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Research Article

Performance Testing Studies and the Selection of Hasmer, Hasak, Hasiv and Linmer Crossbreed Sheep Types: II. Pre-Weaning Growth*

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Abstract: This study was conducted to investigate the pre-weaning growth of crossbreed types. Fifteen genotypes (F_1 and B_1) were obtained by crossbreeding in the Animal Research Institute in Konya from 1989 to 1996. These 15 genotypes were classified in 4 appropriate genotype names: Hasmer, Hasak, Hasiv and Linmer. GLM and Tukey's HSD tests were used for statistical analyses. Year, genotype, sex, birth type, and dam's age were introduced into the model as fixed factors and birth weight was introduced as a covariate along with year x genotype interaction.

While the effects of year, dam's age, birth type, and sex on birth weight were significant, the effects of genotype and year x genotype interaction were insignificant. The overall birth weight means were 4.29, 4.00 and 3.99 kg ($P < 0.001$) for 1997, 1998 and 1999, respectively. The differences between the genotypes were not significant, and the values were 3.95-4.19 kg for all genotypes during the 3-year experimental period. The birth weights of lambs from dams aged 3 years or older were higher than those of lambs with 2-year-old dams. The birth weights of ram lambs were higher than those ewe lambs, and single born lambs had higher birth weights than did twin born ones.

The lambs were weaned at the age of 75 days. All factors except for dam's age and birth type affected the weaning weight. The weights of lambs at 75 days were 17.5-19.8 kg in 1997, 17.0-20.1 kg in 1998, and 19.5-22.5 kg in 1999, and the differences between genotypes were significant in all 3 years, although the superiority of some genotypes over others varied year by year. The year of weaning weights were significant in all genotypes expect for Hasiv, and the values obtained in 1999 were higher than those from 1997 and 1998. The same results were obtained in daily gains in the suckling period. The daily gains were 176-207 g in 1997, 170-212 g in 1998 and 203-243 g in 1999, and the values for 1999 were higher than those for the 2 previous years. The daily gains were 239, 231, 210, 203, 218, 241 and 243 g for the Hasmer, Hasak, Hasiv, Linmer, Merino, Akkaraman and Awassi breeds, respectively, in 1999 and the values for Hasiv and Linmer were lower than those for the other crossbreed types and the Akkaraman and Awassi breeds.

In conclusion, the superiority of 1999 to 1998 and 1997 in terms of growth traits was observed not only in crossbred but also in purebred animals, and this may not be the result of selection but rather of an improvement in environmental factors. In general, the Linmer type exhibited a lower performance.

Key Words: Mutton sheep breed, crossbreeding, selection, new sheep types, growth.

Hasmer, Hasak, Hasiv ve Linmer Melez Koyun Tiplerinde Performans Test ve Seleksiyon Çalışmaları: II. Süt Emme Dönemi Büyüme

Özet: Bu araştırma ile, kuzu eti üretimine uygun yeni koyun tipleri elde etmek amacıyla yapılan melezleme çalışmaları ile elde edilen melezlerde süt emme döneminde büyüme özelliklerinin karşılaştırılması amaçlanmıştır. Konya Hayvancılık Arştırma Enstitüsü'nde

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1989 yılında başlanan melezleme çalışmaları ile 1996 yılına kadar elde edilen ve F_1 ve G_1'lerden oluşan 15 çeşit genotip uygun olan 4 genotip altında (Hasmer, Hasak, Hasiv ve Linmer adları ile) birleştirilmiş ve bu genotipler üzerinde performans test ve seleksiyon çalışması yapılmıştır.

Arştırma 1997-1999 yıllarında yapılmış olup, bu bölümde melezlerin büyüme özellikleri karşılaştırmalı olarak incelenmiştir. İstatistik analizlerde Genel Doğrusal Model (GLM) kullanılmıştır. Modele yıl, genotip, cinsiyet, doğum tipi ve ana yaşı gruplandırılabilir faktör olarak, doğum ağırlığı ise regresyon terimi olarak dahil edilmiştir.

