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ESTIMATION OF GENETIC PARAMETERS OF CONCEPTION RATE, LAMBS BORN AND LAMBS WEANED OF RAHMANI EWES IN EGYPT USING GIBBS SAMPLING

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ABSTRACT

The objective of this study was to estimate the genetic parameters of three important categorical traits in sheep using GIBBS SAMPLING (GS) program. These traits were conception rate (CR), number of lambs born (NLB) and number of lambs weaned (NLW) of Rahmani ewes in Egypt. Data consisted of 1437 Rahmani ewes raised at two farms, Mehallet–Mousa (mid delta) and El-Serw (North Delta), belong to the Animal Production Research Institute (APRI) Ministry of Agriculture. The model included the effects of location, year of lambing, season and parity as fixed effects and the effects of the additive genetic and permanent environmental variances as random effects. The heritability estimates for CR, LB and LW were 0.01, 0.02 and 0.02 as a result of GS program, respectively. Genetic correlations were 0.93, 0.76 and 0.79 between CR and NLB , CR and NLW and between NLB and NLW, respectively.

Keywords: Rahmani, GIBBS SAMPLING, polychotomous traits, conception rate, number of lambs born, number of lambs weaned.

INTRODUCTION

In animal breeding, the major objectives of data analysis are estimation of the genetic merits of animals and genetic parameters (Luo et , (2001). Most applications of quantitative genetics theory to animal breeding concerns with the characters showing a continuous phenotypic distribution. In some prediction problems, the response is categorical rather than quantitative.

Many traits of importance in animal production such as lambs born , lambs weaned and conception rate in sheep present as discrete distribution of phenotypes. This sort of characters known as threshold, can be analysed by postulating an underlying continous distribution of phenotypes which maps into the observed distribution via a set of fixed threshold.

Analysis of categorical data is a very fertile research area and it has a very rich literature. The model for the analysis of ordered categorical data is called threshold model. Accurate estimates of variance components are important for genetic improvement. Recently developed procedures such as the Gibbs Sampler (GS) avoid the need for numerical integration by taking repeated samples from the posterior distributions with generalized Markov Chain Monte Carlo (MCMC) methods (wang, 1998).

The purpose of this study was to estimate genetic parameters (heritability, genetic and phenotypic correlation) using GS in the case of binary trait (CR) and polychotomous traits (NLB and NLW) for Rahmani ewes.

MATERIALS AND METHODS

Data used in the present study were collected from two experimental stations belonging to Ministry of Agriculture during the period of 1970 up to1993. Rahmani flock used in this study were raised on two stations, Mehallet- Mousa (Mid Delta) and El-Serw (North Delta). The total available number of Rahmani ewes for this study was 1437. The numbers of ewes, sires and dams were 371, 62 and 255 from Mehallet Mousa while, were 1066, 128 and 677 from El-Serw, respectively.

Intensive production system of three mating (May, January and September) in two years was followed in the experimental farms. Lambs were weaned at eight weeks of age. At mating, ewes were randomly divided into groups of 30-35 ewes and tethered with a fertile ram. Ewes of each group were kept for 35-45 days. Lambs were kept with their dams all the time up to weaning at the age of eight weeks. From June to November, ewes were fed on crop stubbles and green fodder if available besides a concentrate mixure (24% corn, 38% cotton-seed meal, 37% wheat barn and 1% salt), clover hay and rice straw.

Before the beginning of the mating season the ewes were fed about ¼ kg /ewe/ d supplementary concentrate for two weeks and also during the last 2-4 weeks of pregnancy and first week of lactation if available.

Reproductive studied traits were conception rate (CR), number of lambs born per ewe joined (NLB) and number of lambs weaned (NLW).

Model

The Gibbs Sampling (GS) program was used to estimate the variance -covariance components of the previous mentioned categorical traits. The Gibbs Sampling (GS) program which referred to Monte Carlo Marcov Chain methods is based on Bayesian methods for estimation of variance covariance components. The following threshold multiple-trait model was used to obtain variance and covariance components for the studied traits using gibbs sampling:

$$Y_{ijklmn} = \mu + L_i + R_j + S_k + P_l + a_m + per_m + e_{ijklmn}$$

μ The overall mean;

Y_{ijklmn} is the record of the studied trait (CR, NLB or NLW) belongs to the m^{th} ewe in the i^{th} location of the j^{th} year of the k^{th} season of the l^{th} parity;

L_i is the fixed effect of the i^{th} location (2 levels);

R_j is the fixed effect of the jth year (23 levels);

S_k is the fixed effect of the k^{th} season (3 levels);

P_l is the fixed effect of the l^{th} parity (12 levels);

a_m is the random effect of the additive genetic effect of the m^{th} ewe;

per_m is the random permanent environmental effect on the m^{th} ewe;

e_{ijklmn} is the random residual effects associated with each observation.

