GENETIC AND NON-GENETIC PARAMETER ESTIMATES FOR GROWTH TRAITS OF SÖNMEZ LAMBS

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Abstract. This study was carried out to evaluate lamb weights and daily weight gains and to estimate genetic and phenotypic parameters to develop breeding strategies over the genetic improvement of growth traits in Sönmez lambs. Genetic and non-genetic parameters on growth traits of 574 Sönmez lambs sired by 12 rams over the years 2001-2004 were evaluated. Sex of lamb, birth type and year, age of dam and ewe weight were significant sources of variation for lamb body weight and gains. Estimates of heritability for birth weight, 2-months weight, pre-weaning, 4 months weight and post-weaning daily gains were 0.25, 0.36, 0.61, 0.50 and 0.61, respectively. Genetic and phenotypic correlations among growth traits were found significant. These findings show that there is an opportunity to improve Sönmez lambs based on the selection for the growth rate.
Keywords: Sönmez lamb, growth traits, heritability, genetic and phenotypic correlations.

GENETINIŲ IR NEGENETINIŲ SÖNMEZ ĖRIUKŲ AUGIMO PARAMETRŲ VERTINIMAS

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Santrauka. Įvertinta genetinių ir fenotipinių parametrų įtaką ėriukų svoriui ir dienos svorio prieaugiui, siekiant sukurti tokią Sönmez ėriukų auginimo strategiją, kuri padėtų genetiškai pagerinti augimo parametrus. 2001–2004 metais ištirti 574 Sönmez ėriukų, kilusių iš dvylikos reproduktorių, genetiniai ir negenetiniai augimo parametrai. Ėriukų svoris ir prieaugis labai priklausė nuo lyties, ėriavimosi būdo, metų bei veislinių patelių svorio prieš ėringumą ir ėringumo metu. Svorio paveldimumo vertinimas atvedimo ir atjunkymo metu, taip pat dienos svorio prieaugis iki atjunkinant ir atjunkius, buvo atitinkamai 0,25; 0,36; 0,61; 0,50 ir 0,61. Nustatyta reikšminga genetinė ir fenotipinė koreliacija tarp augimo parametrų. Tyrimų rezultatai rodo esant galimybę tobulinti Sönmez ėriukų auginimą remiantis atranka pagal augimo parametrus.
Raktažodžiai: Sönmez ėriukas, augimo parametrai, paveldimumas, genetinė ir fenotipinė koreliacija.

Introduction. It is accepted that genetic progress which can be achieved with pure breeding and selection is limited. For this reason, crossbreeding studies have been continued for Turkish sheep breeds; thus, new sheep types for milk, meat and/or wool production have been created by crossbreeding, and it has generally been used as a tool of improvement for the breeding of domestic sheep breeds in Turkey. Sönmez sheep was adapted to the conditions of Western Anatolia (Sönmez and Kaymakci, 1982; Kaymakcı et. al., 2002; Taskin et. al., 2003; Kaymakci and Taskin, 2008: Sönmez et. al., 2009).

The Sönmez sheep, which is a milk and fertility synthetic breed, was developed in the Ege University Faculty of Agriculture, Bornova, Izmir, Turkey. This breed contains 75% Tahirova and 25% Chios genotype (Sönmez et al., 2009). The multiple trait selection of male lambs was practiced for the genetic improvement of the productivity. However, it is important to estimate genetic parameters before the development of specific breeding strategies for new sheep types in Western Anatolia conditions (Kaymakci et. al., 2002; Kaymakci et. al., 2003; Kaymakci and Taskin, 2008; Sönmez et. al., 2009). Genetic parameters are needed to estimate breeding values and to compare responses from different selection programs (Tosh and Kemp, 1994). Profitability of sheep for meat production depends on the body weights of the lambs, and therefore, the selection objectives should include these traits (Ozder et al., 2009). The heritability estimates for body weight and growth rate traits for sheep and goat indicated that substantial improvement could be achieved by selection (Bosso et al., 2007).

This study was carried out to evaluate lamb weights and daily weight gains and to estimate genetic and phenotypic parameters to develop breeding strategies over the genetic improvement of growth traits in Sönmez lambs.

Materials and Methods. The body weights of 574 Sönmez lambs sired by 12 rams were collected over a period of 2001–2004 at the Beydere Seed Test Certification Centre of Sheep Breeding Department-Manisa, Turkey. The ewes were grazed under the free range grazing management system. The lambing was realized in October and November. The birth weight of lambs and ewe weight were recorded within 24 hours after lambing. Subsequent weights of lambs were recorded at 1, 2 and 4 months of age. Least squares procedures based on mixed model (SPSS, 1999) were used to analyse the data on growth traits. The general statistical model included fixed effects based on year and sex of lambs, type of birth, age and weight of ewe at lambing, and random effects due to sires and residual error.