İncelenen faktörlerden yıl, ana yaşı, doğum tipi, ve cinsiyetin doğum ağırlığına etkisi önemli, genotip ve yıl x genotip interaksiyonu önemsiz bulunmuştur. Doğum ağırlığı genel ortalaması, 1997, 1998 ve 1999 yılları için, sırasyla, 4,29, 4,00 ve 3,99 kg ($P < 0,001$); genotipler arası fark önemsiz olup tüm genotiplerde 3,95-4,19 kg arasında; anası 3 ve yukarı yaşlı olanlarinki 2 yaşlılarınkinden, erkeklerinki dişilerinkinden, teklerinki ikizlerinkinden önemli düzeyde yüksek bulunmuştur.

Kuzular 75 günlük yaşta sütten kesilmişlerdir. Sütten kesim ağırlığına ana yaşı ve doğum tipi etkili olmazken, yıl x genotip interaksiyonu dahil, diğer faktörler etkili olmuştur. Bütün genotiplerde 75. gün ağırlığı 1997'de 17,5-19,8 kg; 1998'de 17,0-20,1 kg; 1999'da 19,5-22,5 kg arasında bulunmuştur. Hasiv grubu hariç, genotiplerin sütten kesim ağırlığına yılın etkisi önemli olup, 1997 ve 1998 yılına göre 1999 yılı değerleri yüksek bulunmuştur. Her üç yılda da genotipler arası fark önemlidir; ancak genotiplerin birbirine üstünlügü yıldan yıla değişmiştir. Süt emme dönemi GCAA bakımından da aynı sonuçlar alınmış olup, bu özellik için, tüm genotiplerde 1997 yılında 176-207 g, 1998'de 170-212 g ve 1999'da 203-243 g arasında ve 1999 yılı değerleri ilk iki yıldan önemli düzeyde yüksek bulunmuştur. Hasmer, Hasak, Hasiv, Linmer, Merinos, Akkaraman ve İvesi ırkları için 1999 yılı GCAA değerleri, sırasıyla, 239, 231, 210, 203, 218, 241 ve 243 g ve Hasiv ve Linmer tipleri diğer melez tiplerden ve Akkaraman ve İvesi'den önemli düzeyde düşük bulunmuştur.

Sonuç olarak, büyüme özelliklerinde ilk yıllara göre 1999 yılında görülen yükselme, seleksiyon uygulanmayan saf genotiplerde de görüldügü için bunun seleksiyondan ziyade çevresel iyileşmeden kaynaklandığı; genel olarak Linmer'in düşük performans gösterdiği kanaatine varılmıştır.

Anahtar Sözcükler: Etçi koyun ırkı, melezleme, seleksiyon, tip sabitleme, büyüme

Introduction

In order to improve sheep meat production in Turkey a comprehensive study was initiated in 1986. For that purpose, 6 mutton sheep breeds were imported from Britain, Germany and France. Pure breeding and crossbreeding of these breeds with Turkish native breeds have been conducted, and these studies are continuing. In most of the studies carried out on farms belonging to the Ministry of Agriculture and Rural Affairs, F_1 crossbreeds have been obtained, others being B_1 crossbreeds. A number of reports have been published based on these findings (1-3). The objectives of these studies were not to create new sheep types but were mostly focused on commercial crossbreeding. However, the aim of studies carried out at the Konya Animal Research Institute was to produce new sheep types. Along with this project, studies have been initiated for the formation of 4 new types. The first study at this Institute began in 1989 with imported German Blackheaded Mutton (GBM), Hampshire Down (HD) and Lincoln Longwool (L) sires. While the Middle Anatolian Merino (M) was crossed with those breeds, Akkaraman (Akk) and Awassi (A) were only crossed with GBM and HD. The research into growth, fattening performance, carcass characteristics and wool yield of F_1 and B_1 crossbreeds has been concluded (4-8). The results indicate that the F_1 and B_1 crossbred types demonstrated reasonable performance, especially in terms of growth, fattening performance and carcass characteristics. In order to utilize the genetic materials of these crossbreeds, the flock has been closed to other breeds since 1997, and systematic studies have been started to develop new sheep types. In respect of the preliminary results, the genotypes were formed into 4 appropriate genotypes.

The general objective of this study was to develop new mutton sheep types that can be used in commercial crossbreeding programs as sire lines. In this project, a performance test study was conducted on 4 crossbred types, and selection based on the ram lambs was made over 3 years. Research was conducted on pre-weaning growth of pure and crossbred lambs in this part of the project.

