day intervals and forage consumption was determined on a daily basis as well as by periods.

For determination of the cost of absolute live weight gain and its factorial effect, the following real costs were employed: concentrate feed: 0.32 BGN/kg; alfalfa hay –0.33 BGN/kg; corn silage – 0.07 BGN/kg; labour and material costs – 1.20 BGN/kg, market price at the age of 100 days – 4.00 BGN/kg live body weight and 10.00 BGN/kg slaughter weight, market price at the age of 130 days – 3.80 BGN/kg live body weight and 9.00 BGN/kg slaughter weight.

The factorial effect upon the absolute live weight gain was determined by the following equation:

$$y = a_0 + a_1.x_1 + \dots a_n.x_n$$

where:

y: resulting sign (absolute live weight gain)

a_1: regression coefficient

x_1-x_n: factor values (feeds)

The regression coefficients (a_i), the coefficients of elasticity (E_i), of multiple correlation coefficients (R) and coefficients of determination (R^2) were calculated.

On the basis of empirical data about the live weight gain and forage consumption, the biological maximum of the function and the economical optimum of absolute live weight gain, where a maximum profit is gained, were established.

The net income was calculated according to the equation:

$$P = Z.y - R = Z.y - R_1.x_1 - R_2.x_2 - R_3.x_3 - R'$$

where:

P: net income (BGN)

Z: cost of 1 kg live weight gain (BGN)

y: amount of live weight gain

R_1: price of concentrate feed (BGN/kg)

R_2: price of alfalfa hay (BGN/kg)

R_3: price of corn silage (BGN/kg)

R´: labour and material costs (BGN/kg)

x_1, x_2, x_3 : amounts of the three feeds

By replacing the dependent variable (y) with the regression equation that reflects the most precisely the function, the expression becomes as follows:

$$P = Z.(a_0 + a_1.x_1 + a_2.x_2 + a_3.x_3 + a_{11}.x^2_1 + a_{22}.x^3_2 + a_{33}.x^2_3 + a_{12}.x_1.x_2 + a_{13}.x_1.x_3 + a_{23}.x_2.x_3) - R_1.x_1 - R_2.x_2 - R_3.x_3 - R'$$

The solution of the system gives the amounts of forages, at which the absolute live weight gain (y_{opt}) is optimal and the profit is the highest.

Results and Discussion

The highest average live body weight at the ages of 100 and 130 days was that of ¼ IF IntB lambs (Table 1). The differences vs the other two genotpes were statistically significant ($p<0.001$), unlike those between purebred and ¼ AM IntB lambs. The crosses with ¼ blood of Ile-de-France exhibited also the highest absolute live weight gain for both studied ages – 16,73 kg and 27,40 kg, respectively, being considerably superior to the values obtained in the other 2 groups. The differences between purebred and ¼ AM IntB lambs were small, but in favour of the former group.

The lowest cost of 1 kg live weight gain at the ages of 100 and 130 days was established in ¼ IF IntB lambs – 2,088 BGN and 2,251 BGN. By the age of 100 days it was lower by 0,090 BGN (4,13 %) than the respective cost in purebred and by 0,112 BGN (5,58 %) – in ¼ AM IntB lambs. By the age of 130 days, the respective differences were 0.136 BGN (5,70 %) and 0,170 BGN (7,55 %). With regard to this trait too, purebred lambs were superior to those with ¼ blood of AM: the cost of 1 kg live body weight gain at the age of 100 days was lower by 0,022 BGN (1,01 %), whereas at 130 days – by 0,034 BGN (1,42 %) (Table 2).

Due to the realized highest absolute live weight gain, the ¼ IF IntB lambs exhibited the highest levels of net income from live weight gain at both studied ages – 33,998 BGN at the age of 100 days and 42,443 BGN at the age of 130 days (Table 3). The surplus vs purebred was 8,417 BGN (32,90 %) and 11,498 BGN (37,16 %) respectively, whereas vs crosses with Australian Merino blood – 9,554 BGN (39,08 %) and 13,622 BGN (47,26 %) respectively.