The mathematical model was:

$$Y_{ijklmn} = \mu + a_i + b_j + c_k + d_l + f_m + e_{ijklmn}$$

In the model;

$Y_{ijklm,}$ – the effects as follows; i. sex of lambs, j. type of birth, k. year, l. age of dam, m. dam weight

μ – Overall mean,

a_i – the effect of sex of lambs (i= 1, 2: sex of lambs; male and female),

b_j – the effect of type of birth (j= 1, 2; single and twin),

c_k – the effect of year (k= 1, 2, 3, 4; the year of 2001, 2002, 2003, 2004),

d_l – the effect of age of dam (l= 1, 2, 3, 4; age of dams 2nd, 3rd, 4th and 5th),

f_m – the effect of dam weight (m= 1, 2, 3, 4; kg weights of dams, <45, 45-50, 51-55, > 55),

e_{ijklmn} – Random error term.

Genetic parameters were estimated by the paternal half sib method. The standard errors for heritability and genetic correlations were approximations (Swiger et al.,1964; Boldman and Van Vleck, 1991).

Results and Discussion. The analyses of variance showed that effects of year, type of birth and sex of lambs were important environmental sources of variation for all growth traits (P<0.05). The dam age was not important for all growth traits. Body weights at birth, 2 months, 4 months, and daily live pre-weaning and post-weaning weight gains were found 3.62±0.15kg, 17.94±1.23kg, 27.69±0.96kg, 238.66±10.84g and 162.50±10.50 g respectively (Table 1). These effects of the environment are in agreement with other studies on growth traits (Shiekh et. all. 1986; Mavrogenis and Constantinou, 1990; Singh and Dhillon, 1992a, b; Tijani and Boujenane, 1993; Ozturk and Boztepe, 1994; Yazdi et al., 1997; Synman et al., 1997; Bathaei and Leroy, 1998; El Fadili et al., 2000; Al-Shorepy, 2001).

Sex of lamb, birth type, year, age of dam and dam weight had significant influences on body weights and daily gains of lambs (P<0.05). Sönmez male lambs were 5% heavier than female lambs, and their weaning weight was 20% heavier compared to female Sönmez lambs. Single lambs were characterized for 15% heavier (P<0.05) body weights at birth, 28% at the age of 2 months and 23% at the age of 4 months, while 30% more in pre-weaning gain than twin born lambs. Consequently, growth records should be adjusted to these environmental effects in these analyses.

Table1. **Least squares means** (± SEM) **for growth traits of Sönmez lambs**

	Body weights (kg)			Daily gain (g)	
Effects	Birth	2 months	4 months	Pre-weaning (0–2 months)	Post-weaning (2–4 months)
Num of lambs	574	563	552		
Mean ± SEM	3.62±0.15	17.94±1.23	27.69±0.96	238.66±10.84	162.50±10.50
Sex of lambs					
Male	3.76^b±0.18	18.94^b±2.78	28.96^b±1.69	253.00^b±13.85	167.00±22.35
Female	3.54^a±0.15	15.78^a±1.52	25.30^a±0.82	204.00^a±15.73	158.67±11.72
Type of birth					
Single	3.74^b±0.19	19.07^b±0.96	29.78^b±0.53	255.50^b±12.62	178.50^b±7.48
Twin	3.20^a±0.13	14.93^a±1.04	24.25^a±0.76	195.50^a±14.41	155.33^a±9.10
Year					
2001	3.51±0.11	16.98^a±0.37	27.50±0.56	224.50^a±09.00	175.33^a±10.50
2002	3.57±0.14	17.09^b±0.48	27.84±0.67	225.33^a±10.25	177.16^a±09.85
2003	3.60±0.17	17.58^b±0.59	29.16±0.88	233.00^a±12.40	180.67^a±12.00
2004	3.65±0.19	19.15^c±0.67	29.75±0.90	258.33^b±13.60	195.00^b±11.50
Age of dam					
2	3.51±0.11	18.05±0.57	27.84±0.67	239.33±10.27	163.17±8.46
3	3.60±0.12	17.96±0.79	28.39±0.88	242.33±11.16	173.84±10.67
4	3.68±0.14	18.78±0.81	29.16±0.90	251.67±09.59	173.00±8.55
5	3.75± 0.17	19.26±0.93	29.51±0.97	258.50±08.00	170.83±9.64
Dam weight (kg)					
<45	3.29^a±0.09	15.25^a±0.96	24.57^a± 0.90	199.33^a±10.20	145.17^a± 8.76
45-50	3.48^a±0.12	17.93^b±1.17	26.78^a ± 1.03	227.50^a±07.12	160.83^b±10.21
51-55	3.60^b±0.15	18.48^b±1.45	27.19^b ± 1.19	248.00^b±05.35	164.34^b±12.37
>55	3.76^b±0.19	19.78^b±1.77	29.64^c ± 1.25	267.00^c±02.78	172.00^b±11.54

a,b,c: Means with no common superscript in a column for a parameter differ (P<0.05)

In this study, estimates of heritability for birth, weaning weight, pre and post- weaning daily weight gains were 0.25, 0.36, 0.61, 0.50 and 0.61 respectively (Table 2). The heritability estimates are similar to those reported in the literature (Al-Shorepy, 2001; Dixit et al.2001; Safari et al. 2004).