Materials and Methods

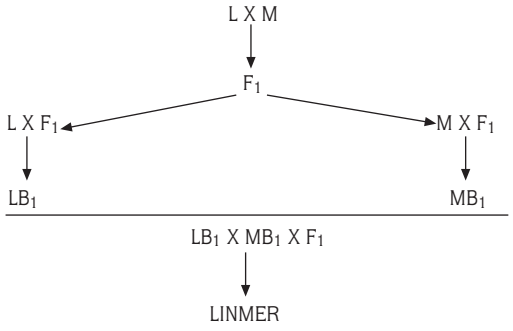
This study was conducted at the Konya Animal Research Institute between 1997 and 1999. The animal material of this study included the purebred animals

reared at this Institute and crossbred materials (F_1 and B_1) obtained via projects supported by the Scientific and Technical Research Council of Turkey (TÜBİTAK) and the Ministry of Agriculture and Rural Affairs from 1989 to 1996. The purebred animals were Middle Anatolian Merino, Akkaraman and Awassi.

Breeding methods: From the previous Lincoln x Merino crossbreeding F_1, MB_1 (first back-cross to Merino) and LB_1 (first back-cross to Lincoln) were obtained. The ewes and rams of these 3 genotypes were used in balanced mating over 3 years. As a result of balanced mating, it was planned that the new type would have a 50% Merino and 50% Lincoln genotype. The name "Linmer" was formed by taking the first syllables of these pure genotypes. In a similar way, F_1 and $(GBM)B_1$ and $(HD)B_1$ were obtained from GBM x Merino and HD x Merino crossbreeding. The results of previous studies (4-7) have shown that there were no practical or statistical differences between GBM and HD crossbreeds in respect of various traits. In addition, the crossbreeds derived from the 2 sire lines were morphologically similar and it was difficult to distinguish one from the other. For these reasons, combining the 2 lines into 1 line was acceptable, and the resulting type was named as "Hasmer" formed from the first syllables of the pure genotypes (based on Turkish pronunciation). Another reason for using a combination of 2 lines was the availability of small quantities of material from each line, which made selection programs impossible. A balanced mating program was achieved between the 2 lines. Therefore, it was planned that the new types would theoretically have 31.25% HD, 31.25% GBM and 37.50% Merino genotypes. For the reasons cited for the Hasmer type, the new type formed from F_1, $GBMB_1$ and HDB_1 obtained by crossbreeding GBM x Akkaraman and HD x Akkaraman was named "Hasak". The new type formed from F_1, $GBMB_1$ and HDB_1 obtained by crossbreeding GBM x Awassi and HD x Awassi was named "Hasiv". In Hasak, the GBM 31.25%, HD 31.25% and Akkaraman 37.50%. In Hasiv, the GBM 31.25%, HD 31.25% and Awassi 37.50%. The breeding scheme of these types is shown in Figures 1-4.

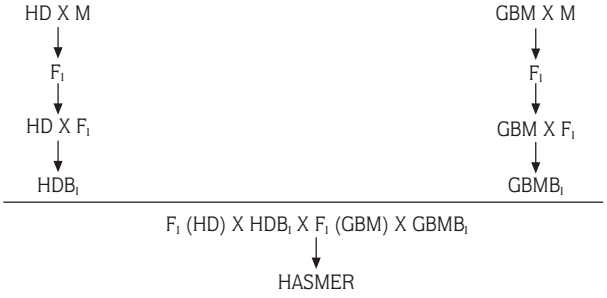
Mating: In the first 2 years (1996 and 1997), all ewes that were anatomically entire and suitable for mating were selected for breeding, and balanced mating was achieved as explained in Figure 5 for the Linmer type. In 1998, the 10% of ewes with the lowest live weights for each genotype were removed from the stock. Approximately 72% of the mated ewes were F_1 and B_1 and the others were new selected lines. Mating was performed by artificial insemination or hand-mating.

Growth: The lambs were kept together with their dams after birth for 1 week in individual paddocks. After that, they were together with their dams only at nights. From 15 days old, the lambs were fed growth ration and alfalfa hay ad libitum. The newborn lambs were weighed at 3 h from birth and in the first 18 h of life using a scale sensitive to 10 g and were numbered using plastic ear



L x M = F_1:	50% Lincoln + 50% Merino
L x F_1 = LB_1:	75% Lincoln + 25% Merino
M x F_1 = MB_1:	25% Lincoln + 75% Merino
LINMER	150/300, 50% Lincoln 150/300, 50% Merino

Figure 1. The breeding scheme and genotypic proportions of the Linmer type.



