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Performance of Willage Sheep Flocks in Central Anatolia. I. Growth of lambs.*

Olaf THIEME, Mehmet KARAZEYBEK
Konya Provincial Directorate Ministry of Agriculture and Rural Affairs, 42040 Konya-TURKEY
M. Ali AZMAN
Central Animal Research Institute, 42040 Konya-TURKEY
Ahmet UĞURLU
Konya Provincial Directorate Ministry of Agriculture and Rural Affairs, 42040 Konya-TURKEY

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Abstract: Performance data on growth of lambs were collectted for two years from 23 village flocks in Central Anatolia. The results from the Akkaraman and Merino breeds and their crosses were analyzed by the least-squares method.
The overall means for birth weight, pre-weaning daily gain, weaning weight and post-weaning growth rate were 3.74 kg, 188.4 gram, 16.4 kg and 83.6 gram, respectively. The performance was lower than reported for the same breeds from institutional flocks in Türkiye. Systematic effects of flock, season of birth, type of birth, sex and weight of dam were significant ($p<0.01$) for all pre-weaning growth traits. The effects of age of dam and year of birth were significant for same of the traits. The results indicate possibilities for improving the growth performance of village flocks by changing the flock management and breeding. The study also shows that even under the best environmental conditions of the area pure Merino sheep are not advantageous.

Key Words: Birth weight, Pre-weaning daily gain, Weaning weight, Post-weaning growth rate, Phenotypic correlations.

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Özet: Orta Anadolu'nun köy sürülerinde iki yıl süreyle yapılan bir araştırmada, 23 köy sürüsünden kuzuların büyüme performansları ile ilgili bilgiler toplanmıştır. Akkaraman, merinos ırkı ve bunların melezlerinden alınan sonuçlar En Küçük Kare Metoduyla (Least-Square Method) analiz edilmiştir.

Ortalama doğum ağırlığı, sütten kesimden önce günlük canlı ağırlık kazancı, sütten kesim ağırlığı ve sütten kesimden sonra günlük büyüme oranı sırasıyla 3.74 kg, 188.4 gram, 16.4 kg, ve 83.6 gram olarak bulunmuştur. Bu performanslar Türkiye' deki resmi kurumlarda aynı sürülerde yapıldığı belirtilen araştırma sonuçlarından daha düşüktür. Sürünün yönetilmesiyle ilgili sistematik etkiler, doğum mevsimi, doğum şekli, cinsiyet ve annenin canlı ağırlığı sütten kesimden önce yapılan denemeler için önem taşımaktadır ($P<0.01$). Annenin yaşının etkisi ve doğum yılı bazı denemeler için önem taşımaktadır.
Alınan bu sonuçlar göstermektedir ki köy sürülerinde sürü idaresi ve yetiştirme metotlarının değiştirilmesiyle büyüme performanslarının iyileştirilmesi imkanları vardır. Bu çalışma ayrıca göstermektedir ki bölgede, hatta en iyi çevre şartlarında bile, safkan merinos koyunu yetiştiriciliği avantajlı değildir.

Anahtar Sözcükler: Doğum ağırlığı, Sütten kesim öncesi günlük ağırlık artışı, Sütten kesim ağırlığı, Sütten kesimden sonra büyüme oranı ve fenotiple ilgili korrelasyonlar.

Introduction

Sheep are the dominating livestock in the farming systems of the Central Anatolian region and substantially contribute to the income of many farmers. An increase of animal numbers to cover the growing demand for mutton and dairy products from sheep is not desirable, because high stocking rates have already resulted in an overgrazing of many areas. Efforts to increase productivity of the production systems, have been limited in the past to animal health and crossbreeding with Merino types of sheep. A considerable amount of research on sheep husbandry, carried out on state farms and research institutes (1), provides the basis for implementing measures to improve productivity. The realization within an effective extension program however, also requires a good knowledge of production levels and limiting factors for increased productivity under farmers' conditions. Collection of such data was carried out on a pilot basis in the Konya and Karaman provinces. Both provinces are representative of the Central Anatolian Highland and together provide of an estimated 2.9 million sheep. The dominant breed is Akkaraman (White Karaman), but there are small numbers of other sheep breeds and about 2.5% of the population are Central Anatolian Merino, a cross between Akkaraman and German Mutton Merino. This paper reports on growth traits of Akkaraman, Merino and crossbred lambs from village flocks and identifies

