Egypt. J. Anim. 18, No. 1, pp. 29—38 (1978)

Phenotypic and Genetic Parameters of Three Body Weight Traits and the First Greasy Fleece Weight in Fleisch Merino Sheep in Egypt

A.S. Abdel-Aziz, S.A. Imam,(*) M.T. Ragab, and M.A. Sharafeldin

Dept. of Animal Production, Faculty of Agriculture, Cairo Univ., Giza, Egypt.

THIS STUDY was carried out in five farms owned by the Egyptian Meat and Milk Organization, located in different regions in Egypt. The study comprised records of 3855 Fleisch Merino lambs born during three successive years starting in 1969. In addition to pedigree information, data on the date and weight of birth, four-month and yearling body weights and weight and date of the first greasy fleece weight were recorded.

The original data were adjusted for the effects of farm, year and season of birth, sex, and type of birth using least squares constants developed by the analysis of variance (Harvey, 1960). Farm × season interaction was adjusted for only in birth weight, and the effect of age on shearing was accounted for by linear regression.

Phenotypic correlations were computed between all possible pairs of traits. Estimates of heritability and genetic correlations were obtained as four times the intraclass correlation among paternal half-sibs after testing the probable effect of twins on the genetic relationship among half-sibs. Estimates of heritability were 0.29 ± 0.058, 0.28 ± 0.057, 0.29 ± 0.058 and 0.32 ± 0.061 for birth, four-month, yearling body weights and for the first greasy fleece weight, respectively.

All phenotypic and genetic correlations between body weight traits were positive and significant ($P < 0.01$). Phenotypic correlations between first greasy fleece weight and each of birth weight, four-month weight and yearling weight were -0.01 ± 0.016, -0.09 ± 0.016, -0.02 ± 0.016, respectively. The second estimate only was ignificant ($P < 0.01$).

Estimates of environmental correlations showed a general trend similar to that of phenotypic correlations. Direct selection for any of the traits that appeared early on the lambs was found to result in a poor or negative correlated response of the late and more important traits because of the small differences between estimates of heritability and the relatively low-to-moderate or negative genetic correlations.

Genetic and phenotypic parameters of economic traits are needed in planning selection programmes, especially if the plan includes improvement of more than one trait and when some traits are expressed on the individual at an earlier age. The magnitude of heritability and the intensity and direction of association between the traits involved would provide the information needed for selection plans.

* Egyptian Meat. & Milk Organization, Cairo, Egypt.

This study was carried out to measure the phenotypic and genetic parameters for birth weight, four-month and yearling body weights and the first greasy fleece weight in five flocks of Fleisch Merino sheep raised under farm conditions in different regions of Egypt using on-the-farm records. The adoption of those traits was based on their impact on selection of individuals when they are one year old for mutton and wool production.

The inclusion of the greasy fleece weight in the study rather than the clean fleece weight which is the final wool product would be justified by the fact, that the greasy fleece weight was the on-the-farm criterion for measuring wool production of individual animals. Also, the genetic correlation of greasy wool weight with clean wool weight was found in many studies to be positive and high (Morley, 1955; Battie, 1962; Brown and Turner, 1968 and Mullaney *et al.*, 1970). The results obtained from this study were expected to provide basic information for selection for body weight and wool production.

Material and Methods

A. *Data*

Data were collected from 3855 lambs born to imported Fleisch Merino ewes maintained in five farms belonging to the Egyptian Meat & Milk Organization. Farms were located in three different regions of the Northern part of Egypt. Two lambing seasons were defined: (1) April 1, to Oct. 31, and (2) November 30, to March 31. Better environmental and pasture conditions usually prevail in the second season. Lambs were kept with their mothers until weaning at approximately four months of age, and creep feeding was provided during the suckling period. Thereafter, lambs were put on pasture, and concentrates were offered when the pasture was poor and at the finishing stage of fattening. Males were separated from females at the age of about eight months and the extra individuals were prepared for marketing. Lambs were shorn for the first time when they were over eight months of age and shearing was done once a year in the month of May. The routine flock management for disease and parasites control was practiced by frequent vaccination, drenshing and dipping.