HD x Merino = F_1:	50% HD + 50% Merino
HD x F_1 = HDB_1:	75% HD + 25% Merino
GBM x Merino = F_1:	50% GBM + 50% Merino
GBM x F_1 = $GBMB_1$:	75% GBM + 25% Merino
HASMER:	150/400, 37.50% Merino 125/400, 31.25% Hampshire Down 125/400, 31.25% German Blackheaded Mutton

Figure 2. The breeding scheme and genotypic proportions of the Hasmer type.

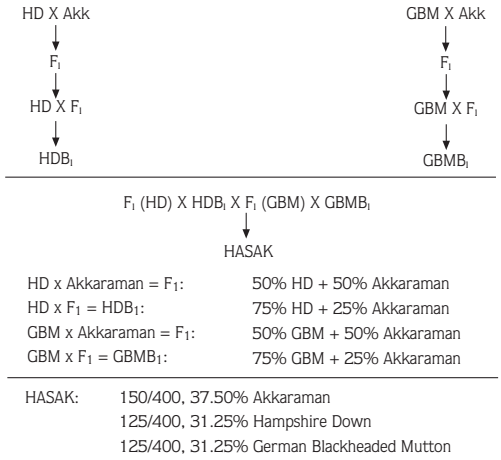


Figure 3. The breeding scheme and genotypic proportions of the Hasak type.

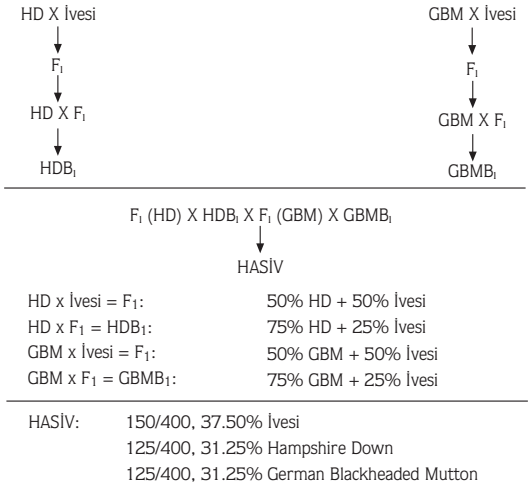


Figure 4. The breeding scheme and genotypic proportions of the Hasiv type.

Balanced breeding:

Sire genotypes:		Ewe genotypes:
LB_1	x	LB_1, MB_1, F_1
MB_1	x	LB_1, MB_1, F_1
F_1	x	LB_1, MB_1, F_1

Figure 5. Balanced mating in the Linmer type.

tags. At this time, the number of lambs, birth weight, birth date, birth type, sex and age of dams were recorded on registration cards. The live weights of lambs were recorded monthly using a scale with 50 g sensitivity. The 75-day live weight (weaning) of lambs was obtained by interpolation from these records. The weighing of lambs was performed when they were not hungry.

Statistical Analyses: The General Linear Model was used in statistical analyses using Minitab software (9). The year, genotype, sex, birth type and age of dams were regarded as fixed factors for estimating birth weight and weaning weight. Birth weight was used as a covariate for estimating weaning weight. The equations according to this model were

For birth weight

$$Y_{ijklmn} = a + b_{1i} + b_{2j} + b_{3k} + b_{4l} + b_{5m} + b_{1i}\, b_{2j} + e_{ijklmn}$$

For weaning weight and daily gain the period 0-75 days

$$Y_{ijklmn} = a + b_{1i} + b_{2j} + b_{3k} + b_{4l} + b_{5m} + b_{1i}\, b_{2j} + b_6 X_{ijklmn} + e_{ijklmn}$$

where Y_{ijklmn} is the live weight or daily gain of the n^{th} lambs from the i^{th} year, j^{th} genotype, k^{th} sex, l^{th} birth type and m^{th} dam's age. a: constant; b_{1i}: year (1997, 1998, 1999); b_{2j}: genotype (Merino, Akkaraman, Awassi, Hasmer, Hasak, Hasiv, Linmer); b_{3k}: sex (male, female); b_{4l}: birth type (single born, twin born); b_{5m}: dam's age (2, 3, 4, 5, 6 and 7+ ages); $b_{1i}\, b_{2j}$: year x genotype interaction; b_6: regression coefficient; X_{ijklmn}: birth weight of each lamb used as a covariate; e_{ijklmn}: randomized error

Because there were no statistically significant interactions between factors except for genotype x year interaction, the interactions between the other factors were not added to the model. The pair-wise comparisons were made by Tukey's HSD test (9).

