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A Study of Reproductive Traits in Magra Sheep

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ABSTRACT

Magra sheep is well accommodated in semi- arid region of India and primarily raised for wool and meat purpose. The data for the present investigation were obtained from the records of organised flock of Magra ewe for the years 1997-2016, located at the Arid Region Campus of the ICAR-Central Sheep and Wool Research Institute, Beechwal, Bikaner. Traits that analysed as age at first service (AFS; 571.43 ± 6.55 days), weight at first service (WFS; 30.07 ± 0.14 Kg), age at first successful service (ASS; 608.66 ± 8.06 days), weight at first successful service (WSS; 30.39 ± 0.18 Kg), age at first lambing (AFL; 761.02 ± 8.53 days), ewe's weight at lambing (WL; 32.18 ± 0.17), conception rate (CR; 0.68 ± 0.02) and days to lambing (DL; 171.94 ± 0.90). For the reproductive traits, the data were adjusted for the effect of non-genetic factors as period of birth and sire of ewe significantly affected all the reproductive traits. Season of birth of ewe was significantly affected to AFS, WFS and WSS. Ewe's weight at birth had a significant influence on AFS, WFS, ASS, WSS and WL. Inbreeding coefficient had a significant influence on WFS. Sires of ewes were included as random genetic effect. AFS, WFS, ASS, WSS and AFL were significantly influenced by their respective covariates. This study indicates that ewe's with better body condition showing superior reproductive performance.

HIGHLIGHTS

- Study focus on the reproductive traits of Magra sheep.
- Non-genetic factor affect the reproductive traits.
- This study indicates that ewe's with better body condition showing superior reproductive performance.

Keywords: Magra, Non-genetic factor, Reproductive trait, sheep

Sheep farming is an important component of rural economy particularly in the arid, semi-arid areas of the country due to its general-purpose use for meat, wool, skin and manure. The sheep is known for its limberness to the harsh environment and use for high meat production (Gowane *et al*., 2010). Magra sheep is distributed in Bikaner, Nagaur, Jaisalmer and Churu districts of Rajasthan. White face with light brown patches around the eyes is characteristic of this breed. Fleece is of medium carpet quality, very white and lustrous and not very dense (CSWRI breed profile 2019). Reproductive traits are the most important traits that affect desirability in sheep breeding and improvement of these traits leads to more potent lamb production (Hanford *et al*., 2003).

The aims of breeding plan are to accelerate the rate of genetic progress for economic traits in livestock species. Reproductive traits are the most important traits in sheep production scheme (Matika *et al*., 2003).

MATERIALS AND METHODS

Data and Management of Sheep

The data for the present investigation were obtained from

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records of organised flock of Magra ewe for the years 1997-2016, located at the Arid Region Campus of the Central Sheep and Wool Research Institute, Bikaner. The geographical location of the station is at an altitude of 234.84 meters above mean sea level on 28° 3' N Latitude and 37° 5' E Longitude. The reproductive traits used for the analysis were: age at first service (AFS), weight at first service (WFS), age at first successful service (ASS), weight at first successful service (WSS), age at first lambing (AFL), ewe weight at lambing (WL), conception rate (CR) and days to lambing (DL). All the sheep were maintained on natural pastures and allowed free range grazing. Additionally, pala leaves (*Zizyphus spp*.) and fodder tree lopping was provided. Ewe's in advanced pregnancy and lactation and rams in breeding season and lean period, 300 g of concentrate mixture was provided. The animals were watered twice, once in morning and again in evening.

STATISTICAL ANALYSIS

Records of 1502 ewes were analysed. For the reproductive traits, the data will be adjusted for the effect of non-genetic factors as period of birth (5 levels), season of birth (2 levels), birth weight (4 levels) and inbreeding class (4 levels) of ewes taken as fixed effects for all the traits. The period of birth was divided into five groups viz. P1 (1997-2000), P2 (2001-2004), P3 (2005-2008) P4 (2009-2012) and P5 (2013-2016). The season of birth of ewe was divided in two groups for the purpose of this study viz. S1 (November – April) and S2 (May- October). The ewe weight at birth was divided into four groups viz. Class 1 (< 2.5 kg), Class 2 (2.6 - 3 kg), Class 3 (3.1 - 3.5 kg) and Class 4 (> 3.5 kg) and inbreeding was divided into four class viz. Class1(0), Class (<1.25%), Class (1.25-5%) and (>5%) whereas WFS, WSS, AFS, ASS and EWL were considered as covariates for AFS, ASS, WFS, WSS and AFL, respectively. Sires of ewes will be included as random genetic effect.