Data included records of lambs for which all of the four traits studied were recorded. The four traits were: birth weight, four-month body weight, yearling body weight and the first greasy fleece weight. All available information on the lamb's pedigree, farm, date of birth, sex, type of birth and date and body weight at the time of first shearing were recorded.

B. *Statistical procedures*

Least Squares analysis of variance descriped by Harvey(1960) was used for partitioning the total variation in the four traits studied into parts attributable to non-genetic sources of variance assumed to influence each trait. The original data for each trait were adjusted for the effects of farm, year of birth, season of birth, sex and type of birth. Birth weight was also corrected for the effect of farm × season interaction and the effect of age on shear weight was accounted for by linear regression. The mean squares obtained from the usual one-way analysis of variance and covariance between and within sires were equated to their expectations to obtain estimates of the components of variance and covariance.

The general model underlying a corrected observation on a lamb could be represented by :

$Y_{ij} = u + S_i + e_{ji}$ where

Y_{ij} = an observation taken on the j *th* lamb of the i *th* ram,

U = overall mean of a trait,

S_i = the effect of the i *th* ram, i = 1, 2,..., r,

e_{ij} = a random effect associated with the ij *th* observation.

The model was considered to be random with s_i and e_{ij} having zero means and variances σ^2_s and σ^2_e respectively.

Estimates of heritability (h^2) were obtained as follows :

$$h^2 = 4\,\sigma_s^2 \;/\; (\sigma_s^2 + \sigma_e^2)$$

The sampling error of heritability estimates was computed by the formula given by Woolf (1961).

Analysis of covariance between all possible pairs of traits was performed in a similar manner to provide estimates of phenotypic and genetic correlations. The correlations were estimated using the variance and covariance components as described by Hazel (1943). Sampling errors of the genetic correlations were calculated according to the formula given by Robertson (1959).

Estimates of environmental correlations and correlated response to selection were derived from estimates of heritability, genetic and phenotypic correlations.

Results and Discussions

A. *Estimates of heritability*

Estimates of heritability for the three body weights studied and for the first greasy fleece weight were calculated as four times the intraclass correlation among half-sibs. It might be argued that the presence of 112 pairs of full-sibs among the progeny representing 5.8% of the total number of observations would result in an upward bias in the estimates of heritability obtained by the half-sib method. To test the significance of this bias, the average relationship between individuals having the same sire was calculated according to the formula given by Rendel (1956):

$$\bar{r}_g = \frac{0.25\,[\,n\,(n-1)\,/\,2 - \Sigma\, b\,(b-1)\,/\,2] + 0.50\,[\Sigma\, b\,(b-1)\,/\,2\,]}{n\,(n-1)\,/\,2}$$

$$= 0.25 \left[\frac{4\,\Sigma\, b\,(b-1)}{n\,(n-1)} \right]$$

where,

rg = the average genetical correlation,

n = number of ewes within groups with the same sire, and,

b = number of ewes in each group of full sibs, within groups of ewes with the same sire.

The calculated average relationship, within sire groups was 0.251. Thus a relationship of 0.25 was assumed and the number of full sibs was considered to be too small to cause sizeable biases in the estimates.

The estimates of heritability arrived at in this study for body weights were presented in Table 1. The estimates agree with many of the reported estimates for these traits (Tallis, 1960; Shalton & Campbell, 1962; Pattia, 1966; Fahmy *et al.*, 1969 a; Galal *et al.*, 1970; Vesely *et al.*, 1970 and Ozcan, 1971).

The estimates of heritability given in Table 1 for the three body weights weights studied were very close to each other and indicated the consistency of the genetic influences on the variance of body weight from birth to yearling age.

It seemed that greasy fleece weight was more heritable than body weight. A higher estimate of heritability for this trait (0.39 ± 0.06) was obtained. This estimate was close to previous estimates given in many studies (Radomska, 1970; Vesely *et al.*, 1970., Nawara and Dumiec, 1972., and Eikje, 1975).