Results

The least-square means and standard errors of pre-weaning growth traits of lambs are illustrated in Tables 1 and 2.

The least-square means of birth weights of lambs were 3.95-4.19 kg in the 3 years for all genotypes, and the differences between genotypes were not significant. The year x genotype interaction was also not significant in birth weight.

However, the effects of year, dam's age, sex and litter size on birth weight were statistically significant. The birth weight means for 1997 were higher than those for 1998 and 1999.

Weaning weight at 75 days and daily gains in the pre-weaning period were significantly affected by all factors except for birth type and dam's age. There were no

Table 1. The least-square means and standard errors of pre-weaning growth traits of lambs.

	Birth weight			75-day weight			Daily gain	
Factors	n	$\bar{x}$	$S_{\bar{x}}$	n	$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$
Year		***			ϕ			
1997	442	4.29	0.040 [a]					
1998	506	4.00	0.037 [b]					
1999	458	3.99	0.037 [b]					
Genotype		-			ϕ			
Hasmer	342	4.16	0.039					
Hasak	249	4.07	0.045					
Hasiv	131	4.19	0.062					
Linmer	248	4.15	0.046					
Merino	253	4.04	0.045					
Akkaraman	93	4.11	0.074					
Awassi	90	3.95	0.074					
Dam's age		***			-			-
2	268	3.77	0.047 [b]	236	19.4	0.25	202	3.4
3	257	4.12	0.048 [a]	236	20.0	0.25	210	3.3
4	299	4.20	0.044 [a]	279	19.9	0.22	208	3.0
5	261	4.15	0.046 [a]	241	19.5	0.24	203	3.2
6	172	4.13	0.056 [a]	158	19.9	0.29	208	3.8
7+	149	4.20	0.059 [a]	138	19.2	0.30	199	4.0
Sex		***			***			***
Male	678	4.22	0.030	611	20.0	0.16	210	2.1
Female	728	3.97	0.029	677	19.3	0.15	200	2.1
Litter size		***			-			-
Single	966	4.45	0.025	889	19.8	0.13	207	1.8
Twin	440	3.74	0.036	399	19.5	0.20	203	2.7

*** $P < 0.001$, - $P > 0.05$,
[a, b] Means without a common superscript within each variable differ ($P < 0.05$).
ϕ Because of genotype x year interaction, this part of the table is presented in Table 2.

significant differences between the ages of the dam groups and between single born and twin born animals, but the values for male lambs were higher than those for females. Because an interaction was found between years and genotypes, comparisons of genotypes were performed for each year and the results are presented in Table 2. In terms of 75-day weight, the differences between genotypes were statistically significant in all years.

While the lowest value was determined in the Linmer type in 1997, the highest values were determined in the Awassi and Hasak types. The other genotypes were similar to each other. In addition, in 1998, the means of the Linmer type were lower than those of the others, except for Merino. The lowest values were determined in Linmer, Hasiv and Merino in 1999. The effects of dam's age and litter size on daily gains of lambs were not statistically significant, but the effects of other factors were significant (Table 1). The same results that were observed in weaning weight were also observed in daily gains. For this trait, although there were no statistically significant differences between years in the Hasiv type, yearly differences were influential in other genotypes, and in general the values for 1999 were higher than those for 1997 and 1998.

Table 2. The least-square means and standard errors of 75-day weight and daily gain of lambs.