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** Present address: Sternstrasse 10, 37083, Göttingen, Germany.

important factors to be considered in the improvement of sheep production.

Material and Methods

Performance data were collected during two years from 23 village flocks with a total number of 2350 ewes. Flocks were selected from five areas namely Center (vicinity of Konya city), South (Karaman province), East (Karapınar district), Center-West (Sarayönü and Kadınhanı districts) and West (Ilgın and Akşehir districts). Information about the size and structure of the recorded sheep flocks in given in Table 1.

Mating and lambing of sheep in the study area are seasonal and timing is arranged by the farmers. In the majority of the flocks mating starts in the first half of September, but in the West as early as mid July and in the large flocks in the Center in October. The corresponding lambing season spreads from December until April. The flocks are grazed from April until December on grassland, stubble (after July) and sugar beet leaves (after September). The basis of indoor feeding during winter is chopped cereal straw, supplemented by wet and ensiled sugar beet pulp and concentrates. Some farmers feed small amounts of legume hay (lucerne, sainfoin) after lambing. Table 1 shows the amounts of concentrates used per ewe in the different areas, clearly reflecting the different body weights of the ewes and the intensity of the indoor feeding period. Farm grown barley is the predominant concentrate, followed by compound feed and cottonseed cake. The largest proportion of concentrates is fed from lambing until weaning, while feeding before lambing is no common practice. Lambs are separated from their mothers a few days after birth and allowed to suck until weaning twice daily only. Supplementary feeding of hay and concentrates is given to the lambs after the first month. During the first half of May, when most lambs are 2-2.5 months old, some are completely weaned and either sold or put on intesive fattening rations. Most however, are only partly weaned and allowed to suck once daily the residual milk after milking of their mothers for another month. Lambs from smaller flocks, which are not needed for replacement, are then sold either directly or after a short fattening period. Owners of the larger flocks however, often form separate lamb flocks and start intensive fattening in autumn.

All ewes of the flocks under study were ear-tagged and age was determined by examination of teeth. Recording of lambing dates and birthweights with a suspended weigher, as well as tagging of lambs was carried out by the farmers and controlled by the extension staff during fortnightly visits. Weaning weight of lambs and weight of ewes were taken by the extension staff close to the time when milking of ewes started. The average age of lambs at recording was 63.2 days. Individual growth rate between birth and weaning was calculated either by considering the own birth weight of the lamb or, if not available, by using the average from the same group of lambs (same genopype, sex and type of birth). Autumn weights were recorded from October onwards after the summer grazing period and standardized with the individual post-weaning growth rate to a 8-month weight.

The growth traits examined were birth weight, pre-weaning daily gain, weaning weight, post-weaning daily gain and 8-month weight. Traits were analyzed by the least-squares method (2) with a mixed model. Effects

Table 1. Number and make-up of recorded sheep flocks.

Area	Number of flocks	Average flocksize (No ewes)	Type of sheep	Average ewe weight (kg)	Feeding of concentratees/ ewe/year (kg)
Center	4	256.8 (186-325)	Akkaraman	36.3	60
South	2	82.5 (48-117)	Akkaraman	37.2	70
East	7	70.3 (41-101)	Akkaraman	36.1	75
Center-West	5	81.2 (67-108)	Akkaraman,	38.2	90
			Crossbred	43.5	
West	5	50.0 (30-64)	Akkaraman,	52.0	130
			Crossbred,	56.4	
			Merino	57.1	

Table 2. Mean square values and test of significance for pre-weaning growth traits.