The purity of breed was maintained in the flock and applied proper breeding plans to avoid inbreeding. Mating between close relatives (half sib, full sib) is avoided. Inbreeding in the flock will be calculated by Wright's formula, and will be computed by path coefficient analysis using PEDIGREE VIEWER V6.5b computer package

The Least Squares analysis of variance will be performed to determine which effects have a significant influence on the variables (IBM SPSS 25). The models that will be employed to examine the effect of genetic and non-genetic factors on various reproductive traits are as follow.

For Age at first service

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + b\,(WFS_{ijklm} - WFS) + e_{ijklmn}$$

For Age at first lambing

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + b\,(WL_{ijklm} - WL) + e_{ijklmn}$$

For Age at first successful service

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + b\,(WSS_{ijklm} - WSS) + e_{ijklmn}$$

For Weight at first service

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + b\,(AFS_{ijklm} - AFS) + e_{ijklmn}$$

For Weight at first sucessful service

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + b\,(ASS_{ijklm} - ASS) + e_{ijklmn}$$

For Weight at lambing

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + e_{ijklmn}$$

For Conception rate

(Conception rate measured as 1and 0that is whether a ewe exposed to a ram did or did not lamb)

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + e_{ijklmn}$$

For days to lambing

$$Y_{ijklmn} = \mu + a_i + P_j + S_k + I_l + E_m + e_{ijklmn}$$

Where,

Y_{ijklmn} = Performance record of the n^{th} progeny of i^{th} sire, j^{th} period of birth, k^{th} season of birth, l^{th} inbreeding class and m^{th} birth weight class.

μ = Overall population mean.

a_i =Random effect of i^{th} sire

P_j = Fixed effect of j^{th} period of birth of ewe

S_k = Fixed effect of k^{th} season of birth of ewe

I_l = Fixed effect of the l^{th} inbreeding class of ewe

E_m = Fixed effect of the m^{th} birth weight class of ewe

e_{ijklmn} = Random error associated with each observation, NID (0, σ^2).

$b(WFS_{ijklm} - WFS)$ = Regression of *AFS* on *WFS*

$b(WSS_{ijklm} - WSS)$ = Regression of *ASS* on *WSS*

$b(AFS_{ijklm} - AFS)$ = Regression of *WFS* on *AFS*

$b(ASS_{ijklm} - ASS)$ = Regression of *WSS* on *ASS*

$b(WL_{ijklm} - WL)$ = Regression of *AFL* on *WL*

RESULTS AND DISCUSSION

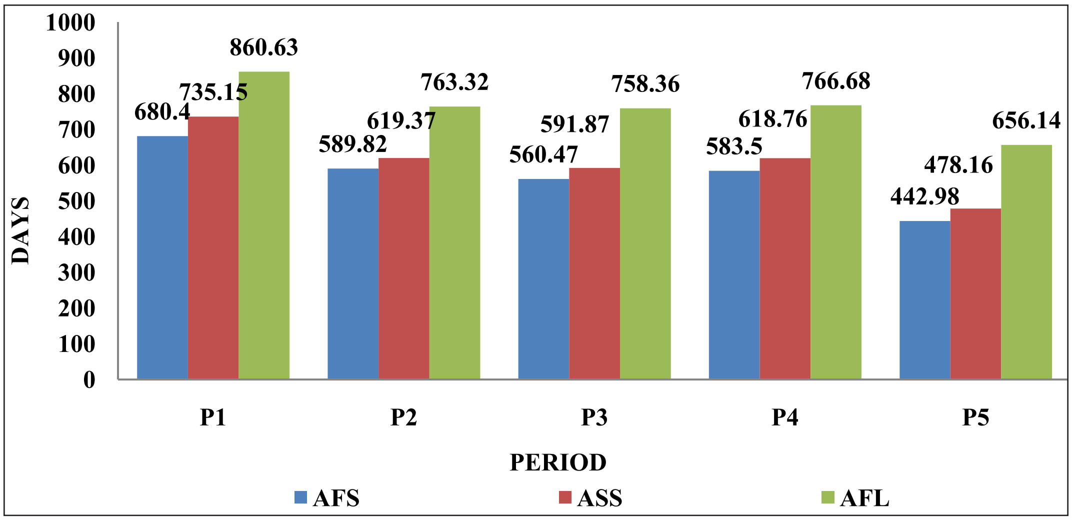
The overall least squares means (LSM) for AFS, ASS and AFL was 571.43 ± 6.55, 608.66 ± 8.05 and 761 ± 8.53 days. The present finding for AFS was closely related with the reports of Mehrotra (2017) as 572.39 ± 6.59 days in Chokla sheep. In contrast of our study higher means of AFS were reported as 632.52 ± 4.47 and 632.76 ± 13.54 days by Gowane *et al.* (2014) and Chander (2011) in Malpura and Magra sheep, respectively and lower means of AFS was reported as 461.7 ± 10.4 days by Mandal *et al*. (2011) in Muzaffarnagari sheep. For ASS higher estimates were reported as 635.71 ± 9.36 and 689.48 ± 5.28 days by Mehrotra (2017) and Gowane *et al.* (2014) in Chokla and Malpura sheep, respectively. For AFL higher estimates of 773 ± 8.77 and 838.55 ± 5.34 days were estimated by Mehrotra (2017) and Gowane *et al*. (2014) in Chokla and Malpura sheep, respectively and lower estimates of AFL as 709.67 ± 8.38 days were estimated by Tailor *et al.* (2006) in Sonadi sheep.

