Effect of non-genetic factors and genetic parameter estimation of reproductive traits in Malpura sheep

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ABSTRACT

Malpura sheep is a heavy and well adapted breed of the semi-arid region of India. A total of 609 Malpura sheep, over a period of 10 years (1994 to 2003) at ICAR-CSWRI Avikanagar were studied. The least squares mean value of AFS, AFSS, WFS, WFSS and AFL for the Malpura ewes was obtained as 598.14 ± 8.43 days, 664.81 ± 13.42 days , 26.18 ± 0.19 kg, 27.08 ± 0.21 kg and 816.54 ± 13.45 days, respectively. Highly significant effect of year was observed on all these reproduction traits, whereas, lambing season of ewes was not significantly affecting all these traits. The heritability of reproductive traits viz., AFS, AFSS, AFL, WFS, WFSS and WFL were estimated as 0.15 ± 0.09, 0.19 ± 0.10, 0.18 ± 0.09, 0.34 ± 0.10, 0.20 ± 0.10and 0.16 ± 0.10 respectively. The heritability estimates were significant and with moderate values, which will be helpful in selective breeding of the animals for these traits.

Keywords: Malpura sheep, heritability, reproductive traits
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Manuscript received: 10.7.2017; accepted: 28.7.2017

Abbreviation: AFS: Age at first service, AFSS: Age at first successful service,
WFS: weight at first service, WFSS: weight at first successful service,
AFL: Age at first lambing and WFL: weight at first lambing

INTRODUCTION

Sheep has played a noteworthy role in shaping and maintaining the socio-economic and cultural status of the rural folk. Rural human population constitutes 72.22 % out of which majority are dependent directly or indirectly on the agriculture and livestock related occupation. Malpura sheep is one of the well adapted and heavy breed of sheep in semi-arid (Tonk District) of Rajasthan,India. The information on reproductive traits in Malpura sheep is scanty and information with regards to components of these traits and their statistical and genetic analysis are also less. Therefore, there is a need to generate more information on these traits.

MATERIALS AND METHODS

Data and management of sheep

Data for the present study were collected from the livestock data registers such as inventory, reproduction registers maintained at the AG&B Division, CSWRI, Avikanagar (Rajasthan). A total of 609 Malpura sheep spread over a period of 10 years from 1994 to 2003 comprised the material for this study. The information on these animals were used to study reproductive trait

Statistical analysis of data

The data of reproductive traits, were analysed by taking year of birth, lambing season, WFS as fixed effect. Only two seasons (Jan-Jun and Jul-Dec) were taken because more in these seasons. Frequency distribution across year and across Weight at First Service group was tested using chi squares statistics. Least square means were estimated by SPSS14. The genetic parameters were analysed by using which Animal model using WOMBAT (Mayer, 2006).

A single-trait linear mixed animal models (in matrix notation) was fitted for NID traits as follows:

$y = X\beta + Z_a a + Z_m m + \varepsilon$; with $Cov(a_m, m_o) = A\sigma_{am}$

Where, y is the vector of records; β, a, m and ε are vectors of fixed, direct additive genetic, maternal genetic and residual effects, respectively; with association matrices X and Z_a and Z_m. Assumptions in the model were $V(a) = A\sigma^2_a$, $V(m) = A\sigma^2_m$; and $V(e) = I\sigma^2_e$; where I is an identity matrix, A is the numerator relationship matrix between animals and σ^2_a, σ^2_m and σ^2_e are additive direct, maternal direct and residual variances, respectively. Direct heritability was estimated using single trait analysis.

RESULTS AND DISCUSSION

Results reveal the performance of the lambs born to 609 ewes over the period of 10 years (1996 to 2003). In total 2341 lambs were born to 609 ewes, out of which 1165 were female lambs born (sex ratio 50.23%).

Age at first service (AFS) and Age at first successful service (AFSS) in Malpura ewes

The least squares mean value of AFS for the Malpura ewes was obtained as 598.14 ± 8.43 days (Table 1). The statistical analysis showed the effect of year was significant which supports the findings of Kumar et al., 2001 in Chokla and Avivastra sheep, Dass et al., 2000 in Muzaffarnagri sheep and Qureshi et al., 2010 but contradict with Dey and Poonia, 2005Dey and Poonia, 2005 reported that year had non-significant effect on AFS (662.20±52.98 to 888.73±88.73days) in Nali sheep. The analysis revealed (Table 1-2) that the effect of season on AFS is non-significant. This supports the study of Dass et al., 2000 in Muzaffarnagri sheep but contradict with findings of Kumar et al., 2001 in Chokla and Avivastra sheep, Qureshi et al., 2010 and Dey and Poonia, 2005 in Nali sheep, where effect of season was significant They showed that the effect of season on AFS was significant. The effect of weight at first service groups on AFS is significant. Highest number of observations were recorded in WFS group ≥29 kg and lowest in ≤23 kg. The least squares mean value of AFSS for the Malpura ewes was 664.8±13.42 (Table 1).