The first binary trait (CR) was classified into two categories (0 or 1), the second (NLB)and the third (NLW) were order categorical traits classified into 4 levels (0,1,2 or 3) for each of them.

Analysis of variance was obtained using SAS (1996). The model contained all fixed effects in the previous model to obtain the significancy of each effect.

RESULTS AND DISCUSSION

Anova (table 1) indicated that all main effects and all the interactions between each two of them were highly significant (P<0.01) except the interaction between L*S (P>0.05). Table 1, also contained the overall mean and SD for each trait.

Table 1. Analysis of Variance of conception rate (CR), lambs born (NLB) and lambs weaned (NLW).

		Mean Square		
S.O.V	**D.F.**	**CR**	**NLB**	**NLW**
L	1	4.97^{**}	10.744^{**}	11.512^{**}
Y	22	0.517^{**}	1.391^{**}	1.329^{**}
S	2	0.794^{**}	4.660^{**}	4.840^{**}
P	11	0.223^{ns}	2.084^{**}	1.503^{**}
L*Y	19	0.486^{**}	0.984^{**}	1.084^{**}
L*S	1	0.027^{ns}	0.069^{ns}	0.234^{ns}
L*P	11	0.334^{*}	1.311^{**}	0.896^{**}
Y*S	11	1.064^{**}	2.095^{**}	2.211^{**}
Y*P	174	0.272^{**}	0.599^{**}	0.595^{**}
S*P	18	0.323^{**}	1.158^{**}	0.960^{**}
TOTAL	7058	-	-	-
ERROR	6781	0.169	0.396	0.386
R2		0.132	0.146	0.142
C.V.		23.523	67.825	78.750
OVERALL MEAN	**1.749**	**00.928**	**00.789**	
SD	**0.433**	**00.667**	**00.658**	

* pr<= 0.05
** pr<=0.01
ns not significant(pr>0.05)

The heritability estimates for each of the three traits are shown in table 2 , also the estimates of genetic (above) and phenotypic (below diagonal) correlations are shown in the same table.

Most heritability estimates of reproductive traits in sheep ranged from 0 to 0.2 (Turner 1969). The results of the present study indicated that the heritability estimates were 0.014 ± 0.002, 0.022 ± 0.010 and 0.025 ± 0.001 for the three studied traits, respectively.

Table 2. Heritability estimates (on), genetic (above) and phenotypic (below) diagonal of conception rate (CR), lambs born (NLB) and lambs weaned (NLW), respectively and the respective standard errors.

	CR	NLB	NLW
CR	0.014+0.002	0.939+0.120	0.761+0.140
NLB	0.994+0.130	0.022+0.010	0.799+0.110
NLW	0.927+0.110	0.916+0.100	0.025+0.001

