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BREED GENETIC COMPONENTS OF EWE REPRODUCTIVE PERFORMANCE AND LAMB SURVIVAL RATES FOR EGYPTIAN RAHMANI AND OSSIMI BREEDS AND THEIR CROSSES WITH FINNSHEEP

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SUMMARY

The average effects of breed genetic components (individual direct effects; g^I, maternal direct effect; g^M, individual heterosis; h^I, maternal heterosis; h^M and individual recombination loss; r^I) were estimated for five reproductive parameters: conception rate (CR), number of lambs born per ewe lambed (NLB), kg born per ewe lambed (KGB), number of lambs weaned per ewe lambed (NLW), kg weaned per ewe lambed (KGW) and lamb survival rates from birth to: seven days and two and six mo of age.
Data collected over 21 years represent a total of 1633 ewes and 6292 lambs of Rahmani (R) breed and its Finnsheep (F) crossbreds and 889 ewes and 3116 lambs of Ossimi (O) breed and its F crossbreds.

Individual heterosis in R-crossbreds and O-crossbreds ranged from 3-15% for lamb survival rates, -8-3% for CR, 0.03-0.07 lambs for NLB, -0.07-0.19 kg for KGB, 0.06-0.24 lambs for NLW and 0.71-0.88 kg for KGW. The estimates of g^I_{R-F} and g^I_{O-F} were generally positive for lamb survival rates, indicating that local lambs were superior to the F-crossbred lambs, and were negative for CR, NLB, KGB and NLW. Conversely, the estimates of g^M_{R-F} for CR, NLB, NLW and KGW were positive. Although, g^I significantly affected most of lamb survival rates, g^M, h^I, h^M and r^I had no significant effect on most of the traits studied.

Keywords: Sheep, crossbreeding, Finnsheep-crosses, lamb survival, reproductive, heterosis and recombination, Ossimi, Rahmani

INTRODUCTION

An experiment was initiated by the Egyptian Ministry of Agriculture and

Land Reclamation in 1974 to investigate the effective use of native sheep breeds (Rahmani and Ossimi) and Finnsheep in crossbreeding systems for genetic improvement .Finnsheep were chosen primarily because of their higher prolificacy (Donald *et al.*,1968).Results obtained indicated that Finn cross exceeded native sheep significantly in conception rate, number of lambs born per ewe lambed and Kg born per ewe lambed (Elshennawy *et al.*,1998). On the other hand, lamb survival rates were lower for Finn-crosses than those for native breeds. As the performance of the breed crosses may be greatly affected by their genetic components of the component breeds, the objective of this study was to estimate breed genetic components effects on ewe reproductive traits and lamb survival rates.

MATERIALS and METHODS

Data used in this study were collected from the sheep flocks raised at two experimental stations located in the Nile delta (Sakha and Mahallet Mousa) of the Ministry of Agriculture and Land Reclamation (MOA) during the years from 1974 to 1995.

The breeding plan was to cross Finn (F) rams with both Rahmani (R) and Ossimi (O) ewes to produce the halfbreds F.R and F.O, which were used to produce both reciprocal back crosses (R.FR and FR.R) and (O.FO and FO.O). The breed groups R.FR and O.FO were then inter se mated for 1, 2, or 3 generations (designated by superscript 1, 2 and 3 for the three generations, respectively).

A total of 1633 ewes and 6292 lambs of Rahmani breed and its F crossbreds and 889 ewes and 3116 lambs of Ossimi breed and its F cross-breds were utilized in this study.

An accelerated lambing system, with mating every 8 mo, was practiced. The mating seasons were January, May, and September. Lambing took place in June, October and February. Lambs were weaned at 8 weeks of age.

Details concerning other management procedures have been described in detail by Elshennawy *et al.* (1998).