Variable	DF	Birth weight	Pre-weianing Daily gain (*10 –3)	Weaning weight
Group	6	3.0^{ns}	16.5^{ns}	61.1^{ns}
Flock: group	( )	(II) 4.6 ***	(24) 38.3 ***	(24) 199.4 ***
Age of dam	4	0.7 ^{ns}	14.3 ***	34.9 **
Season of birth	3	5.1 ***	9.8 **	104.1 ***
Year of birth	1	8.3 ***	6.2 ^{ns}	108.9 ***
Type of birth	1	35.0 ***	294.6 ***	1818.3 ***
Sex	1	4.8 ***	154.1 ***	744.7 ***
Weight of Dam lin.	1	7.0 ***	274.5 ***	1175.7 ***
Weight of Dam Quad.	1	-	50.5 ***	124.5 ***
Age at weaning lin.	1		48.4 ***	4601.5 ***
Age at weaning Quad.	1		4.8^{ns}	87.7 ***
Age at weaning cub.	1		71.1 ***	278.2 ***
Remainder	( )	0.3 (1085)	1.9 (1803)	7.7 (1803)

Levels of significance: ns: not significant, ** P <0.01, *** P< 0.001.

of genotype and area were combined into a group of factors. The Akkaraman were of the local type in the respective areas. The Merino were bred on state farms and sold to the farmers before first lambing. The crossbred sheep had an unspecified but assumed Merino proportion of 50% or more. Dams and sires of the lambs were from the same breeds/types. Flock effects were considered random and nested within the group of factors. The model used for analysis of birth weight was as follows:

$$Y_{ijklmnop}=m+G_1+F_{ij}+A_k+M_1+Y_m+T_n+S_o+b(X_{ijklmnop}-X)+e_{ijklmnop}$$

Where $Y_{ijklmnop}$=estimated value, m=population mean, G_1=fixed effect of genotype-area-group, F_{ij}=random effect of flock nested within group, A_k=fixed effect of age of ewe (2,3,4,5>5 years), M_1=fixed effect of season of birth (until Dec., Jan., Feb., March and later) Y_m=fixed effect of year (90,91), T_n=fixed effect of type of birth (single, twin), S_o=fixed effect of sex (male, female), b= linear regression coefficient of birth weight on weight of dam, $X_{ijklmnop}$=individual weight of dam at weaning, x= mean weight of ewes at weaning and $e_{ijklmnop}$=random error.

The models used for the analysis of the two other pre-weaning growth traits were similar, while post-weaning growth traits were analyzed with a fixed model; details are given with the results. Difference within variables were evaluated by t-test.

Results

Birthweight

The average birthweight from the recorded flocks was 3.74 kg (Table3). The influences of flock, season, year, type and sex of lamb and of weight of dam on birthweight were highly significant (p<0.001), while the influence of age of dam was close to signifiance (p<0.07). The differences between the means from the areas and genetic groups do not show clear trends and reach no important significance levels (Table2). Higher birthweights were recorded for single lambs (4.09 kg vs. 3.39 kg) and for male lambs (3.81 kg vs. 3.68 kg). The relationship between birthweight and weight of dam was positive, with the heavier ewes giving birth to heavier lambs. The differences between years, month of birth and flocks reflect different management and feeding conditions, but the flock effect may also include genetic differences. Analysis with a sub-sample of the data revealed, that birthweight had a highly significant influence (p<0.001) on weaning weight, but no influence on pre-weaning daily gain.