B.*Phenotypic and genetic correlations*

Table 2 includes the phenotypic and genetic correlations obtained between pairs of traits. The phenotypic correlations between different body weights had positive values and were, in general, high and very close to their corresponding genetic correlations. All values were highly significant ($P<0.01$). Phenotypic correlation between body weight traits increased from 0.328 and 0.23 between birth weight and four-month weight and between birth weight and yearling weight, respectively, to 0.48 between four-month weight and yearling weight. Similarly, the genetic correlations increased from 0.29 and 0.20 to 0.46 judging from the coefficients of determination given in Table 2 it could be concluded that more than 20% of the phenotypic and genetic variances in yearling weight could be explained by variation in four-month weight.

Concerning the association between first greasy fleece weight and body weight at different ages, it seemed that there was an almost consistent negative relationship between body weight and fleece weight (Table 2).

However, while genetic correlations were all significant ($P<0.01$), only the phenotypic correlation between four-month body weight, which preceded the age of first shearing and the greasy fleece weight of that shear was significant ($P<0.01$). Yet, the value of this correlation coefficient (-0.09 ± 0.016) was very low as compared to the corresponding genetic correlation (-0.38 ± 0.109).

The large discrepancies observed in this study between phenotypic correlations involving body weight and fleece weight and their corresponding genetic correlations would need an explanation. It might be assumed that adjusting the records for non-genetic effects would influence the association between adjusted records. If the remaining sources of environmental variation had variable effects on the traits, the rather low phenotypic correlation between them would be expected.

TABLE 1. **Estimates of heritability(1) for body weight and first greasy fleece weight traits.**

Trait	Estimate	Standard error
Birth weight	0.29	0.058
4-Month body weight .	0.28	0.057
Yearling body weight .	0.29	0.058
1st Fleece weight . . .	0.39	0.061

(1) d.f. for sire = 465
d.f. for error = 3389

The phenotypic correlation between two traits could be expressed by the equation :

$$r_p = h_1 r_g h_2 + r_e [(1 - h_1^2) (1 - h_2^2)]^{\frac{1}{2}}$$

Where r_p 'r_g and r_e are the phenotypic,genetic and environmental correlations respectively, and h_1^2 and $h_2^2$are the estimates of heritability for the two traits.

The environmental correlations were, therefore, derived as follows :

$$r_e = (r_p - h_1 r_g h_2) / [(1 - h_1^2) (1 - h_2^2]^{\frac{1}{2}}$$

The estimates of environmental correlations arrived at betwen birth weight and four-month weight, birth weight and yearling weight, and four-month weight and yearling weight were 0.28,0.24, and 0.49, respectively. These estimates were very close to their corresponding phenotypic and genetic correlations. The environmental correlations between fleece wieght and each of birth weight, and four- month weight were 0 04, and 0.05, respectively.

The low positive estimates of environmental correlations would indicate that the same source of variation vould have different effects on fleece weight and body weight. However, the relatively moderate estimate obtained for the correlation between yearling weight and first greasy fleece weight (0.19) indicated that both traits tended to be more environmentally associated.

In general, estimates of phenotypic and genetic correlation arrived at in this study, fall within the range of estimates reported in many published studies. Estimates of phentoypic correlations ranged from 0.25 to 0.68, from 0.22 to 0.28, from 0.37 to 0.66 and from-0.03 to 0.48 for the phenotypic correlations between birth weight and weaning weight, birth weight and yearling body weight, weaning weight and yearling body weight and for the phenotypic correlation beween body weights and fleece weights, respectively. The corresponding genetic correlations arrived at in available studies ranged from 0.12 to 0.77, from -0.56 to 0.51, from 0.06 to 0.68, and from -0.33 to 0.36 respectively, (Mac Naughton, 1956 ; Osman and Bradford 1965 ; Shelton and Menzies, 1968; Fahmy *et al.*, 1969 b; Vesely *et al.*, 1970; Acharya and Malik, 1971., and Chopra and Acharya, 1971).

The negative estimates of genetic correlations between body weight traits and fleece weight obtained in this study would hamper breeding programmes. Direct selection for body weight would lead to a reduction in the first fleece weight.