The effect of period of birth was highly significant (P ≤ 0.01) on AFS, ASS and AFL. The highest and lowest least-squares means for AFS, ASS and AFL were 680.40 ± 11.08 and 442.97 ± 9.71, 735.15 ± 13.34 and 478.16 ±

Table 1: Least-squares means ± S.E. for AFS, ASS and AFL (days) in Magra sheep

FACTORS	AFS	ASS	AFL
Overall Mean (µ)	571.43 ± 6.55 (1468)	608.66 ± 8.06 (1362)	761.02 ± 8.53 (1295)
PERIOD	**	**	**
P1 (1997-2000)	680.40 ± 11.09^c (282)	735.15 ± 13.34^d (276)	860.63 ± 13.99^d (256)
P2 (2001-2004)	589.82 ± 11.08^d (243)	619.37 ± 13.51^c (226)	763.32 ± 14.24^c (211)
P3 (2005-2008)	560.47 ± 9.53^b (307)	591.87 ± 11.63^b (287)	758.36 ± 11.81^b (282)
P4 (2009-2012)	583.50 ± 8.05^d (397)	618.76 ± 9.94^c (359)	766.68 ± 10.50^c (343)
P5 (2013-2016)	442.98 ± 9.71^a (239)	478.16 ± 12.00^a (214)	656.14 ± 12.11^a (203)
SEASON	**	NS	NS
S1 (November - April)	581.17 ± 7.22 (929)	611.44 ± 8.85 (864)	765.14 ± 9.26 (838)
S2 (May – October)	561.08 ± 8.04 (539)	605.88 ± 9.86 (498)	756.91 ± 10.37 (457)
INBREEDING COEFFICIENT	NS	NS	NS
Class 1 (0)	584.02 ± 4.88 (1062)	615.74 ± 6.03 (993)	759.90 ± 6.21 (948)
Class 2 (< 1.25%)	563.75 ± 9.74 (211)	606.41 ± 11.95 (192)	758.70 ± 12.33 (180)
Class 3(1.25-5%)	567.41 ± 10.80 (154)	594.25 ± 13.28 (140)	752.25 ± 13.59 (135)
Class 4 (> 5%)	570.54 ± 19.49 (41)	618.24 ± 24.06 (37)	773.24 ± 25.98 (32)
EWE'S BIRTH WEIGHT	*	**	NS
Class 1 (≤ 2.5 KG)	592.52 ± 11.35^d (158)	632.89 ± 13.74^d (150)	769.37 ± 14.35 (142)
Class 2 (2.6-3KG)	577.49 ± 7.67^c (528)	618.49 ± 9.48^c (490)	763.73 ± 10.04 (459)
Class 3 (3.1-3.5KG)	561.01 ± 7.66^b (616)	592.01 ± 9.30^b (581)	747.56 ± 9.72 (559)
Class 4 (>3.5KG)	554.713 ± 11.29^a (166)	591.25 ± 14.14^a (141)	763.43 ± 14.54 (135)
COVARIATE	**WFS** **	**WSS** **	**WL** **
Regression Coefficient	11.34 ± 1.25	14.84 ± 1.427	0.0034 ± 0.0014
SIRE	**	**	**

No. of observations are in parenthesis. Figures with different superscripts differ significantly; ** - Highly significant (P≤0.01); * - Significant (P≤0.05); NS - Non – significant.