Pre-weaning Daily Gain

The average daily gain before weaning was 188.4 gram. All effects except area-group and year of bith had

a highly significant ($p<0.001$) influence on this trait (Table 2). The best performance was achieved by the Akkaraman flocks in the southern area. The crossbred lambs had weight gains similar to the Akkaraman lambs from the same area (Table3), but the preweaning daily gain of the Merino was lower. Just as for birthweight, the flock effects on preweaning daily gain are the joint effects of genetic make-up of the flock and management influences. Direct management influences are the schedule of suckling and time and intensity of supplementary feeding to the lambs. While relevant indirect influences on growth performance are housing factors and animal health. Ewes lambing the first time, i.e. those of two years of age, produced lambs with the lowest growth rate (171.9 gram). With increasing age of ewe, growth rate of lambs improved until the age of 4 years, but decreased again with higher ewe ages. The influences of type and sex of birth on pre-weaning growth are in the same direction as for birthweight, but more pronounced (Table 3). The relationship between weight of ewe and growth rate of lamb was positive and highly significant ($p<0.001$). The potential reasons underlying this relationship are an inherited higher genetic growth potential, and/or a better condition and

Table 3. Least squares Means for Birtweight, Pre-weaning Daily Gain and Weaning Weight.

Variable	Birth Weight (kg)			Daily Gain (g)			Weaning	Weight (kg)
	N	m+c	s(m+c)	N	m+c	s(m+c)	m+c	s(m+c)
General mean	1114	3.74	0.330	1849	188.4	15.23	16.4	1.10
Area- Group								
Center	592	3.50	0.469	395	197.3	28.24	16.4	2.05
South	96	4.03	0.383	172	201.6	24.07	17.0	1.74
East	143	3.75	0.298	576	188.2	19.60	16.0	1.42
Center-West	128	3.79	0.296	369	175.1	19.07	15.7	1.38
West	12	3.55	0.330	59	193.0	20.65	16.9	1.47
Crossbred	24	3.83	0.264	97	186.9	17.76	17.1	1.27
Merino	119	3.68	0.413	181	176.4	27.12	15.8	1.96
Age of dam								
Two years	89	3.68	0.336	157	171.9 [a]	15.69	15.6 [a]	1.13
Three years	114	3.66	0.334	232	193.9 [b]	15.51	16.7 [b]	1.11
Four years	428	3.79	0.331	585	194.5 [b]	15.29	16.7 [b]	1.11
Five years	330	3.82	0.331	526	193.2 [b]	15.31	16.7 [b]	1.11
> Five years	153	3.75	0.332	349	188.2 [b]	15.39	16.5 [b]	1.11
Season of birth								
L December	105	3.68 [a]	0.345	152	203.1 [a]	16.44	17.8 [a]	1.17
January	157	4.06 [b]	0.333	601	180.9 [b]	15.39	15.7 [b]	1.11
February	455	3.61 [a]	0.333	751	181.2 [b]	15.47	15.6 [b]	1.11
3 March	397	3.61 [a]	0.335	345	188.3 [ab]	16.39	16.6 [ab]	1.16
Type of birth								
Single	1012	4.09 [a]	0.329	1608	210.9 [a]	15.20	18.2 [a]	1.10
Twin	102	3.39 [b]	0.333	241	165.8 [b]	15.48	14.7 [b]	1.11
Sex								
Male	565	3.81 [a]	0.330	894	197.6 [a]	15.28	17.1 [a]	1.10
Female	549	3.68 [b]	0.330	955	179.1 [b]	15.26	15.8 [b]	1.10

Means within variables having no common superscript letters are significantly different ($P<0.05$)

Tablo 4. Result of Analysis of Variance and LSQ Means for Postweaning Growth.