The observed estimates were low and were in common with that observed by most workers (Olesent *et al* 1995) while were lower than those estimates of (Mousa 1999). However, these traits will respond very slowly to selection. Results from Olesent *et al.* (1995) showed that the heritability estimates of number of lambs born at 1,2 and 3 years were 0.12, 0.08 and 0.06 , respectively. Olesent *et al.* (1995) also discussed that number of lambs born is a typical categorical trait, which deviate from the normal distribution assumed by the linear model. Estimates of the genetic and phenotypic correlations between the three traits are also given in table 2. The genetic correlations obtained generally tended to be high and all of them were positive. The phenotypic correlations are all positive and tend to be greater than the corresponding genetic ones, may be due to the high effect of the environmental factors on the studied traits. The results of Aboul-Naga et. al. (1985), were close to that in present study, where the overall h^2's of conception rate , NLB and NLW per ewe joined and for NLB and NLW per ewe lambing were 0.11 ± 0.05, 0.01 ± 0.04, 0.07 ± 0.04 , 0.05 ± 0.05 and 0.11 ± 0.05. Genetic correlations between CR and NLB and NLW per ewe joined ranging from 0.56 to 0.91 for Ossimi and from 0.67 to 0.86 for Rahmani. In another study of Galal *et al.* (1988), the h^2's averaged 0.06 ± 0.06 for NLB per ewe mated, 0.05 ± 0.05 for NLW per ewe mated. From the results of the same study, authors reported that genetic correlation between traits were generally high and positive as in the present study. Also Brash et. al., (1994) reported that estimates of h^2 were 0.06 ± 0.02 for NLB, 0.04 ± 0.01 for NLW (per ewe joined) and 0.02 ± 0.01 for fertility. Snyman *et al.* (1998) showed the variance-covariance components and genetic correlations using derivative free restricted maximum liklihood procedure, so high significant genetic (0.828-0.998) and phenotypic (0.791-0.920) correlations were obtained among the reproduction traits (NLB and NLW).

Olesen *et al.* (1995) compared linear model , threshold model and poisson model for genetic evaluation of litter size in sheep. The models were found to perform similarly, indicating that little is gained by using the more computer-demanding non-linear models, that don't require normal distribution of the data.

Luo *et al.* (2001) reported that the gibbs sampling has opened broad prospects for the application of bayesian analysis in animal breeding . However for categorical traits, because of the extreme category problem in which all observations for some subclasses are in the same category, threshold animal model using gibbs sampling may yield biased estimates, poor or slow mixing of the gibbs chain (Luo *et al.*, (2001)).

In conclusion, From Turner (1969) study to Luo *et al.* (2001) study, the categorical studied traits yielded poor estimates of genetic parameters as indicated in the present study. The development of the estimation procedures didn't yield an improvement in the estimates of these traits. So, these traits will respond very slowly to selection (O'Ferrall, 1976).

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تقدير المعالم الوراثية لصفات الخصوبة و عدد الحملان المولودة وعدد الحملان المفطومة للنعاج الرحماني في مصر باستخدام برنامج الجيبس

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قدرت المعالم الوراثية علي ١٤٣٧ نعجة رحماني لمحطتي محلة موسي و السرو التابعتين لمعهد بحوث الإنتاج الحيوانى التابع لوزارة الزراعة . و قد اشتمل النموذج الاحصائي علي تأثير المحطة (محطتين) والسنة (٢٣ سنة) والفصل (٣ فصول) وترتيب الموسم (١٢) كتأثيرات ثابتة . وقد اشتمل النموذج أيضا علي التأثير الوراثي التجمعي و البيئي الدائم كتأثيرات عشوائية.
حللت السجلات لتقدير المعالم الوراثية (المكافئ الوراثي و الارتباطات الوراثية و المظهرية) لثلاثة صفات سلمية هي الخصوبة (CR) وعدد الحملان المولودة (NLB) وعدد الحملان المفطومة (NLW) لكل نعجة دخلت التلقيح (per ewe joined) .

و قد استخدم في التحليل برنامج الجيبس (Gibbs Sampling) وهو برنامج خاص بتحليل الصفات السلمية. أشارت النتائج المتحصل عليها أن تقديرات المكافئ الوراثي لصفات الخصوبة و عدد الحملان المولودة و عدد الحملان المفطومة كانت ٠،١٤ ، ٠،٠٢٢ ، ٠،٠٢٥ علي الترتيب . و قد أوضحت النتائج أيضا أن الارتباطات الوراثية بين صفتي الخصوبة و عدد الحملان المولودة ثم بين الخصوبة و عدد الحملان المفطومة ثم بين عدد الحملان المولودة و عدد الحملان المفطومة كانت كما يلي: ٠،٩٣٩ ، ٠،٧٦١ ، ٠،٧٩٩ علي الترتيب . أما الارتباطات المظهرية بين نفس الصفات المذكورة بنفس الترتيب فكانت ٠،٩٩٤ ، ٠،٩٢٧ ، ٠،٩١٦ .

ونستخلص من هذه النتائج أن الصفات المدروسة لا زالت تعطي مكافئات وراثية منخفضة رغم تقدم وسائل التقدير مما يؤكد بأن الانتخاب لهذه الصفات غير ذي نفع .