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GENETIC AND NON-GENETIC FACTORS AFFECTING LIFE-TIME PRODUCTION OF OSSIMI AND RAHMANI EWES

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SUMMARY

A total of 520 Ossimi and 629 Rahmani ewes were used in the present study to estimate non-genetic factors affecting, heritability and genetic and phenotypic correlations of life-time lamb and wool production traits.

Estimates of least squares means of total life-time number of lambs born (TLB), total life-time number of lambs weaned (TLW), total life-time kilograms born (TKB), total life-time kilograms weaned (TKW) and total life-time kilograms of fleece weight (TFWT) were 4.23, 3.73, 12.83, 46.98 and 5.86 respectively, in Ossimi ewes and 4.47, 3.74, 13.81, 48.09 and 6.55 respectively, in Rahmani ewes.

Differences among years and among locations were highly significant in both Ossimi and Rahmani ewes. Age of dam and type of birth had non significant effects. Season of birth significantly affected all studied traits in Ossimi ewes except TKW, while it non-significantly affected all studied traits in Rahmani ewes.

The effect of weaning weight of the ewe on her life-time production was not significant in both breeds, while the effect of yearling weight was significant on all studied traits in Ossimi ewes except TFWT and non significant on all studied traits in Rahmani ewes.

Estimates of heritability of studied traits were .013, .031, .031, .004 and .234, respectively for Ossimi and

.131, .154, .121, .142 and negative, respectively for Rahmani. The genetic correlations ranged from -.765 to 1.3 and phenotypic correlations ranged from .011 to .97 in Ossimi, while the genetic correlations ranged from -.060 to 1.1 and phenotypic correlations ranged from -.029 to .96 in Rahmani.

Keywords: Ossimi, Rahmani, life-time production traits, lamb production, wool production, heritability, genetic and phenotypic correlation

INTRODUCTION

Life-time performance of the ewe is the ultimate indicator of her utility in the flock since it takes account of the stayability of the ewe in the flock and possible trade-offs between performances in consecutive seasons. Life-time performance is also important in investigating flock economics. Very few studies have been made to estimate life-time performance of the ewe and factors affecting it in Egyptian breeds of sheep. This investigation was carried out to estimate life-time, lamb and wool, production of ewes from Ossimi and Rahmani breeds, genetic and environmental factors influncing it and its genetic and phenotypic relationship with the ewe weight early in her life.

MATERIALS AND METHODS

The present study included data on 520 Ossimi (O) and 629 Rahmani (R) ewes, raised on experimental stations belonging to the Ministry of Agriculture during the period 1970-1988.

A total original number of 1566 Rahmani and 1236 Ossimi ewes were available for the study. Ewes which were sold for breeding or used in expriments and those that were too young to have the chance to complete nine seasons were excluded from the data. Only ewes which had the chance to complete nine lamb crops were considered for the analysis. These include ewes that were sold for infertility or which died as a result of diseases. Daughters of sires which had less than four daughters were excluded from the data. Thus numbers were decreased to 520 Ossimi and 629 Rahmani ewes.

Management

Generally, there were three matings per two years in May, January and September. lambs were weaned at eight weeks of age.

From December to May sheep grazed on Egyptian clover (Trifolium alexandrinum). From June to November ewes were fed on crop stubbles and green fodder if available, besides concentrate mixture, clover hay and rice straw. Ewes were allowed supplementary feeding during mating and late pregnancy through lactation.

Life-time production of the ewe

The life-time production was measured in five traits including number of lambs born (LB), number of lambs weaned (LW), kilograms born (KGB), kilograms weaned (KGW) and greasy fleece weight (FWT).

In this study the ewes were allowed nine consecutive reproduction seasons in possibly 6 yr. When a mating season was delayed for the whole flock in some stations, this period of six years was increased to 7 or 8 years or sometimes more to allow for the missed seasons. If the ewe did not conceive in any season, her production value was considered as zero.

Life-time production for the ewe was calculated by summing up all records of the ewe each for LB, LW, KGB, KGW and FWT, after making appropriate adjustments as explained later.

The record of the ewe included her pedigree, birth weight (BWT) and weaning weight (WWT).