The factorial analysis of the absolute live weight gain in purebred lambs showed the highest absolute and relative effect of concentrate feed (a_1=1,2; E_1=0,987), i.e. the increase in the amount of concentrate by 1%, the absolute live weight gain increased by 0,98% (Table 4). The model showed a very high degree of correlation of the absolute live weight gain and the total effect of feeds (R=0,990), as well as a very high percentage of factorial effect upon the absolute live weight gain (R^2=0,979), i.e. a very high percentage of the total possible factorial effect. percent of the variance in the dependent explained uniquely or jointly by the independents

The maximization of the function on the basis of regression analysis showed a biological maximum of the absolute live weight gain y_{max}=15,068 kg at x_1=32,914 kg, x_2=16,583 and x_3=28,940 kg. Given the individual price of

feeds and cost of the live weight gain of 4,00 BGN/kg, the optimum of the function where the maximum profit was realized, was:

y_{opt} = 14,690 kg at x_1=32,217 kg; x_2=16,192 kg and x_3=28,146 kg

In lambs with ¼ blood of AM (internal breeding), there was a relatively equal influence of the individual feeds upon the absolute live weight gain, the highest effects being those of concentrate feed (E_1=0,998) and silage (E_3=0,866). The model exhibited higher values of multiple correlation coefficients (R=0,959) and coefficients of determination (R^2=0,906). The maximum of the function was 14,986 kg at x_1=33,396 kg; x_2=16,912 kg and x_3=29,540 kg. The optimal absolute live weight gain in the animals from this group was 14,078 kg at x_1=32,914 kg; x_2=16,842 kg and x_3=28,746 kg.

In the ¼ IF IntB group, the results for the biological maximum and the economical optimum were the best. The factorial analysis showed balanced absolute and relative effects of feeds upon the absolute live weight gain. The highest influence was those of concentrate feed (E_1=0,993) and silage (E_3=0,942). The relationship between the absolute live weight gain and the three used feeds was very close (R=0,992), similarly to the relative share of the explained factorial effect upon the level of the absolute live weight gain (R^2=0,984).

The biological maximum in the group of ¼ IF IntB was the highest compared to the other two groups – y_{max}=17,956 kg at x_1=35,518 kg, x_2=18,396 and x_3=30,766 kg. The optimum absolute live weight gain, where the maximum income was observed, was also the highest – y_{opt}=17,240 kg at x_1=34,712 kg; x_2=17,946 kg and x_3=29,668 kg.

The factorial analysis of the three groups of lambs, done at the age of 130 days, showed tendencies similar to the age of 100 days (Table 5). Again, the highest values of parameters were observed in the ¼ IF IntB lambs. The model shoed a very high strength of dependence between the absolute live weight gain and feeds as well as a high relative share of the absolute factorial effect upon the live weight gain in this group (R^2=0,99).

Compared to the other two groups (purebred and ¼ AM IntB lambs), the biological maximum of the function for ¼ IF IntB was higher by nearly 6 kg. The maximum y_{max}=28,102 kg at feed amounts x_1=58,912 kg, x_2=30,316 and x_3=55,479 kg, respectively. The optimum y_{opt}=27,430 kg at x_1=57,734 kg, x_2=29,289 and x_3=54,386 kg

The analysis of data obtained in the other two groups at the age of 130 days shoed lower biological and economical results (Table 5).

Conclusions

The ¼ IF lambs (internal breeding) were considerably superior to both purebred NEBM lambs and those with ¼ blood of Australian Merino (internal breeding), exhibiting absolute live weight gains of 16,73 kg and 27,40 kg, costs of 1 kg live weight gain of 2,008 BGN and 2,251 BGN and net incomes from the live weight gain of 33,998 BGN and 42,443 BGN at the age of 100 and 130 days, respectively.

A very high factorial influence of feeds upon the absolute live weight gain was found to exist, as well as a very high relative share of feed effects of the total factorial effect. This assumption was supported by the high values of multiple correlation (R=0,687 – 1,000) and determination (R^2=0,772 – 1,000) coefficients.

The ¼ IF IntB group exhibited highest values of the biological maximum (17,956 kg and 28,102 kg) and of the economical optimum (17,240 kg and 27,430 kg) at the background of balanced absolute and relative influence of the three feeds upon the absolute live weight gain.

The import of 25% blood of the Ile-de-France breed and the subsequent internal breeding with the Northeast Bulgarian Merino breed influenced positively the absolute live weight gain and its economical assessment in crosses. The breeding with Australian Merino according the same schedule resulted in a slight negative effect on the levels of studied traits.