Graph 1: Significant effect of period of ewe birth on AFS, ASS and AFL

11.99 and 860.62 ± 13.98 and 656.13 ± 12.11 days in P1 and P5, respectively. Consistent decrease in all these traits observed over the period indicating the effective selection and better management and nutrition of the breeding stock. All these traits increased in P4 due to round the year matting in the flock. These findings are in agreement with the reports of Mehrotra (2017) who found significant effect of period of birth of ewes on AFS, ASS and AFL in Chokla sheep.

The effect of season of birth on AFS was found significant ($P \leq 0.05$). Similar results reported by Gohil (2010) in Marwari sheep. The effect of ewe's weight at birth found significant ($P \leq 0.05$) on AFS and highly significant ($P \leq 0.01$) on ASS. The highest and lowest least-squares means for ASS were 632.89 ± 13.74 and 591.25 ± 14.14 days for Class 1 (≤ 2.5 kg) and Class 4 (> 3.5 kg), respectively. It suggested that animals with heavier birth weight attaining early sexual maturity. Similar results reported by Mehrotra (2017) in Chokla sheep. The effect of covariate (WFS, WSS and WL) was highly significant ($P \leq 0.01$) on AFS, ASS and AFL, indicating that the ewes attained more weight at early age they are reproductively active at early age. Similar results were estimated by Mehrotra (2017) in Chokla sheep. The random effect of sire on AFS, ASS and AFL was highly significant ($P \leq 0.01$). By selection of superior sire's genetic improvement in that traits are possible. For AFS and AFL, similar significant effect of sire was reported by Mehrotra (2017), Chander (2011) and Gohil (2010) in Chokla, Magra and Marwari sheep, respectively.

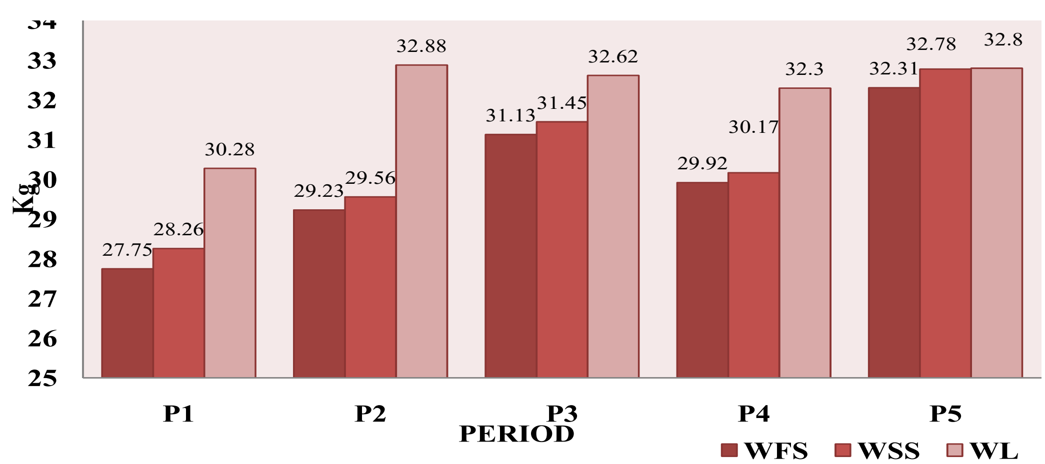
The overall least-squares mean for WFS, WSS and WL was reported as 30.07 ± 0.14, 30.45 ± 0.15 and 32.18 ± 0.17 kg. In contrast of our report higher estimate of WFS was reported by Baber and Javed (2009) as 42.10 ± 0.24 kg in Lohi sheep and lower estimates of 29.06 ± 0.16 and 25.16 ± 0.16 kg for WFS were reported by Umeel *et al.* (2018) and Mehrotra (2017) in Munjal and Chokla sheep, respectively. Lower estimates of WSS as 25.85 ± 0.16 and 26.74 ± 0.09 kg was reported by Mehrotra (2017) and Gowane *et al.* (2014) in Chokla and Malpura sheep, respectively. Lower estimates of WL was reported by Mehrotra (2017) and Gownae *et al.* (2014) as 28.61 ± 0.21and 27.94 ± 0.10kg in Chokla and Malpura sheep, respectively.