Statistical analysis

Data consisted of two parts, the first included lamb data and the second ewe data. Data were analyzed on two stages, the first was concerned with analyzing of lamb data to obtain constants for fixed effects to adjust BWT, WWT and ewe data to obtain constants for fixed effects to adjust annual fleece weight using Harvey's Mixed Model Least-squares and Maximum Likelihood Computer Program (LSML 87). The second stage was concerned with analyzing ewe data to estimate the genetic parameters for life-time production traits.

Correction for fixed effects for lambs weights

Lambs birth weight was adjusted for breed (to respective local breed), sex and type of birth of the lamb, lambing season, block, parity and two way interactions, while weaning weight was adjusted for the same effects in addition to age at weaning (60 days).

Correction for fixed effects for wool

Ewe fleece weight was adjusted for year of fleece, season of fleece, age of ewe and two way interactions.

First fleece weight was separately dealt with in the analysis while the subsequent fleeces were considered together. Every two 6 mo fleeces were added as one yearly fleece. Season was considered as season of the second seasonal fleece.

All respective adjusted records during the ewe life-time were summed to represent her life-time production.

The estimation of genetic parameters of life-time production traits of Ossimi and Rahmani

The second part of statistical analysis of this study is concerned with analyzing data within each breed to estimate life-time production of LB, LW, KGB, KGW and FWT and WT2 (weaning weight) and WT12 (yearling weight) and the variance and covariance components for the random effect (sire within block-location) and the fixed effects (block-location, season, age of dam and type of birth of the ewe).

Disconnection problem occurred when there were not enough ji subclasses (of sire j and block-location i) contained in the observations in order that differences between all levels of sires and all levels of block-location are estimable, thus sires were considered within block-location.

The model was :

$$Y_{ijklmn} = \mu + b_i + r_{ij} + a_k + s_l + t_m + e_{ijklmn}$$

where,

Y_{ijklmn} is the adjusted LB, LW, KGB, KGW and FWT and WT2 and WT12,

μ is the overall mean,

b_i is an effect due to the i^{th} block-locations,

r_{ij} is an effect due to ji^{th} sire within block-location,

a_k is an effect due to k^{th} age of dam,

s_l is an effect due to l^{th} season of birth of the ewe,

t_m is an effect due to m^{th} type of birth of the ewe and

e_{ijklmn} is the effect due to the random error.

A similar model but with the addition of ewe weight was applied to estimate the regression coefficient of life-time production traits (LB, LW, KB, KW and FWT) on the weaning or yearling weight of the ewe.

Estimation of genetic parameters

Heritability (h^2) of LB, LW, KB, KW and FWT was estimated as

$$h^2 = 4 \frac{\sigma^2_s}{\sigma^2_s + \sigma^2_e}$$

where,

σ^2_s is the sire variance component.

σ^2_e is the residual variance component.

Genetic correlations between life-time production traits and each of weaning weight and yearling weight were estimated as

$$r_g\ (a,a') = \frac{\sigma_{ss'}}{\sigma_s\ \sigma_{s'}}$$

where,

$r_g\ (a,a')$ is the genetic correlation between a and a' traits,

$\sigma_{ss'}$ is the sire covariance component estimate between the two traits,

σ_s and $\sigma_{s'}$ is the geometric mean of the two half-sib family variances, while phenotypic correlations were estimated as

$$r_p\ (a,a') = \frac{\sigma_{ss'} + \sigma_{ee'}}{\sqrt{\sigma^2_s + \sigma^2_e}\ \sqrt{\sigma^2_{s'} + \sigma^2_{e'}}}$$

where,

$r_p\ (a,a')$ is the phenotypic correlation between a and a' traits.

RESULTS AND DISCUSSION

Life-time Production of the Ewe

Life-time production of the ewe is a function of the length of her productive life and seasonal production. It is an indication of the ewe fertility and prolificacy, and the lamb characteristics such as mortality and growth rate up to weaning. Average number of life-time lambings of each of Ossimi and Rahmani ewes during their life was estimated in this study as 5.45 and 4.83 over six production years (potentially nine parities),respectively. Tomar and Mahajan (1980) reported that total number of lambings of 55 Ramouillet ewes averaged 2.96 over 10 years. Younis <u>et al</u>. (1988) estimated the mean of total number of lambings of 174 Barki ewes as four lambings.