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Table 1. Change of live body weight and absolute weight gain at the age of 100 and 130 days by genotype

Genotype	Live body weight at the beginning of the experiment, n=14		Live body weight at the age of 100 days, n=14			Live body wei
	X ± Sx	C	X ± Sx	C	Absolute weight gain	X ± Sx
Purebred NEBM	13,15 ± 0,106	3,02	27,19 ± 0,519	7,15	14,04	35,05 ± 0,867
NEBM (3/4) x AM(1/4)	13,28 ± 0,186	5,24	26,86 ± 0,512	7,13	13,58	34,18 ± 0,780
NEBM (3/4) x IF(1/4)	13,68 ± 0,152**	4,18	30,41 ± 0,500 ***	6,15	16,73	41,08 ± 1,086

Table 2. Cost of 1 kg live weight gain until the age of 100 and 130 days of age by genotype

Genotype	By the age of 100 days n=14										By the age of 13				
	Forage costs								Labour and other costs per kg	Cost per 1 kg	Expenses for f				
	Concentrate feed 0.32 BGN/kg		Alfalfa hay 0.33 BGN/kg		Corn silage 0,07 BGN/kg		Total for feeds				Concentrate feed 0.32 BGN/kg		Alfalfa hay 0.33 BGN/kg		
	kg	BGN	Kg	BGN	kg	BGN	kg	BGN	BGN	BGN	kg	BGN	kg	BGN	
Purebred NEBM	2,19	0,701	1,10	0,143	1,92	0,134	5,21	0,978	1,20	2,178	2,38	2,38	1,25	0,163	2
NEBM (3/4) x AM(1/4)	2,23	0,714	1,13	0,147	1,98	0,139	5,34	1,000	1,20	2,200	2,45	2,45	1,32	0,172	2,
NEBM (3/4) x IF(1/4)	1,98	0,634	1,03	0,134	1,72	0,120	4,73	0,888	1,20	2,088	2,10	2,10	1,08	0,140	1,

Table 3. Net income from live weight gain of lambs at the ages of 100 and 130 days (by genotype), in BGN.

Breed	By the age of 100 days n=14					By the age o		
	Absolute live weight gain	Cost of 1 kg live weight gain	Total costs	Income from sales at 4.00 BGN/kg	Net income from live weight gain	Absolute live weight gain	Cost of 1 kg live weight gain	T c
	kg	BGN	BGN	BGN	BGN	kg	BGN	E
Purebred NEBM	14,04	2,178	30,579	55,160	25,581	21,90	2,387	5
NEBM (3/4) x AM(1/4)	13,58	2,200	29,876	54,320	24,444	20,90	2,421	5
NEBM (3/4) x IF(1/4)	16,73	2,088	34,932	66,920	33,998	27,40	2,251	6

Table 4. Factorial analysis and optimization of the quantitative function of feed vs absolute live weight gain by genotyp

Genotype groups	Purebred NEBM			NEBM (3/4) x AM(1/4)		
Parameters	x_1	x_2	x_3	x_1	x_2	x_3
1. Regression coefficient (Q_i)	1,200	1,122	0,663	0,583	1,152	0,691
2. Coefficient of elasticity (E_i)	0,987	0,021	0,084	0,998	0,756	0,866
3. Multiple regression coefficient (R)	0,990			0,959		
4. Coefficient of determination (R^2)	0,979			0,906		
5. Maximum of function (y_{max})	15,068			14,986		
6. Amounts of feeds at y_{max}	32,914	16,583	28,940	33,396	16,912	29,540
7. Optimum of the function (y_{opt})	14,690			14,078		
8. Amounts of feeds at y_{opt}	32,217	16,192	28,146	32,914	16,842	28,746

Table 5. Factorial analysis and optimization of the quantitative function of feed vs absolute live weight gain by genotyp

Genotype groups	**Purebred NEBM**			**NEBM (3/4) x AM(1/4)**			
Parameters	x_1	x_2	x_3	x_1	x_2	x_3	
1. Regression coefficient (Q_i)	0,420	0,800	0,433	0,408	0,081	0,058	
2. Coefficient of elasticity (E_i)	0,386	1,100	1,019	1,046	1,001	0,001	
3. Multiple regression coefficient (R)	1,00			0,687			
4. Coefficient of determination (R^2)	1,00			0,772			
5. Maximum of function (y_{max})	23,008			22,700			
6. Amounts of feeds at y_{max}	54,719	28,694	53,150	55,612	29,866	53,584	5
7. Optimum of the function (y_{opt})	21,070			22,340			
8. Amounts of feeds at y_{opt}	53,663	27,563	52,843	54,973	29,312	53,114	5