Weight at first service (WFS) and weight at first

Table 1. LSM±SE for Age at First Service (AFS), Age at First Successful Service (AFSS), Weight at First Service (WFS), Weight at First Successful Service (WFSS) and Age at First Lambing (AFL) traits in Malpura ewes

Effect	AFS (Days)	AFSS (Days)	WFS (Kg)	WFSS (Kg)	AFL (Days)
Overall	598.14 ± 8.43 (609)	664.81 ± 13.42 (597)	26.18 ± 0.19 (609)	27.08 ± 0.21 (597)	816.54 ± 13.45 (597)
Year	**	** **	**	**	
1994	^{de}666.58 ± 14.45 (82)	^{ab}680.29 ± 22.76 (81)	^{a}24.38 ± 0.31 (82)	^{a}25.02 ± 0.36 (81)	^{ab}832.12 ± 22.79 (81)
1995	^{a}504.91 ± 15.99 (66)	^{a}617.11 ± 25.68 (61)	^{b}26.29 ± 0.36 (66)	^{bc}27.35 ± 0.41 (61)	^{a}763.32 ± 25.72 (61)
1996	^{cd}609.08 ± 14.39 (70)	^{ab}673.88 ± 22.71 (68)	^{b}26.42 ± 0.32 (70)	^{bc}26.97 ± 0.36 (68)	^{ab}826.26 ± 25.72 (68)
1997	^{e}687.87 ± 29.47 (16)	^{b}732.45 ± 45.94 (16)	^{a}24.19 ± 0.66 (16)	^{a}24.69 ± 0.74 (16)	^{b}885.36 ± 46.02 (16)
1998	^{de}661.79 ± 18.47 (49)	^{b}751.36 ± 28.88 (49)	^{a}24.52 ± 0.41 (49)	^{a}25.73 ± 0.46 (49)	^{b}901.79 ± 28.93 (49)
1999	^{bc}576.57 ± 15.57 (66)	^{a}626.99 ± 24.59 (65)	^{b}26.11 ± 0.34 (66)	^{b}26.88 ± 0.39 (65)	^{a}779.18 ± 26.64 (65)
2000	^{bc}584.28 ± 17.23 (58)	^{a}637.02 ± 27.01 (58)	^{c}27.64 ± 0.39 (58)	^{c}28.42 ± 0.44 (58)	^{a}791.23 ± 27.06 (58)
2001	^{bc}572.17 ± 17.03 (64)	^{a}645.33 ± 26.69 (64)	^{b}25.99 ± 0.37 (64)	^{b}26.99 ± 0.42 (64)	^{a}798.12 ± 26.73 (64)
2002	^{bc}557.68 ± 26.77 (66)	^{a}638.44 ± 26.87 (64)	^{d}30.05 ± 0.36 (66)	^{d}30.94 ± 0.41 (64)	^{a}790.14 ± 26.91 (64)
2003	^{b}560.50 ± 15.41 (72)	^{a}645.26 ± 24.24 (71)	^{b}26.21 ± 0.35 (72)	^{bc}27.81 ± 0.39 (71)	^{a}797.86 ± 24.28 (71)
Wt. at First Service(Kg)	**	**NS**	**-**	**-**	**NS**
≤ 23	565.34 ± 14.23 (97)	666.08 ± 22.45 (96)	-	-	818.34 ± 22.49 (96)
23-26	588.97 ± 10.16 (227)	653.48 ± 16.14 (224)	-	-	805.79 ± 16.17 (224)
26-29	616.05 ± 10.85 (181)	665.91 ± 17.27 (173)	-	-	816.81 ± 17.30 (173)
≥ 29	622.21 ± 14.74 (104)	673.78 ± 23.11 (104)	-	-	825.20 ± 23.15 (104)
Lambing Season	**NS**	**NS**	**NS**	**NS**	**NS**
Jan.-June	599.91 ± 5.67 (543)	655.51 ± 8.86 (535)	26.16 ± 0.12 (543)	27.76 ± 0.14 (535)	806.74 ± 8.87 (535)
July-Dec.	596.37 ± 15.41 (66)	674.12 ± 24.66 (62)	26.19 ± 0.34 (66)	27.40 ± 0.39 (62)	826.34 ± 24.70 (62)

Number in the parentheses are total number of animals for the observations.
NS = Non- Significant, ** (P≤ 0.01) at level of significance.

Table 2. ANOVA for Age at First Service (AFS), Age at First Successful Service (AFSS), Weight at First Service (WFS), Weight at First Successful Service (WFSS) and Age at First Lambing (AFL) traits in Malpura ewes (M.S. Value).