Means of life-time production traits of Ossimi and Rahmani

The least squares means and standard errors of total number of lambs born (TLB), total number of lambs weaned (TLW), total kilograms born (TKB), total kilograms weaned (TKW) and total kilograms grease fleece weight (TFWT) are represented in Table 1 for Ossimi and Table 2 for Rahmani.

Table 1. Least squares means±standard errors(kg) for life-time production traits and estimate of heritability (h^2) ± SE and variance components (σ^2_s) and (σ^2_e) for in Ossimi ewes

Factor	TLB Mean±	SE	TLW Mean±	SE	TKB Mean ±	SE	TKW Mean±	SE	TFWT Mean±	SE	WT2		WT12	
μ	4.23±	.15	3.73±	.14	12.8 ±	.5	47.0±	1.8	5.9 ±	.2				
Age of dam, yr														
2	3.30	.35	2.87	.33	10.3	1.1	36.2	4.1	5.0	.4				
3	4.02	.34	3.55	.31	12.2	1.0	44.9	4.0	5.7	.4				
4	4.72	.35	4.06	.32	14.2	1.1	51.8	4.1	6.1	.4				
5	4.41	.37	3.90	.34	13.4	1.1	47.1	4.3	6.1	.4				
6	4.57	.42	4.13	.39	13.7	1.3	52.9	4.9	6.3	.5				
>6	4.33	.25	3.84	.23	13.3	.8	49.1	3.0	6.1	.3				
Season of birth														
Feb.	4.02	.33	3.54	.30	12.0	1.0	44.6	3.8	6.1	.4				
June	3.70	.30	3.28	.28	11.2	.9	42.5	3.5	5.2	.3				
Oct.	4.96	.30	4.35	.28	15.3	.9	53.9	3.5	6.3	.3				
Type of birth of the ewe														
Single	4.15	.17	3.63	.16	12.8	.5	46.6	2.0	6.0	.2				
Twin	4.31	.23	3.82	.21	12.9	.7	47.4	2.7	5.7	.3				
Reg. on														
WT2	.02	.05	.001	.04	.05	.14	.11	.55	.01	.05				
WT12	.07	.03	.07	.02	.25	.08	.98	.30	.05	.03				
h^2	.013	.104	.031	.107	.031	.107	.004	.103	.234	.130	.387	.146	.370	.145
σ^2_s:BL	.02		.04		.46		.84		.43		.70		2.18	
σ^2_e	6.34		5.39		58.83		879.81		6.98		6.51		21.41	

σ^2_s:BL estimate of sire variance component.
σ^2_e estimate of error variance component

Table 2. Least squares means± standard errors (kg) for life-time production traits and estimate of heritability (h^2)± SE and variance components (σ^2_s) and (σ^2_e) for in Rahmani ewes

Factor	TLB Mean±	SE	TLW Mean±	SE	TKB Mean±	SE	TKW Mean±	SE	TFWT Mean±	SE	WT2	WT12
μ	4.47±	.21	3.74±	.19	13.8±	.6	48.1±	2.4	6.6±	.2		
Age of dam												
2	4.01	.43	3.17	.39	12.3	1.3	43.8	5.0	6.3	.4		
3	4.35	.38	3.93	.34	13.4	1.2	45.7	4.4	6.3	.4		
4	4.34	.40	3.41	.36	13.6	1.2	47.3	4.7	6.7	.4		
5	4.42	.38	3.86	.34	13.9	1.2	46.7	4.4	6.2	.4		
6	5.24	.50	4.33	.45	16.0	1.5	56.9	5.8	7.0	.5		
>6	4.43	.31	3.71	.29	13.7	1.0	48.2	3.7	6.8	.3		
Season of birth												
Feb.	4.80	.39	4.01	.35	14.9	1.2	52.7	4.6	6.4	.4		
June	4.21	.36	3.42	.33	13.1	1.1	43.1	4.3	6.4	.4		
Oct.	4.39	.37	3.77	.34	13.5	1.1	48.5	4.3	6.8	.4		
Type of birth												
Single	4.36	.24	3.60	.22	13.4	.7	46.1	2.8	6.6	.2		
Twin	4.57	.27	3.87	.24	14.2	.8	50.1	3.1	6.5	.3		
Reg. on												
WT2	.06	.05	.06	.05	.18	.16	.70	.60	-.06	.05		
WT12	.03	.03	.03	.03	.13	.09	.45	.36	.01	.03		
h^2	.131	.113	.154	.115	.121	.112	.142	.114	--a	.279	.126	.201 .120
σ^2_s:BL	.32	.30	2.74	46.89	.000		.50		1.01			
σ^2_e	9.33	7.59		87.46		1270.79			9.68		6.70	19.10