Table 2. **Estimates of heritability, genetic and phenotypic correlations among growth traits in Sönmez lambs**

Effects	Birth weight	2-months weight	Pre-weaning (0-2 months)	4-months weight	Post-weaning (2-4 months)
Birth weight	0.25±0.08	0.29±0.04 (0.41)	0.10±0.03 (0.25)	0.23±0.06	0.06±0.01 (0.31)
2-month weight	0.20±0.15	0.36±0.12	0.95±0.10 (0.90)	0.60±0.09	-0.22±0.04 (0.26)
Pre-weaning (0-2 months)	0.45±0.20	0.79±0.21	0.61±0.09	0.69±0.07	-0.29±0.03 (-0.36)
4-month weight	0.39±0.17	0.65±0.19	0.52±0.11	0.50±0.08	0.28±0.05 (0.10)
Post-weaning (2-4 months)	0.41±0.18	0.32±0.14	0.23±0.12	0.36±0.05	0.61±0.08

*: Figures in parentheses are environmental correlations

The heritabilities, genetic and phenotypic correlations are along the diagonal, below the diagonal and above the diagonal, respectively. All the phenotypic parameters >0.03 are different from zero (P<0.01)

The heritability estimates obtained for lamb body weight in the present investigation indicated that response to selection for traits of lamb body weight were possible to improve growth traits through genetic selection at all ages

Dixit et al. (2001) found that the birth weight was moderately heritable (0.23), and the 3rd month weight and pre-weaning daily gain were lowly heritable (0.14–0.17) in Bharat Merino lambs. Cloete et al. (2009) reported estimates of 0.17 for birth weight in Merino lamb. Ozder et al. (2009) reported that estimates of heritability were 0.14, 0.29 and 0.29 for birth weight, 3 months weight and pre-weaning daily gains respectively in Turkish Merino lambs. Bossoa et al. (2007) found a heritability of 0.39 for birth weight, 0.54 for pre-weaning and 0.23 for post-weaning in Djallonké sheep. Heritability estimates for weight at birth, weaning 6 and 9 of age were 0.09, 0.21, 0.06 and 0.10 respectively in Muzaffarnagari sheep (Mandal et al., 2006). The estimates of direct heritability for lamb body weights were 0.31 at birth, 0.10 at weaning and 0.19 at six months of age in Lori-Bakhtiari sheep (Vatankhah and Talebi, 2008). Yalcin (1972) reported paternal half-sib h^2 of 0.02 and 0.09 for litter size at weaning of Konya Merino ewes. Van Wyk et al.(2003) estimated h^2 to be 0.026, 0.107 and 0.038 for litter size at weaning, litter weight at birth and litter weight at weaning, respectively. Estimates of h^2 for mutton and wool type dual-purpose breeds (Columbia, Rambouillet, Targhee, Polypay) were from 0.06 to 0.11 for litter size at weaning and from 0.02 to 0.11 for LWW (Rao and Noter, 2000; Bromley et al., 2001; Matos et al., 1997; Hanford et al., 2002).

The high estimates of heritability for post-weaning growth traits indicated that these traits, if included in selection criteria, can increase in body weight. The estimates of phenotypic correlations indicated presence of desirable association among growth traits except for the correlations of post-weaning daily gain with pre-weaning daily gain and weaning weight (Matika et al., 2003; Fadili et al., 2000; Bossoa et al., 2007) . The correlations between body weights are probably due to the greater similarity in environmental and management conditions as well as automatic correlation between adjacent records (Fossceco and Notter, 1995). The estimates of genetic correlations were in agreement with those reported by Ligda et al. (2000).

Conclusion. The heritability estimates obtained for lamb body weight in the present investigation indicated that response to selection for traits of lamb body weight were possible to improve growth traits through genetic selection at all ages. The estimates of genetic correlations between lamb body weight traits were positive and ranged from low to high. Estimates of genetic correlations between weaning weight and daily gain at pre-weaning and weaning of age were very high and positive; suggesting that selection based on increasing weaning weight or weight at four months of age may increase genetic merit in ewe productivity traits. Therefore, weaning weight or weight at two months of age could be considered as selection criteria to indirectly improve the reproductive traits (ewe productivity) in breeds of sheep. However, accuracy of such estimates is low due to the small data set in this study. Because of Beydere Seed Test Certification Centre hasn't issued any data since it was closed by the Ministry of Agriculture in 2004. Nevertheless, this incident was proved to be a wrong decision by the demands from breeders. For this reason, it is necessary that similar studies should be increasingly done on a greater number of sheep.

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