Source of variation	D.F.	AFS	AFSS	WFS	WFSS	AFL
Year	9	149454.97**	81303.09**	174.07**	177.90**	82666.77**
Season	1	644.98	16870.63	0.08	20.38	18699.37
WFS_ Class	3	62277.10**	9783.36	-	-	879.19
Error	595	13108.76	31762.69	6.76	8.47	31868.89

** ($P \leq 0.01$) at level of significance

Table 3. Variance components and genetic parameters for different reproductive traits from univariate analysis in Malpura ewes.

Z	AFS	AFSS	AFL	WFS	WFSS	WFL
σ^2_a	2034.71±1198.74	6168.34±3304.79	6059.64±3293.09	2.17±0.73	1.68±0.89	1.64±1.06
σ^2_e	10212±1145.20	25903±2960.29	26110.90±2980.71	3.84±0.54	6.12±0.74	8.00±0.90
σ^2_p	12937.40±784.39	32073.60±1967.97	32182±1973.12	6.38±0.40	8.24±0.51	10.25±0.62
h^2	0.15±0.09	0.19±0.10	0.18±0.09	0.34±0.10	0.20±0.10	0.16±0.10
e^2	0.78±0.08	0.80±0.09	0.81±0.09	0.60±0.09	0.74±0.09	0.78±0.08
m^2	0.05±0.06	0.00±0.06	0.00±0.06	0.05±0.06	0.05±0.06	0.05±0.06

σ^2_a , σ^2_e and σ^2_p are additive direct, maternal genetic, residual variance and phenotypic variance, respectively; h^2 obtained from WOMBAT (Meyer, 2006)

successful service (WFSS) in Malpura ewes

The least squares mean value of WFS for the Malpura ewes was obtained as 26.18±0.19 kg (Table 1). The statistical analysis showed the effect of year on WFS to be significant which supports the findings of Kumar et al., 2001 in Chokla and Avivastra sheep and Qureshi et al., 2010 but in contradiction with Dey and Poonia, 2005. They reported that year had non-significant effect on WFS (24.92 ±0.22kg) in Nali sheep (Table 2). In present study the effect of season on WFS is non-significant which supports the study of Dass et al., 2000 in Muzaffarnagri sheep but contradict with findings of Kumar et al., 2001 in Chokla and Avivastra sheep and Qureshi et al., 2010 and Dey and Poonia, 2005 in Nali sheep. They showed that effect of season on WFS was significant. The least squares mean value of WFSS for the Malpura ewes was 27.08±0.21kg (Table 1). This showed that the weight of ewes at first successful service was obtained around 27 kg. The statistical analysis showed that the year had significant effect on WFSS but season had non-significant effect.

Age at first lambing (AFL) in Malpura ewes

The least square mean value of AFL for the Malpura ewes was obtained as 816.541±3.45 days (Table 1). Upto 1998 there was increase in AFL and then suddenly dropped and remain almost stagnant. This may be due to proper management in the farm in successive years. The statistical analysis showed the effect of year on AFL to be significant which were similar to findings of Dass et al., 2000 in Muzaffarnagri sheep and Qureshi et al., 2010 but was in contradiction with Dey and Poonia, 2005 study. They reported that year had Non-significant effect on AFS, AFL (925.08±13.02 days) in Nali sheep. The effect of season on AFL was non-significant that contradicts with findings of Qureshi et al., 2010 and Dey and Poonia, 2005 in Nali sheep. They showed that effect of season on AFL is significant. The effect of weight at first service groups on AFL is non-significant. Highest number of observations were recorded in WFS group ≥29 kg and lowest in 23-26 kg WFS group.

Genetic analysis

The analysis of variance and its components for reproductive life are presented in Table 3. The heritability estimates of AFS, AFSS, AFL, WFS, WFSS, WFL were observed to be 0.157±0.091 days, 0.192±0.10 days, 0.188±0.099 days, 0.34±0.107 kg, 0.205±0.105 kg and 0.160±0.102 kg, respectively (Table 3). The h2 for the best model obtained from WOMBAT (Meyer, 2006) was 0.34±0.107 for WFS.

CONCLUSION

The significant to highly significant effect of non-genetic factors (Year, Lambing season and WFS) play important role in reproductive performance of animal so higher emphasis on management practices, nutrition, health cover will help in improving the reproductive performance of animal. The low to moderate heritability observed in most of the traits under study indicated that improvement in management practices can further enhance the better expressibility of these reproduction traits.

ACKNOWLEDGEMENTS

The authors acknowledge with gratitude the financial help received from Indian Council of Agricultural Research and National Dairy Research Institute, Karnal, provided the M.V.Sc. scholarship to first author. They are thankful to the Director, ICAR-Central Sheep and Wool Research Institute, Avikanagar for providing the necessary facilities.

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