Veriable		Daily Gain After Weaning (g)		8- Month Weight (kg)	
	N	m+c	s (m+c)	m+c	s (m+c)
GENERAL MEAN	337	83.6	1.83	29.1	0.25
Age of Ewe		NS		*	
Two years	64	79.8	2.65	28.4 [a]	0.44
Three years	68	80.4	2.47	28.5 [a]	0.40
Four years	99	85.6	2.45	29.6 [b]	0.37
Five years	72	86.5	2.51	29.4 [ab]	0.40
> Five years	34	86.0	3.39	29.8 [b]	0.56
AREA-FLOCK		***		***	
CENTER					
Flock 1 Female	61	72.7 [a d]	5.25	25.0 [a]	0.52
Flock 2 Female	49	87.0 [a b]	3.62	30.1 [b]	0.42
Flock 3 Female	87	93.2 [b]	2.74	30.0 [b]	0.36
Flock 3 Male	68	108.2 [c]	2.81	32.7 [ab]	0.39
CENTER-WEST					
Flock 4 Female	6	99.9 [b c]	7.56	34.6 [d]	1.27
Flock 5 Female	17	95.8 [b]	4.65	31.6 [bc]	0.80
Flock 6 Female	11	64.0 [d]	8.09	21.9 [a]	0.91
SOUTH					
Flock 7 Female	38	48.5 [e]	3.21	27.3 [f]	0.53
WEANING WEIGHTH LINEAR		N.S		***	
AUTUMNWEIGHT of EWE LINEAR		N.S.		N.S.	
LENGTH OF GROWTH PERIOD		*		-	

Means within variables having no common superscript letters are significantly different (P<0.05).

Significance Levels: N.S.= Not significant, *P<0.05, *** P<0.001.

thus better milk yield of the heavier ewes. The relationship between age at weaning and growth rate was positive which means, that the daily gain increased with the age of the lambs.

Weaning Weight

The average weaning weight was 16.4 kg. Weaning weight and daily gain before weaning are highly correlated traits (Table 5), and the influence of the studied effects was very similar (Table 2) to the trends discussed for daily gain above. Lambs which were born before January (17.8 kg) and during March or later (16.6 kg) achieved higher weaning weights than in two months in between. While early lambing is practiced in flocks with higher supplementary feeding for ewes and lambs, late born lambs benefit from the beginning of the grazing period and thus from better nutritional supply of their mothers. Lambing in January and February on the other hand coincides with the coldest months of the year and poorest condition of the ewes. Single lambs had a 23.8% higher weaning weight (18.2kg vs. 14.7 kg) than twins and males were 8.2% heavier than females (17.1 kg vs. 15.8 kg.). Each increase of body weight of ewe by 1 kg resulted in a 168 gram higher weaning weight of the lamb.

Post-weaning Growth

Most of the lambs from the studied flocks were sold early, and growth data after weaning were therefore only avaliable from a smaller number of the Akkaraman lambs. Results from analysis of variance, and least-squares-means are given in Table 4. The average daily gain after

Tablo 5. Phenotypic Correlations Among Growth Traits.

	Ewe weight	Birth weight	Preweaning daily gain	Weaning weight	Postweaning daily gain
Ewe weight	-				
Birthweight	0.29 **	-			
Preweaning daily gain	0.33 **	0.24 **	-		
Weaning weight	0.34 **	0.42 **	0.73 **	-	
Postweaning daily gain	0.21 **	-0.16	-0.10	-0.25 **	-
8-Mounths weight	0.41 **	0.08	0.41 **	0.45 **	0.59**

** P<0.01

weaning was 83.6 gram and lambs achieved an average 8- months weight of 29.1 kg. Age of ewe effects on post-weaning growth, resulting in better growth of lambs from older ewes, are still noticeable but only significant ($p<0.05$) for 8-months weight. Flocks effects are the major source of variability and cause that daily growth rates for female lambs range from 48.5 gram to 99.9 gram. Different grazing conditions are the most likely reason for those effects. Results from one flock, retaining both sexes, show that male lambs achieved a 16% higher gain under grazing conditions than females. The weaning weight had a highly significant ($p<0.001$) positive influence on 8- months weight, but none on post-weaning weight gain. The relationship between post-weaning gain and length of growth period appears to be negative ($p<0.05$), which can be explained by the poorer nutrition and drop of growth rates after the month of October.