TABLE 2. **Phenotypic and genetic correlations between body weight and the first greasy fleece weight traits.**

Pair of traits	Phenotypic correlations			Genetic correlations		
	Estimate	(2) S.E.	(3) C.D.	Estimate	(2) S.E.	(3) C.D.
Birth weight & 4- Month body wt.	0.28*	0.015	0.07	0.29*	0.131	0.08
Birth weight & Yearling body wt.	0.23*	0.015	0.05	0.20*	0.135	0.04
4- Month body wt. & Yearling body wt.	0.48*	0.012	0.23	0.46*	0.111	0.21
Birth weight & 1*st* Fleece weight	0.01	0.016	0.0	0.11*	0.124	0.01
4- Month body wt. & 1*st* Fleece weight	0.09*	0.016	0.01	0.38*	0.109	0.14
Yearling body wt. & 1*st* Fleece weight.	0.02	0.016	0.0	0.37*	0.108	0.13

(1) Based on 3855 pairs of observations.

(2) S.E. = Standard error.

(3) C.D. = Coefficient of determination calculated as the squared correlation coefficient op < 0.01.

However, although Slen *et al.* (1954) found that the relationship between clean fleece weight and body weight was linear, yet, when their data were considered on the basis of clean wool production per unit of body weight, it was found that the heaviest individuals were not necessarily the most efficient wool producers. Earlier, Hunt (1935) and Winters *et al.* (1946) reported that in the case of greasy fleece weights, the relationship was not completely linear and when a certain body weight was recorded, wool production began to decline.

Evidently this was due to the fact that under poor pasture conditions, the large individuals were unable to obtain sufficient extra feed to maintain their body functions and produce as much as medium sized ones. Also, this assumption holds true relating ewes rearing lambs.

Yet, these relationships need further study because of the economic importance of both mutton and wool production in sheep enterprise. Selection at the earliest possible age is desirable, not only to ensure the rapid genetic progress in body weight, but also in some cases to improve wool production.

The logical procedure in utilizing the phenomenon of correlated response to selection in breeding plans is to select directly for the traits that appear early to improve indirectly the traits expressed at older ages. Because of the negative genetic correlations obtained in this study between body weights and fleece weight, selecting for any of the birth weight, four-month or yearling weights would lead to a negative response in first greasy fleece weight.

Further, the positive estimates of genetic correlation among body weights (Table 2) were not high enough to ensure a considerable amount of genetic imporvement in body weight at older age by direct selection for body weight at earlier stages. The small differences among estimates of heritability of the traits (Table 1) would also support this conclusion. Correlated response of a trait to direct selection for another could be computed using the expression rgh_1/h_2 where rg is the genetic correlation, and h is the square root of heritability. The subscripts 1 and 2 refer to the trait directly selected for and the correlated trait, respectively.

Direct selection for birth weight would result in an improvement in four-month and yearling weights of only 30% and 20% of the genetic gain expected if any of the traits were directly selected for, respectively. Improving yearling weight selecting for four-month weight would lead to 40% of the improvement expected from direct selection for it.

The improvement of both mutton and wool production is of great importance to the extent that a selection index should be considered as a means of selection for both traits. However, the efficiency of such index would need to be investigated.

References

Acharya, R.M. and Malik, R.C. (1971) Genetic and phenotypic parameters for pre and post-weaning body weight in Nali and Lohi; and their crosses with Nellore and Mandaya. *Indian, J. Anim. Sci.*, **41** 1126.

Eattie, A.W., (1962) Relationships among productive characters of Merino sheep in North-Western Queensland.II. Estimates of genetic parameters with particular reference to selection for wool weight and crimp frequency. *Qd J. Agric. Sci.* **19**, 17

Brown, G.H. and Turner, Helen Newton (1968) Response to selection in Australian Merino sheep.II. Estimates of phenotypic and genetic parameters for some production traits in Merino ewes and analysis of possible effects of selection on them. *Aust.J. Agric. Res.*, **19**,303.

Chopra, S.C. and Acharya, R.M. (1971) Genetic and phenotypic parameters of body weights in Bikaneri sheep Margra strain. *Anim. Prod.* **13**,343.