Estimation of breed genetic components. Three multiple regression models were used to estimate the partial regressions associated with five covariate terms reflecting five estimable genetic components following the techniques developed by Dickerson (1969) as shown in Table 1. These covariate terms were: (1) The deviation of the additive effect of the individual genes of L from F (g^{I}_{L-F}), (2) The deviation of the additive effect of the maternal individual genes of L from F (g^{M}_{L-F}), (3) The effect of the individual heterosis for L and F (h^{I}_{LF}), (4) The effect of the maternal heterosis for L and F (h^{M}_{LF}) and (5) The effect of the individual recombination for L and F (r^{I}_{LF}).

Table 1. Covariate terms for estimating breed genetic components under different mating types

Mating type [a]	g^I_{L-F}	g^M_{L-F}	h^I_{LF}	h^M_{LF}	r^I_{LF}
L.L	1	1	0	0	0
F.L	0	1	1	0	0
L.FL	1/2	0	1/2	1	1/4
FL.L	1/2	1	1/2	0	1/4
(L.FL)[1]	1/2	1/2	3/8	1/2	1/4
(L.FL)[2]	1/2	1/2	3/8	3/8	1/4
(L.FL)[3]	1/2	1/2	3/8	3/8	1/4

The letter(s) before the dot represent(s) breed of sire, and the letter(s) after the dot represent(s) breed of dam, L= Local breeds (Rahmani or Ossimi), and F= Finnsheep.
g^I = Average direct effects of the individual, g^M = Average direct maternal genetic effect, h^I = Individual heterosis, h^M = maternal heterosis and r^I = recombination loss in the individual.

To obtain the genetic parameters related to the five covariate terms for conception rate (CR), number of lambs born per ewe lambed (NLB), Kg born per ewe lambed (KGB), number of lambs weaned per ewe lambed (NLW) and Kg weaned per ewé lambed (KGW). The following model was utilized :

$$Y_{ijklm} \quad \mu + C_i + D_j + F_k + G_l + DG_{il} + B_1X_{1ijklm} + B_1(X_1G)_{ijklm} + B_2X_{2ijklm} + B_2(X_2G)_{ijklm} + B_3X_{3ijklm} + B_3(X_3G)_{ijklm} + B_4X_{4ijklm} + B_4(X_4G)_{ijklm} + B_5X_{5ijklm} + B_5(X_5G)_{ijklm} + e_{ijklm},$$

Where,

Y_{ijklm} is the reproductive trait measured on m^{th} ewe in the i^{th} parity, at the j^{th} location, of the k^{th} year of mating and of the l^{th} season of mating, b's are the partial linear regressions associated with the covariate terms and X's are the coefficients of the covariate terms reflect g^I_{L-F}, g^M_{L-F}, h^I_{LF}, h^M_{LF} and r^I_{LF}, respectively.

To estimate the genetic parameters related to the covariate terms of g^I_{L-F}, g^M_{L-F}, h^I_{LF}, h^M_{LF} and r^I_{LF} for lamb survival rates from birth to 7 days (SR7D), 2 mo (SR2M) and 6 mo (SR6M) the following model was used :

$$Y_{jklmno} \quad \mu + B_j + C_k + D_l + F_m + G_n + BC_{jk} + BF_{jm} + B_1X_{1jklmno} + B_1(X_1F)_{jklmno} + B_2X_{2jklmno} + B_2(X_2F)_{jklmno} + B_3X_{3jklmno} + B_3(X_3F)_{jklmno} + B_4X_{4jklmno} + B_4(X_4F)_{jklmno} + B_5X_{5jklmno} + B_5(X_5F)_{jklmno} + e_{jklmno},$$

where,

Y_{jklmno} is the o^{th} lamb at the j^{th} location (station), of the k^{th} sex, of the l^{th} year of birth, of the m^{th} season of birth and from the n^{th} age of dam, measured as 1 if live and 0 if dead.

RESULTS AND DISCUSSION

Estimates of the breed genetic component effects on ewe reproductive performance and lamb survival rates, are shown in Tables 2 and 3 (for the Rahmani and Ossimi groups, respectively.

The $g^{I}_{R\text{-}F}$ component had an effect (P<0.01) on NLB and SR6M and (P<0.05) on SR2M while $g^{I}_{O\text{-}F}$ had an effect (P<0.01) on CR, NLB and KGB and (P<0.05) on SR7D and SR6M.