a is negative estimate of zero

Stillbirth is included in the number of lambings but excluded from number of lambs born, therefore number of lambings had a higher estimate than number of lambs born. The higher estimate of TLB in Rahmani ewes is partially due to the higher twinning rate. Twinning rate was estimated as 1.35 in Rahmani ewes and 1.23 in Ossimi (Almahdy, 1987). Although number of lambs born of Rahmani ewes was higher than that of Ossimi ewes rate of lamb mortality of Rahmani lambs was also higher than that of Ossimi lambs in the period from birth till 4 mo of age (El-Hagry, 1980), hence no observable difference of TLW between Ossimi and Rahmani ewes. TKB in Rahmani ewes was higher than that in Ossimi ewes due to higher TLB. Younis <u>et</u> <u>al</u>. (1988) reported that TLB, TLW, TKB and TKW per Barki ewe during her life ranged from one to six lambings with an average of 3.07, 2.54, 10.2 and 40.0, respectively. El-Kimary and Sharaby (1985) estimated TLB, TLW, TKW and TFWT as 4.45, 3.35, 82.2 and

6.82, respectively in Barki ewes and 5.68, 4.22, 101.3 and 6.35, respectively in Rahmani ewes.

Environmental and genetic factors affecting life-time production traits in Ossimi and Rahmani Environmental factors

The effect of block-location on TLB, TLW, TKB, TKW and TFWT was highly significant in each of Ossimi and Rahmani ewes, while age of dam non-significantly affected life-time production traits in both breeds. Although age of dam was generally non-significant the ewes from maiden dams had always less production than those from mature dams. Season of birth of the ewe had a highly significant effect on TLB, TKB and TFWT, and significant effect on TLW and non-significant effect on TKW in Ossimi ewes. In Rahmani ewes it had non-significant effect on all traits studied. The highest least squares means of TLB, TLW, TKB, TKW and TFWT in Ossimi ewes were of ewes born in October followed by those born in February and those born in June, while in Rahmani ewes there were little differences among the seasons of lambing in each of TLB, TLW, TKB, TKW and TFWT. Type of birth of the ewe non-significantly affected TLB, TLW, TKB, TKW and TFWT in both Ossimi and Rahmani ewes. Although the differences between the two classes of type of birth were not significant. The least squares means of TLB, TLW, TKB and TKW of twin born ewes were slightly higher than those of single born ewes in Ossimi and Rahmani ewes. These results indicated that the reproduction efficiency of twin born ewes is somewhat higher than singles. Ewe weaning weight had non-significant effect on TLB, TLW, TKB, TKW and TFWT in Ossimi and Rahmani ewes. The results showed that each one kg increase in weaning weight was associated with .02, .001 , .05, .11 and .01 kg increase in TLB, TLW, TKB, and TFWT, respectively, in Ossimi ewes (Table 1) and .06, .06, .18 and .7 increase in TLB, TLW, TKB, and TKW, respectively and .06 kg decrease in TFWT in Rahmani ewes (Table 2). Ewe yearling weight had a significant effect ($P< .01$) on TLB, TLW, TKB, TKW and non-significant ($P> .05$) on TFWT in Ossimi ewes and non-significant effect on all these traits in Rahmani ewes. Each one kg increase in yearling weight was associated with .07, .07, .25, .98 and .05 kg increase in each of TLB, TLW, TKB, TKW, and TFWT, respectively, in Ossimi ewes (Table 1) and .03,.03, .13, .45 and .01 kg increase in TLB, TLW, TKB, TKW and TFWT, respectively in Rahmani ewes (Table 2).