The effect of period of birth was highly significant ($P \leq 0.01$) on all that weight traits. The highest and lowest least-squares means for WFS and WSS were 32.31 ± 0.21 and 27.75 ± 0.24 and 32.78 ± 0.23 and 28.26 ± 0.25 kg for P5 and P1, respectively. Enhancement in WFS and WSS was observed in the P5 period which might be attributed to selective breeding, better availability of pasture and improved management at farm. For WL highest and lowest least-squares means were for P2 and P1 were 32.88 ± 0.29 and 30.28 ± 0.28 kg, respectively. In P4 WFS, WSS and WL was decreased due to round the year matting, growth of ewes was decreased. These

Table 2: Least-squares means ± S.E. for WFS, WSS and WL in Magra sheep

FACTORS	WFS	WSS	WL
Overall Mean (µ)	30.07 ± .14 (1468)	30.45 ± .15 (1362)	32.18 ± .17 (1416)
PERIOD	**	**	**
P1 (1997-2000)	$27.75 \pm .24^{a}$ (282)	$28.26 \pm .25^{a}$ (276)	$30.28 \pm .28^{a}$ (293)
P2 (2001-2004)	$29.23 \pm .23^{b}$ (243)	$29.56 \pm .25^{b}$ (226)	$32.88 \pm .29^{c}$ (233)
P3 (2005-2008)	$31.13 \pm .20^{d}$ (307)	$31.45 \pm .21^{d}$ (287)	$32.62 \pm .24^{b}$ (300)
P4 (2009-2012)	$29.92 \pm .17^{c}$ (397)	$30.17 \pm .18^{c}$ (359)	$32.30 \pm .21^{ab}$ (383)
P5 (2013-2016)	$32.31 \pm .21^{e}$ (239)	$32.78 \pm .23^{e}$ (214)	$32.80 \pm .25^{bc}$ (207)
SEASON	**	**	**NS**
S1(November - April)	29.55 ± .15 (929)	30.01 ± .16 (864)	32.21 ± .18 (911)
S2 (May- October)	30.59 ± .17 (539)	30.88 ± .18 (498)	32.14 ± .21 (505)
INBREEDING COEFFICIENT	*	**NS**	**NS**
Class 1 (0)	$29.71 \pm .10^{a}$ (1062)	30.06 ± .11 (993)	32.04 ± .13 (1044)
Class 2 (< 1.25%)	$30.14 \pm .20^{b}$ (211)	30.48 ± .23 (192)	32.23 ± .25 (194)
Class 3(1.25-5%)	$30.40 \pm .23^{c}$ (154)	30.58 ± .25 (140)	32.78 ± .28 (140)
Class 4 (> 5%)	$30.03 \pm .41^{ab}$ (41)	30.66 ± .45 (37)	32.65 ± .51 (38)
EWE'S BIRTH WEIGHT	**	**	**
Class 1 (≤ 2.5 KG)	$28.96 \pm .24^{a}$ (158)	$29.25 \pm .26^{a}$ (150)	$31.21 \pm .29^{a}$ (158)
Class 2 (2.6-3KG)	$29.68 \pm .16^{b}$ (528)	$30.13 \pm .18^{b}$ (490)	$31.79 \pm .20^{ab}$ (503)
Class 3 (3.1-3.5KG)	$30.35 \pm .16^{c}$ (616)	$30.77 \pm .17^{c}$ (581)	$32.18 \pm .20^{b}$ (608)
Class 4 (>3.5KG)	$31.29 \pm .23^{d}$ (166)	$31.65 \pm .26^{d}$ (141)	$33.53 \pm .30^{c}$ (147)
COVARIATE	AFS **	ASS **	-
Regression Coefficient	0.0053 ± 0.00059	0.0053 ± 0.00051	-
SIRE	**	**	**

No. of observations are in parenthesis. Figures with different superscripts differ significantly; ** - Highly significant (P≤0.01); * - Significant (P≤0.05); NS - Non – significant.