The positive estimates of $g^{I}_{R\text{-}F}$ and $g^{I}_{O\text{-}F}$, indicated that lambs from both local (Rahmani and Ossimi) were superior to Finnsheep lambs in all survival traits while Rahmani ewes were superior to F-ewes in KGW. On the other hand, the negative estimates of $g^{I}_{R\text{-}F}$ and $g^{I}_{O\text{-}F}$ indicated that Finnsheep ewes were superior to the local (Rahmani and Ossimi) ewes in CR, NLB, KGB and NLW. There were no significant effects for the interaction between season of mating and either $g^{I}_{R\text{-}F}$ $g^{I}_{O\text{-}F}$ on any of the reproductive traits studied Indicating that seasonal breeder at home is not any longer in Egypt etc. Only the interaction between $g^{I}_{R\text{-}F}$ and season of birth had an effect (P<.01) on SR7D, SR2M and SR6M.

The direct maternal genetic effects ($g^{M}_{R\text{-}F}$ and $g^{M}_{O\text{-}F}$) and their interactions with season of birth had no significant effect on all lamb survival rates studied, suggesting that g^{M} was not important. Although not significant ,a positive estimates of $g^{M}_{R\text{-}F}$ for CR, NLB, NLW and KGW, indicate that Rahmani dams were superior to Finnsheep dams for these traits. The estimates of $g^{M}_{O\text{-}F}$ showed that ewes born to the local Ossimi ewes were superior to Finnsheep ewes in conception rate (CR) while Finnsheep ewes were superior to the local Ossimi ewes in NLB, KGB, NLW and KGW. The interaction between $g^{M}_{R\text{-}F}$ and the season of mating had an effect (P<.05) on KGB and NLW.

Heterosis for lamb survival rates ranged from 0.03 to 0.15 among Rahmani crossbred lambs and from 0.04 to 0.11 among Ossimi crossbred lambs, with important indication of decline in February and June birth season among Ossimi crossbred lambs. A similar pattern was observed among Rahmani crossbred lambs as lambs became older. The estimates of h^{I}_{RF} and h^{I}_{OF} for SR2M are close to the values reported by Sidwell *et al.* (1962); Galal *et al.* (1972); Vesely and Peters (1972); Holtmann and Brenard (1969); Sidwell and Miller (1971a); Dickerson *et al.* (1975) and Dickerson and Glimp (1975), but smaller than the estimates of 0.098 reported by Nitter (1978). The effect of both h^{I}_{RF} and h^{I}_{OF} and their respective interactions with season of mating was not significant for any of the ewe reproductive traits studied.

Positive estimates of heterosis were found for all reproductive traits studied, except for CR and KGB among F.O ewes. The estimates of maternal heterosis (h^{M}_{RF}) were 0.00, -0.00 and –0.08 in SR7D, SR2M and SR6M, respectively. The corresponding estimates of h^{M}_{RF} were –0.03, -0.06 and –0.15, respectively. Both h^{M}_{OF} and its interaction with season of birth had an

Table 2. Least squares means (LSM), standard errors (SE) and significant status (SS) for the effect of breed genetic components on ewe reproductive traits and lamb survival rates of Rahmani and its Finnsheep crosses