Genetic factors.

Estimates of sire (σ^2_s : BL)and error (σ^2_e) variance components for life-time production traits are presented in Table 1 of Ossimi and Table 2 of Rahmani ewes.

The variation, both genetic and phenotypic, of Rahmani in life-time production traits is higher than that of Ossimi. The variation in climatic conditions and other environmental factors between Delta locations did not seem to cause much variation in ewe productivity of the Ossimi breed, whereas it caused considerable variations in the Rahmani breed (Aboul-Naga, 1976).

Heritability.

The estimates of heritability (h^2) for TLB, TLW, TKB, TKW, TFWT, WT2 and WT12 are presented in Table 1 for Ossimi and Table 2 for Rahmani ewes. Theoretically, the present results indicated that mass selection for life-time production traits in Ossimi ewes would be of little use with the exception of TFWT, where selection may be useful. As with variation, h^2 was higher among Rahmani all traits except TFWT. However, direct mass selection for life-time traits may be impractical since it will lengthen the generation interval greatly. The estimated heritability of WT2 and WT12 in the present study are high enough to indicate that mass selection for WT2 in both breeds and WT12 in Ossimi could be more effective in increasing life-time production per unit of time taking into consideration the estimates of the genetic correlations than that for life-time production traits in Ossimi and Rahmani. However, h^2 for weaning weight (WT2) and yearling weight (WT12) cannot represent the breeds in general. They represent only females that went into the breeding flock and had the chance to stay for nine mating seasons.

To make sure of the previous statements, the following formula was used to know which method is more effective.

$$\frac{\sqrt{h^2_x}}{\sqrt{h^2_y}} \cdot r_{Gx.y}$$

where,

x is weaning weight or yearling weight.

y is life-time production trait

$r_{Gx.y}$ is genetic correlation between traits

The calculated estimates of genetic improvement by this formula (Table 3) indicated that in Ossimi selection for weaning weight will be more effective in improving TLW and TKW, while selection for yearling weight is more effective in all life-time production traits.

Table 3. The calculated estimates of genetic improvement for Ossimi and Rahmani

	WT2		WT12	
	Ossimi	Rahmani	Ossimi	
TLB	.507	.185	6.210	
TLW	1.293	.499	2.560	
TKB	.413	.226	1.593	
TKW	7.466	.303	19.755	
TFWT	.258	---		.011

The higher estimate of response to direct selection is due to the higher estimate of heritability in Rahmani. However, one should take in consideration that indirect selection will be effective per unit of time in Rahmani as compared with direct selection due to the increase in generation interval. In additiion the added cost of recording life-time production traits as compared to that of early records.

Genetic and phenotypic correlations.

Estimates ofgenetic and phenotypic correlations between traits arepresented in Table 4 for Ossimi and Rahmani ewes.

In Ossimi ewes the high genetic correlation between WT12 and each of TLB, TLW, TKW and between WT2 and TKW indicates that selection for WT12 will improve each TLB, TLW and TKW and for WT2 will improve TKW. In Rahmani ewes the genetic correlations between WT12 and life-time production traits were low or negative. Selection for WT12 will lower the TLB and TKB traits. Selection for WT2 in Rahmani ewes may cause some improvement in TLW.

Table 4. Genetic(r_G) correlations ± SE and phenotypic (r_P) between traits in the two breeds