Phenotypic correlations among growth traits

The phenotypic correlations among the studied growth traits are given in Table 5. The majority of ascertained relationships are low or moderate positive (r_p=0.2-0.6). The only high correlation is between pre-weaning daily gain and weaning weight (r_p=0.73) As can be expected, phenotypic relationships between growth traits and weight of ewe become closer with growing age of lamb, while those with birtweight become lower. The low, negative correlation between weaning weight and post-weaning daily gain may indicate that lambs with lower weaning weight can partly compensate this handicap during the summer grazing period.

Discussion and Conclusions

A sufficient birthweight is important, because lambs with lower birthweight have greater susceptibility to environmental stress and greater risk of loss (3). Feeding of the ewe during late pregnancy plays an important role for the development of the lamb before and after birth (4). Different feeding levels of the farms during this period contribute to the variable results for birthweight and pre-weaning growth of lambs. Research by Öztürk et al. (5) indicates, that the negative influences of low nutritional supply during late pregnancy may be stronger on Merino than on the local Turkish breeds. The birth weights from this study are lower than the results reported from most of the institutional flocks in Türkiye, but similar to another study from village conditions (6). The deviation is greater for Merino (7, 8) than for Akkaraman (9, 10) which supports the idea, that feeding during late pregnancy was more critical in the village flocks with Merino sheep. The pre-weaning growth rates and weaning weights from the villages were on the lower end of the range of results from other Turkish studies (6, 9, 10, 11). Compared to the results from other breeds kept under similar ecological conditions (12, 13, 14), the growth performance of all three genetic groups in the studied village flocks is however advantageous. There is only few comparable information from Türkiye on post-weaning growth rate during the first grazing period, but the results reported by Gürbüz (10) and Demir (11) for Akkaraman and Dağlıç sheep from Government farms are similar to those from the present study.

The effects of type of birth and sex on the growth traits were as expected and similar to the results from other studies (7,10,14). The influence of age of dam on growth of its progeny results from the development of the ewe and its level of milk production. Results from a study which included the same breeds as in this investigation show that especially first lactating ewes have a significantly lower milk prodoction (15). The negative effect of young age of ewe on growth of its progeny was smaller in the investigated flocks than in other studies carried out under similar conditions (10,14). It was however, comparable to results from

sheep kept under intensive conditions (16), apparently indicating that the ewes from the studied flocks had a good early growth development. The phenotypic correlations between birth weight and weaning weight or pre-weaning growth were smaller than in other studies (8,17,18), which may indicate that under the studied conditions even lambs with poorer birth weight can achieve reasonable pre-weaning growth rates.

The investigation shows that the effect of the indivudual flock is a very important influence on the growth performance of lambs. This effect is a combination of genetic and managerial factors, and although the relative importance of these two factors is not known, the results of the study indicate that there are realistic chances for better growth performance of lambs by improving the genetic material and by bringing the management up to the level of the better flocks. The large flocks from the center of the Konya province with their low level of feeding intensity and the small flocks in the West with their high input of concentrates represent the two extremes of management practices. The results of the investigation show no evidence that an investment in heavier ewes and higher feeding levels of concentrates like in the western areas of the Konya province is rewarded by a substantial better growth performance of the produced lambs. It also appears that the production of lambs from pure Merino sheep is not advantageous, even under the better environmental conditions in western Konya province. Maintaining Akkaraman ewes with a good growth rate potential or Merino crossbred would probably be a better option. Arranging the ideal lambing season is a very important management decision. The better growth performance of the early lambs might be an important benefit for those smaller flocks which practice intensive lamb fattening. For the large flocks the additional cost of indoor feeding will probably prevent early lambing and their best choice might be to continue with the traditional system of lambing in March.

Correspondenece author:

Dr. M. Ali AZMAN

F.Ü. Veteriner Fakültesi

Hayvan Besleme ve Beslenme

Hast. ABD.

Elazığ-Turkey

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