Eikje, E.O. (1975) Studies on sheep production records. VII. Genetic, phenotypic and environmental parameters for productivity traits of ewes. *Acta Agriculture Scandianavia*, **25**,242

Fahmy, M.H., Galal, E. Salah, E. and Ghanem, Y.S. (1969a) Birth weight of Hungarian Merino sheep in North Western Coastal Egyptian desert. *J.Anim. Prod. U.A.R.*, **9**, 149.

Fahmy , M.H., Galal E., Ghanem Y.S., and Khishin, S.S., (1969 b) Genetic parameters of Barki sheep under semi-arid conditions. *Anim. Prod.* **11**, 361.

Galal, E., Salah, E., Hazel, L.N., Sidwell, G.M. and Terrill, C.E. (1970) Correlation between purebred and crossbred half-sibs n sheep. *J. Anim. Sci.* **30**, 375.

Harvey, W.R. (1960) Least-squares analysis of data with unequal subclass numbers *Mimeo-, graph U.S. Dept. Agric., ARS,* 20-80.

Hazel, L.N. (1943) The genetic basis for constructing selection indexes. *Genetics*, **28**, 476.

Hent, W·E. (1935) The effect of size and type of ewe on efficiency of production. *Marlyland Agr. Exp. Sta. Bull.* 380.

Mac Naughton, W.N. (1956) *Repeatability and heritability of birth, weaning and shearing weights among range sheep in Canada*. Ph. D. Thesis, Iowa State Univ., Ames. A.B.A. **25**, 1926.

Morley, F.H.W. (1955) Selection for economic characters in Australian Merino sheep. V. Further estimates of phenotypic and genetic parameters. *Aust. J. Agric. Res.* **6**, 77.

Mullaney, P. D., Young, S.S.Y. and Hayland, P.G. (1970) Genetic and phenotypic parameters. for wool characteristics in fine-wool Merino, Corriedale, and Polworth sheep. II. Phenotypic and genetic correlations, heritability and repeatability. *Aust. J. Agric. Res.* **21**, 526.

Nawara, W. and Duniec, H. (1972) Heritability of the main production traits in polish Mountain sheep. *A.B.A.*, **41**,2144.

Osman, A.H. and Bradford, G.E. (1965) Effects of environments on phenotypic variation. in sheep *J. Anim. Sci.*, **24**,766.

Ozcan, H. (1971) The heritabilities of live weight, greasy fleece weight, staple length, and fibre diameter and the relationships among these characters in kivircik yearling sheep in Innah State Farm. *Ankara Univ. vet. Fak. Derg.*, **18**,149 (*A.B.A.*, **40**, 4648.

Pattie, W.A. (1966) Selection for weaning weight in Merino sheep. I. Direct response to selection. II. Correlated responses in other production characters. *Aust. J. Exp. Agric. Anim. Husb.*, **5**,353,361.

Radomska, M.J. (1970) Preliminary results of investigation on the heritability of some production traits in Kent sheep in Poland. *A.B.A.* **41**,3491.

Rendel, J. (1956) Heritability of multiple birth in sheep *J. Anim. Sci.* **15**,193.

Robertson, A. (1959) The sampling variance of the genetic correlation coefficients. *Biometrics*, **15**, 469.

Shelton, M.J. and Campbell, F. (1962 Influence of environmental adjustments on heritability of weaning weight of Range Rambouillet lambs. *J. Anim. Sci.* **21**,91.

Shelton, M.J. and Menzies, J.W. (1968) Genetic parameters of some performance characteristics of range fine-wool ewes. *J. Anim. Sci.* **27**,1219.

Slen, S.B. Peters, H.F. and Myher, P.I. (1954) The relationship of clean fleece weight to body weight in Range sheep . *Canad. J. Agric. Sci.* **34**, 198.

Tallis, G.M. (1960) Effects of some controllable error on estimates of genetic parameters, with special reference to early postnatal growth in Merino sheep. *J. Anim. Sci.* **19**,1208.

Verely, J.A., Peters, H.F., Slen, S.B. and Robison, O.W. (1970) Heritabilities and genetic correlations in growth and wool traits of Rambouillet and Romnelet sheep. *J. Anim Sci.* **30**, 174.