Genetic Component [a]	CR			NLB			SR7D			SR2M			SR6M			KGB			NLW			KGW		
	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS
g^I_{R-F}	-.10	.06	NS	-.32	.08	**	.03	.03	NS	.11	.05	*	.22	.07	**	-.34	.26	NS	-.04	.12	NS	.19	1.63	NS
g^I_{R-F} - Feb.	-.02	.10	NS	-.36	.15	NS	-.05	.06	NS	-.04	.10	NS	.14	.15	NS	-.45	.45	NS	-.33	.21	NS	-3.21	2.84	NS
g^I_{R-F} - June	-.00	.11		-.32	.14		.08	.05		.16	.09		.11	.12		-.65	.44		.26	.20		3.56	2.77	
g^I_{R-F} - Oct.	-.28	.10		-.30	.13		.09	.04		.21	.06		.43	.09		.06	.40		-.07	.18		.24	2.50	
g^M_{R-F}	.08	.07	NS	.02	.10	NS	.04	.02	NS	.05	.04	NS	-.01	.06	NS	-.27	.30	NS	.13	.14	NS	.39	1.87	NS
g^M_{R-F} - Feb.	.30	.12	NS	-.13	.19	NS	.06	.05	NS	.08	.08	NS	.00	.12	NS	-1.14	.53	**	-.01	.25	*	-1.72	3.36	NS
g^M_{R-F} - June	-.00	.14		-.04	.19		.02	.04		-.02	.07		-.02	.10		-.70	.53		-.17	.25		-3.03	3.36	
g^M_{R-F} - Oct.	-.05	.13		.24	.16		.05	.04		.10	.06		-.03	.09		1.03	.45		.59	.21		5.93	2.84	
h^I_{RF}	.03	.06	NS	.03	.07	NS	.03	.02	NS	.07	.04	NS	.15	.06	*	.19	.21	NS	.06	.10	NS	.71	1.37	NS
h^I_{RF} - Feb.	.16	.10	NS	-.04	.14	NS	-.03	.06	NS	-.02	.10	NS	.08	.14	NS	.18	.39	NS	-.28	.18	*	-4.44	2.47	*
h^I_{RF} - June	.01	.10		.01	.13		.08	.04		.16	.07		.08	.10		-.28	.37		.33	.17		3.31	2.34	
h^I_{RF} - Oct.	-.08	.10		.12	.12		.05	.03		.08	.05		.29	.07		.69	.34		.14	.16		3.27	2.15	
h^M_{RF}	.04	.07	NS	-.01	.10	NS	.00	.01	NS	-.00	.03	NS	-.08	.04	NS	-.29	.28	NS	.03	.13	NS	-.89	1.75	NS
h^M_{RF} - Feb.	.20	.11	NS	-.13	.18	NS	.04	.02	NS	.06	.04	NS	-.04	.06	NS	-.99	.50	**	-.11	.24	*	-2.34	3.18	NS
h^M_{RF} - June	-.10	.13		-.07	.18		-.02	.03		-.08	.05		-.08	.08		-.77	.50		-.31	.23		-4.33	3.17	
h^M_{RF} - Oct.	.04	.12		.18	.15		-.01	.03		.00	.05		-.12	.08		.88	.42		.52	.20		3.97	2.64	
r^I_{RF}	.25	.09	NS	-.16	.11	NS	.00	.07	NS	-.00	.11	NS	.01	.16	NS	.94	.34	**	-.23	.16	NS	-1.06	2.16	NS
r^I_{RF} - Feb.	.42	.16	**	-.36	.19	NS	-.09	.18	NS	-.18	.29	NS	.05	.41	NS	-.07	.60	NS	-.68	.28	NS	-8.74	3.75	*
r^I_{RF} - June	.61	.16		-.09	.19		.03	.11		.16	.17		.01	.25		.94	.57		.04	.27		-1.06	3.59	
r^I_{RF} - Oct.	-.27	.17		-.04	.20		.06	.06		.01	.09		-.01	.14		1.95	.62		-.07	.29		6.62	3.90	

[a] See footnote below Table (1).

NS=Non significant, * = Probability of type I error <.05, ** = Probability of type I error <.01, CR= conception rate, NLB = number of lambs born per ewe lambed, SR7D= lamb survival rate from birth to 7 days, SR2M = lamb survival rate from birth to 2 mo, SR6M = lamb survival rate from birth to 6 mo, KGB = kilograms born per ewe lambed, LW = number of lambs weaned per ewe lambed and KGW = kilograms weaned per ewe lambed

Table 3. Least squares means (LSM), standard errors (SE) and significant status (SS) for the effect of breed genetic components on ewe reproductive traits and lamb survival rates of Ossimi and its Finnsheep crosses.