	Year								
	1997			1998			1999		
Genotype	n	$\bar{x}$	$S_{\bar{x}}$	n	$\bar{x}$	$S_{\bar{x}}$	n	$\bar{x}$	$S_{\bar{x}}$
					75-day weight				
Hasmer	102	18.3^{c}	0.35^{ab}	112	19.7^{b}	0.33^{a}	96	22.2^{a}	0.36^{ab}
Hasak	69	19.7^{b}	0.42^{a}	83	20.1^{b}	0.39^{a}	82	21.6^{a}	0.39^{ab}
Hasiv	35	19.0	0.58^{ab}	50	18.7	0.49^{ab}	38	20.0	0.56^{c}
Linmer	60	17.5^{b}	0.45^{b}	95	17.0^{b}	0.36^{c}	68	19.5^{a}	0.42^{c}
Merino	79	18.7^{b}	0.40^{ab}	80	17.3^{c}	0.39^{bc}	69	20.6^{a}	0.42^{bc}
Akkaraman	26	18.7^{b}	0.69^{ab}	24	19.7^{b}	0.71^{a}	34	22.3^{a}	0.59^{a}
Awassi	29	19.8^{b}	0.65^{a}	26	19.7^{b}	0.68^{a}	31	22.5^{a}	0.62^{a}
					Daily gain				
Hasmer		187^{c}	4.6^{ab}		205^{b}	4.5^{a}		239^{a}	4.8^{ab}
Hasak		206^{b}	5.6^{a}		212^{b}	5.1^{a}		231^{a}	5.2^{abc}
Hasiv		196	7.8^{ab}		193	6.5^{ab}		210	7.5^{cd}
Linmer		176^{b}	6.0^{b}		170^{b}	4.7^{c}		203^{a}	5.6^{c}
Merino		192^{b}	5.3^{ab}		174^{c}	5.2^{bc}		218^{a}	5.6^{bcd}
Akkaraman		193^{b}	9.2^{ab}		205^{b}	9.5^{a}		241^{a}	7.9^{a}
Awassi		207^{b}	8.7^{a}		206^{b}	9.1^{a}		243^{a}	8.3^{a}

^{a}, ^{b}, ^{c}, ^{d} Means without a common superscript within each variable differ ($P < 0.05$); in the same column, for genotype (right); in the same row, for year (left).

Discussion

The birth weight differences between years might be due to the fact that the weighing of lambs at birth in 1997 was performed once a day, and most of the measurements were taken at 18 h after birth or later. In 1998 and 1999, however, weighing was performed twice a day. In agreement with the literature (4,5,7,10,11), the values for lambs whose dams were 2 years old were statistically lower than those for the others, the birth weights of male lambs were significantly higher than those of females. The birth weights of single born lambs were higher than those of twin born lambs. When the results were compared with those from previous studies, birth weight values were lower than those of Konya Merino (10), Merino and their crossbreeds (4,8), Akkaraman (12) and various breeds and their crossbreeds (5,13,14).

These results were similar to those reported by Başpınar et al. (15) for Konya Merino, and by Esenbuğa and Dayıoğlu (11) for Awassi. These findings were expected for Merino, Akkaraman and Awassi but were unexpected for crossbreed types. Because the results were lower than expected, it was revealed that there were unsuitable environmental conditions such as poor care and feeding and crowded paddocks. Similar findings were found with regard to pregnancies (16). On the other hand, the majority of young dams being from crossbreed types in the population may have caused the lower birth weights. Consequently, by using older dams in breeding and improving the environmental conditions in future years, it may be expected that these results will be higher than at present.

With regard to weaning weight and daily gains, although there were no statistically significant differences between the years in the Hasiv type, yearly differences were influential in other genotypes and in general the values for 1999 were higher than those for 1997 and 1998.

However, the values for 1999 were higher than those for the other years, not only for crossbreeds but also for purebred animals. Consequently, based on the 3-year selection program, it is not claimed that an improvement in the crossbreeds was seen in the present study. The daily gains determined in this study were lower than

those in Merino and other crossbreed types (7,8). Because the lower values were found not only in crossbreeds but also in purebred animals, and because there were differences between years, it may be concluded that if conditions are improved future results will also be better. However, it is possible that the crossbreed types, especially the Hasmer and Hasak types, have adapted to the environmental conditions.

In conclusion, the superiority of 1999 to 1998 and 1997 in terms of growth traits was observed in purebred as well as crossbred animals. This may not result from selection but from an improvement in environmental factors. All of the crossbreeds except for Linmer showed acceptable values.

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