Winters, L.M., Dailey, D.L., Kiser, O.M., Jordan, P.S., Hodgsen, R.M., and Green, W.W. (1946) Factors affecting productivity in breeding sheep. *Minn. Agr. Exp. Sta. Tech. Bull.* 174.

Woolf, B. (1961) Lecture notes, Diploma in Animal Genetics, Edinburgh University.

المقاييس الوراثية والمظهرية لبعض صفات وزن الجسم والصرف الخام فى أغنام المارينو الألمانى فى مصر

أحمد سعيد عبد العزيز ، السيد أحمد امام * ، محمد توفيق رجب
و ممدوح عبد الوهاب شرف الدين

كلية الزراعة ، جامعة القاهرة ، الجيزة

أجريت الدراسة فى خمس مزارع تابعة للمؤسسة العامة للحوم والألبان فى مصر ، وموزعة فى جهات مختلفة • وتناولت الدراسة سجلات ٢٨٥٥ حملا من أغنام المارينو الالمانى التى ولدت فى ثلاث سنوات متتابعة تبدأ من عام ١٩٦٩ وبالاضافة الى معلومات النسب ، شملت السجلات بيانات تاريخ ووزن الميلاد، الوزن عند أربعة أشهر وعند سنة ، وكذلك وزن وتاريخ الجزة الأولى الخام•

استعملت طريقة الحد الأدنى للمربعات لتصحيح البيانات الأصلية لأثر المزرعة وسنة وموسم الميلاد والجنس ونمط الميلاد (مفرد أو توأم) • كما تم التصحيح لأثر التداخل بين المزرعة وموسم الميلاد فى وزن الميلاد فقط وتصحيح أثر وزن الجسم على وزن الجزه الخام بالانحدار الخطى •

حللت البيانات المصححة وحسب المعامل الوراثى لكل من الصفات الأربعة ومعاملات الارتباط الوراثى بينها منمكونات التباين والتباين المشترك بين وداخل المجاميع الأبوية الناتجة من التحليل أحادى التصنيف • واهمل وجود نسبة من القوائم بين الحملان تمثل ٨ر٥٪ من عددها الكلى بعد حساب أثرها على معامل التلازم الوراثى بين أنصناف الأشعة وثبوت ضآلته • كما حسبت معاملات الارتباط المظهرى والبيئى بين كل زوج من الصفات الاربعة •

كانت تقديرات المعامل الوراثى لأوزان الجسم عند الميلاد ، عمر أربعة شهور وسنة ووزن الجزة الأولى الخام ٠ر٢٩ ± ٠ر٠٥٨ ، ٠ر٢٨ ± ٠ر٠٥٧ ، ٠ر٢٩ ± ٠ر٠٥٨ ، ٠ر٣٢ ± ٠ر٠٦١ على التوالى • ووجد أن جميع معاملات الارتباط الوراثية والمظهرية بين أوزان الجسم المختلفة كانت موجبة ومعنوية عند مستوى احتمال ٠ر٠١ ، بينما كانت معظم المعاملات سالبة ومعنوية عند مستوى احتمال ٠ر٠١ فيما عدا معاملى الارتباط المظهرى بين الجزة الأولى وكل من وزن الميلاد والوزن عند عمر سنة •

---

* الشركة المصرية العامة للحوم والألبان ، القاهرة .

وقد استخدمت المعاملات السابقة فى حساب معاملات الارتباط البيئى بين الصفات التى تبعت فى معظم الأحوال نمط المعاملات المظهرية ، كما حسبت الاستجابة المرتبطة للانتخاب وثبت عدم جدواها فى احراز تحسين ملموس فى أى من صفات وزن الجسم بالانتخاب المباشر لصفة أخرى بسبب ضآلة الفروق بين المعاملات الوراثية وصغر قيمة الارتباط الوراثى فى معظم الحالات • أما الحالات التى كان معامل الارتباط الوراثى فيها سالبا كالارتباط بين أى من أوزان الجسم ووزن الجزة الأولى الخام ، فان التغيير فيها يسير فى اتجاهين متضادين •