Genetic [a] Component	CR			NLB			SR7D			SR2M			SR6M			KGB			NLW			KGW		
	M	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS	LSM	SE	SS
g^I_{O-F}	-.25	.08	**	-.35	.11	**	.11	.03	**	.05	.06	NS	.19	.09	*	-.94	.36	*	-.07	.15	NS	-2.04	2.04	NS
g^I_{O-F} - Jan.	-.30	.13	NS	-.33	.18	NS	.03	.05	**	.01	.09	**	.03	.13	**	-.18	.57	NS	.16	.25	NS	2.92	3.22	NS
g^I_{O-F} - May	-.19	.15		-.55	.22		.02	.06		-.16	.10		.00	.15		-2.19	.69		-.54	.30		-8.32	3.91	
g^I_{O-F} - Sep.	-.24	.12		-.16	.15		.28	.06		.33	.10		.54	.15		-.45	.51		.14	.22		-.74	2.88	
g^M_{O-F}	.18	.10	NS	-.01	.13	NS	.01	.03	NS	-.00	.05	NS	-.07	.08	NS	-.60	.37	NS	-.08	.16	NS	-.26	2.10	NS
g^M_{O-F} - Jan.	.06	.17	NS	-.18	.23	NS	.03	.04	NS	.08	.08	NS	.08	.11	NS	-.98	.63	NS	-.39	.27	NS	-5.53	3.56	NS
g^M_{O-F} - May	.23	.18		.14	.26		.05	.06		-.03	.10		-.12	.14		-.29	.73		.15	.32		4.84	4.11	
g^M_{O-F} - Sep.	.24	.15		.00	.19		-.04	.06		-.06	.10		-.17	.15		-.53	.52		-.02	.23		-.11	2.96	
$h^I_{O F}$	-.08	.07	NS	.07	.10	NS	.08	.03	**	.04	.05	NS	.11	.07	NS	-.07	.29	NS	.24	.12	NS	.88	1.65	NS
$h^I_{O F}$ - Jan.	-.00	.12	NS	.04	.17	NS	.00	.04	*	.03	.07	NS	-.01	.11	NS	.22	.47	NS	.45	.20	NS	5.32	2.65	NS
$h^I_{O F}$ - May	-.11	.14		-.13	.21		.06	.04		-.05	.07		.03	.11		-.91	.60		-.15	.26		-4.45	3.37	
$h^I_{O F}$ - Sep.	-.11	.12		.30	.13		.17	.05		.15	.08		.31	.13		.47	.38		.43	.16		1.79	2.17	
$h^M_{O F}$	.12	.09	NS	.02	.13	NS	-.03	.02	NS	-.06	.04	NS	-.15	.07	*	-.36	.35	NS	-.05	.15	NS	.79	1.99	NS
$h^M_{O F}$ - Jan.	-.03	.16	NS	-.14	.22	NS	.02	.03	NS	.03	.05	NS	.06	.08	*	-.70	.60	NS	-.41	.26	NS	-5.21	3.39	NS
$h^M_{O F}$ - May	.15	.17		.22	.25		-.01	.05		-.05	.08		-.20	.12		.09	.70		.31	.30		7.03	3.94	
$h^M_{O F}$ - Sep.	.25	.14		-.01	.18		-.12	.06		-.17	.10		-.30	.14		-.49	.49		-.07	.21		.55	2.80	
$r^I_{O F}$	.44	.11	**	.01	.13	NS	-.00	.05	NS	.05	.09	NS	.14	.13	NS	.29	.45	NS	-.06	.20	NS	-1.42	2.58	NS
$r^I_{O F}$ - Jan.	.44	.19	NS	-.10	.23	NS	-.19	.12	NS	.03	.21	NS	-.07	.29	NS	-.84	.81	NS	-.12	.35	NS	-.65	4.60	NS
$r^I_{O F}$ - May	.40	.20		-.04	.26		.15	.10		.09	.17		.32	.24		.82	.84		-.03	.36		-1.14	4.73	
$r^I_{O F}$ - Sep.	.48	.18		.18	.21		.04	.07		.05	.12		.19	.17		.90	.76		-.03	.33		-2.47	4.29	

Symbols as those outlined in footnote of Table (2).

effect (P<.05) on SR6M. These negative estimates of maternal heterosis might indicate that Finnsheep ewes provided poorer maternal conditions to their progeny than that of the local ewes.