Graph 2: Significant effect of period of ewe birth on WFS, WSS and WL

Table 3: Least-squares means ± S.E. for CR and DL in Magra sheep

FACTORS	CR	DL(days)
Overall Mean (μ)	0.68 ± 0.02 (1502)	171.94 ± 0.90 (1186)
PERIOD	*	**
P1 (1997-2000)	0.73 ± 0.03^{c} (299)	170.15 ± 1.43^{ab} (240)
P2 (2001-2004)	0.67 ± 0.03^{b} (253)	171.49 ± 1.45^{b} (206)
P3 (2005-2008)	0.71 ± 0.02^{bc} (312)	168.30 ± 1.24^{a} (259)
P4 (2009-2012)	0.66 ± 0.02^{ab} (399)	173.99 ± 1.09^{c} (309)
P5 (2013-2016)	0.65 ± 0.02^{a} (239)	175.75 ± 1.30^{d} (172)
SEASON	**NS**	**NS**
S1(November-April)	0.69 ± 0.02 (948)	172.85 ± 0.98 (773)
S2(May-October)	0.68 ± 0.02 (554)	171.02 ± 1.08 (413)
INBREEDING COEFFICIENT	**NS**	**NS**
Class 1 (0)	0.71 ± 0.01 (1092)	172.04 ± 0.64 (882)
Class 2 (< 1.25%)	0.70 ± 0.02 (212)	170.93 ± 1.30 (159)
Class 3(1.25-5%)	0.72 ± 0.03 (154)	171.75 ± 1.43 (117)
Class 4 (> 5%)	0.61 ± 0.05 (44)	173.02 ± 2.74 (28)
EWE'S BIRTH WEIGHT	**NS**	**NS**
Class 1 (≤ 2.5 KG)	0.71 ± 0.03 (164)	173.47 ± 1.46 (138)
Class 2 (2.6-3KG)	0.68 ± 0.02 (542)	173.07 ± 1.05 (416)
Class 3 (3.1-3.5KG)	0.70 ± 0.02 (628)	170.95 ± 1.01 (514)
Class 4(>3.5KG)	0.64 ± 0.03 (168)	170.25 ± 1.54 (118)
SIRE	**	**

**-Highly significant (P≤0.01); *-Significant (P≤0.05); NS-Non- significant.

results are in agreement with those reported by Mehrotra (2017) and Gohil (2010) who reported significant effect of period of birth on the WFS in Chokla, and Marwari sheep, respectively. Mehrotra (2017) and Gowane *et al.* (2014) reported significant effect of period of birth on the WSS and WL in Chokla and Malpura sheep, respectively. The effect of season of birth on WFS and WSS was observed highly significant (P≤0.01). Similar results were reported by Baber and Javed (2009) in Lohi sheep for WFS and for WSS by Mehrotra (2017) in Chokla sheep. The effect of inbreeding on WFS was significant (P≤0.05). Mehrotra (2017) was reported non-significant effect of inbreeding on WFS in Chokla sheep. The effect of ewe's weight at birth was highly significant (P ≤ 0.01) on WFS, WSS and WL. The highest and lowest least-squares means were observed for Class 4 (>3.5 kg) and Class 1 (≤ 2.5 kg) as 31.29 ± 0.23 and 28.96 ± 0.24 kg, 31.65 ± 0.26 and 29.25 ± 0.26 and 33.53 ± 0.30 and 31.21 ± 0.29 kg for WFS, WSS and WL, respectively. These results may be attributed to animal with heavier birth weight attaining more weight at subsequent ages. Mehrotra (2017) reported similar results in Chokla sheep. The AFS and ASS had a highly significant effect (P≤0.01) on WFS and WSS. Similar results were reported by Mehrotra (2017) in Chokla sheep. The sire had a highly significant (P≤0.01) effect on all that weight traits.

The overall least-squares mean for CR and DL was 0.68±0.02 and 171.94±0.90. In contrast of our report higher estimates of CR as 0.88 ± 0.32 and 0.94±0.04 reported by Jafari *et al*. (2014) and Boujenane *et al.* (2013) in Makuie and D'mans ewe, respectively. Lower estimates of DL were observed as 164.72±9.04 and 165.7 days by Lobo *et al.* (2009) and Casellas *et al.* (2007a), in multibreed meat sheep population and Ripollesa ewe, respectively. Significant effect (P ≤ 0.05) of period of birth of ewe on CR was observed in this study. The highest and lowest least-squares means for CR were 0.73 ± 0.03 and 0.65 ± 0.02 for P1 and P5, respectively. Significantly reduce CR due to increased number of exposure of ewe's but significant effect show this trait can be improved by management. The period of birth of ewe was highly-significant (P≤0.01) effect on DL. The highest and lowest least-squares means for DL were 175.75±1.30 and 168.30±1.24 days for P5 and P3, respectively. Improvement in DL may be possible through selection of female which was conceived earlier in breeding season. Sire had a highly significant (P≤0.01) effect on CR and DL. Improvement in CR and DL can be possible through selection of superior sire.

CONCLUSION

All the reproductive traits are significantly influenced by the effect of period of birth. Non-significant effect of inbreeding indicated that level of inbreeding is much less than that caused inbreeding depression. Most of the reproductive traits were influenced by ewe's birth weight. This indicates that ewe's with better body condition showing superior reproductive performance.

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