Trait		Ossimi		Rahmani	
		r_G ± SE	r_p	r_G ± SE	r_p
	TLW	1.326±2.696	.939	.783±.207	.880
	TKB	.864± .587	.968	1.068±.070	.964
	TKW	-.765±3.079	.918	.947±.079	.926
	TFWT	.575±1.680	.673	--	-.001
	Wt2	.093±1.486	.016	.127±.488	.054
	Wt12	1.164±5.011	.151	-.060±.556	.042
TLW	TKB	1.079± .422	.921	.786±.219	.855
	TKW	1.219±10.756	.946	.939±.102	.885
	TFWT	.696± .881	.644	--	.015
	Wt2	.366±1.152	.011	.499±.457	.075
	Wt12	.741±1.496	.152	.253±.517	.054
TKB	TKW	.879±5.561	.916	.920±.090	.946
	TFWT	.883±1.021	.689	--	-.004
	Wt2	.117± .972	.014	.226±.505	.057
	Wt12	.461±1.145	.157	-.039±.576	.056
TKW	TFWT	.403±4.430	.657	--	-.012
	Wt2	.759±11.932	.016	.303±.470	.063
	Wt12	2.054±31.192	.165	.248±.533	.063
TFWT	Wt2	.201± .389	.028	--	-.029
	Wt12	.009± .398	.084	--	-.010

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تقدير بعض المواد الغير وراثية وبعض المعايير الوراثية المتعلقة بصفات طول الحياة الانتاجية

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حللت البيانات باستخدام نماذج احصائية مختلطة تضمنت تأثير كل من السنة - المحطة ، عمر الام للنعجة ، موسم الودلاة للنعجة ونوع الميلاد للنعجة كعوامل ثابتة وتأثير الطلوقة داخل السنة - المحطة كعامل عشوائى٠
تضمنت صفات طول الحياة الانتاجية:
العدد الكلى للحملان المولودة، العدد الكلى للحملان المفطومة ، الوزن الكلى للحملان المولودة (كجم) ، الوزن الكلى للحملان المفطومة (كجم) والوزن الكلى لجزات الصوف الخام (كجم) وقد اظهرت نتائج الدراسة ما يلى :
- المتوسطات الاقل مربعات العامة لصفات طول الحياة الانتاجية كانت كالتالى ٤,٢٣ ، ٣,٧٣ ، ١٢,٨٣ ، ٤٦,٩٨ ، ٥,٨٦ على الترتيب فى الاوسيمى وكانت ٤,٤٧ ، ٣,٧٤ ، ١٣,٨١ ، ٤٨,٩ ، ٦,٥٥ على الترتيب فى الرحمانى٠
- التأثير المعنوى جدا للإختلافات بين سنوات - محطات التربية على كل صفات طول الحياة الانتاجية لكل من الاوسيمى والرحمانى٠
- التأثير الغير معنوى للاختلافات بين اعمار الامهات فى كلتا السلالتين٠
- التأثير المعنوى للاختلافات بين مواسم الولادة (اكتوبر ، نوفمبر ، يونيه) على جميع الصفات المدروسة فى الاوسيمى ماعدا الوزن الكلى للحملان المفطومة اما فى النعاج الرحمانى لم يكن للإختلافات بين المواسم تأثير معنوى على أى من الصفات المدروسة ٠
- التأثير الغير معنوى لنوع الميلاد لكل من الاوسيمى والرحمانى على كل الصفات المدروسة ٠
- كان تأثير وزن الفطام للنعجة على كل الصفات المدروسة فى كلتا السلالتين غير معنوى٠

- كان تأثير وزن النعجة (عمر سنة) معنويا على كل الصفات المدروسة فـى الاوسيمى ماعدا صفة الوزن الكلى لجزات الصوف وكان غير معنـوى علـى كل الصفات المدروسة فى الرحمانى٠

كانت تقديرات المكافىء الوراثى لجميع الصفات المدروسة فى الاوسـيمى ٠,٠١٣، ٠,٠٣١، ٠,٠٠٤، ٠,٢٣٤ وكـــانت ٠,١٣١، ٠,١٥٤، ٠,١٢١، ٠,١٤٢ وتقدير سالب لمجموع وزنات الجزة فى الرحمانى٠

الارتباط الوراثى بين كـل الصفـات المدروسـة تـتراوح مـن – ٠,٧٦٥ الـى ٠,١٣ والارتباط المظهرى تـرواح مـن ٠,٠١١ إلـى ٠,٩٧ فـى الأوسـيمى بينمـا الإرتبـاط الوراثـى تـراوح مـن ٠,٠٦٠– ٠,١١ والإرتبــاط المظهـرى تراوح من ٠,٠٢٩ الى ٠,٠٩٦ فى الرحمانى٠