Estimates of h^M tended to decline from birth to 6 mo, which was expectbecause maternal genetic effects associated with litters would decrease in importance as lambs became older.

Positive estimates of h^M_{RF} were detected for CR and NLW, while positive estimates of h^M_{OF} were detected for CR, NLB and KGW. Neither h^I_{RF} nor h^I_{OF} significantly affected any of the studied traits, but the h^I_{RF}-season interaction had an effect (P<.01) on KGB and an effect (P<.05) on NLW.

Mansour and Aboul-Naga (1988) working on the same flocks used in the present study, reported similar estimates for h^I_{RF} and h^M_{RF}. They reported positive estimates of h^I_{RF} for CR, NLB and KGB, while negative estimates of h^M_{RF} were reported for the same traits. They also reported negative estimates for h^I_{OF} and positive estimates for h^M_{RF} for CR, NLB and KGB.

The estimates of individual recombination loss (r^I_{RF}) were 0.00, -0.00 and 0.01 for SR7D, SR2M,and SR6M, respectively. The corresponding estimates of r^I_{OF} were –0.00, 0.05 and 0.14, respectively. Both r^I_{RF} and r^I_{OF} and their interaction with season of birth did not have any significant effect on any of the studied survival traits.

The effect of r^I_{RF} was significant on CR, KGB and KGW, while the effect of r^I_{OF} was significant on CR. The interaction between r^I_{RF} and season of mating significantly affected CR and KGW.

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المكونات الوراثية للسلالة لصفات الأداء التناسلي للنعجة ونسب الحياتية للحملان لسلالتي الرحمانى والاوسيمى المصرية وخلطانهما مع أغنام الفنلندي

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إشتملت البيانات على ٧ مجاميع وراثية لكل من أغنام الرحماني والاوسيمي وخلطانهما المختلفة مع الفنلندي المرباة تحت نظام الثلاث و لدات كل سنتان. ولقد جمعت السجلات المتاحة على مدي ٢١ عام لعدد ١٦٣٣ نعجة و٦٢٩٢ حمل ولعدد ٨٨٩ نعجة و٣١١٦ حمل، على التوالي.

تراوحت قوة الهجين الفردية نتيجة الخلط بين الفنلندي وكل من الرحمانى والاوسيمى من ٣ إلى ١٥٪ للنسب الحياتية للحملان، من –٨ إلى ٣٪ لنسبة النعاج الوالدة للنعاج التي لقحت، من ٠,٠٣ إلى ٠,٠٧ حمل لعدد الحملان المولودة لكل نعجة ولدت ، من –٠,٠٧ إلى ٠,١٩ كجم لعدد الكيلو جرامات المولودة لكل نعجة ولدت ، من ٠,٠٦ إلى ٠,٢٤ حمل لعدد الحملان المفطومة لكل نعجة ولدت ومن ٠,٧١ إلى ٠,٨٨ كجم لعدد الكيلوجرامات المفطومة لكل نعجة ولدت وعموما كانت تقديرات التأثير الوراثي التجمعى لسلالة الفرد موجبة للنسب الحياتية للحملان مما يشير لتفوق الحملان المحلية على الحملان الخليطة ، بينما كانت سالبة لصفات الأداء التناسلي للنعجة . وعلى العكس من ذلك كانت تقديرات التأثير الوراثي التجمعى لسلالة الأم موجبة لمعظم صفات الأداء التناسلي للنعجة وعلى الرغم أنة كان التأثير الوراثي التجمعى لسلالة الفرد معنوى على أغلب النسب الحياتية للحملان لم تظهر المكونات الوراثية الأخرى أي تأثير معنوي على معظم الصفات التي دُرست.