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Genetic and phenotypic parameters of growth traits in Muzaffarnagari sheep

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Growth rate and survival are two important factors in sheep production that directly reflect the economics of the sheep production. In sheep husbandry, the sale of surplus animals alone contributes about 65% income and remaining 35% jointly contributed from the sale of wool and manure. Evaluation of growth of lambs at birth and subsequent ages is important to know the growth rate of lambs at particular age which helps in deciding the continuation of particular animal in a flock and average daily gain per day tells about importance of particular growth period for special care of lambs. Any breed improvement programme for economic traits essentially requires to have the knowledge about genetic and phenotypic parameters of these traits. This study was therefore, conducted to assess the impact of sex, season of lambing and period of laming on body weights, average daily weight gains in different age intervals and to estimate genetic and phenotypic parameters in Muzaffarnagari lambs.

Data on 2,540 Muzaffarnagari lambs born during the 15 years (1992–2006) at the CIRG were utilized for this investigation. The animals were maintained under the research project entitled 'Genetic improvement in Muzaffarnagari Sheep for body weight and wool yield' of Network Project on Sheep Improvement. The lambs were weaned at 2 months of age due to poor milk production and short lactation period of their dams. After weaning, the lambs were maintained under the semi-intensive feeding system, in which they were provided 100–400 g growth ration (concentrate) during various growth stages with some dry and green fodder and 5–6 h grazing daily. The concentrate was containing 72% TDN and 16% DCP prepared from maize (15%), barley (20%), groundnut cake (35%), wheat bran (20%), molasses (7%), mineral mixture (1.5%) and salt (1.5%). Breeding rams were selected using selection index constructed from 6 month body weight and greasy fleece yield in first 6 monthly clip.

The growth of lambs was evaluated through body weights at different ages and average daily gains during various age intervals. The data were recorded for sire number, sex of lamb, year of lambing, dams' weight at lambing and body weights at birth, 3, 6, 9 and 12 months of age. The average daily weight gain of individual lamb during 0–3, 3–6, 6–9, 9–12 and 3–12 months was calculated as weight gain during a particular period divided by duration of that period in days. The genetic and phenotypic parameters, viz. heritabilities, genetic and phenotypic correlations between and among body weights and average daily weight gains were estimated. The statistical analysis was carried out using LSMLMW computer programme (Harvey, 1990) to assess the impact of sex and year of lambing on growth traits and to estimate genetic and phenotypic parameters using paternal half sib correlation method.

Least squares means of body weights at birth, 3, 6, 9 and 12 month age are given in Table 1. In consonance to present findings Dass *et al*. (2008) reported similar body weights at same ages while lower body weights than present study were reported by Mandal *et al*. (2003) in Muzaffarnagari sheep. The influence of sex and year of lambing on all the body weights were found highly significant (P<0.01). Similarly Dass *et al.* (1998) in Marwari sheep and Mandal *et al.* (2003) also observed highly significant impact of sex and year of lambing on body weights in Muzaffarnagari sheep. Comparison of body weights in two sexes indicated that male lambs gained significantly higher weights than female lambs at all stages which might be due to quantitative differences in the secretion of gònwth and sex hormones in 2 sexes. These findings were supported by Dass *et al.* (1998) in Marwari and Mandal *et al*. (2003) in Muzaffarnagari sheep. Body weights in different years did not show any definite trend. However, the lambs born in 2002 and 2004 were superior in growth as compared to lambs born in other years. The difference in the weights in different years may be attributed to variation in availability of foraging material in pasture during different years and variation in the genetic composition of the flock over different years. Regression of dam's weight at lambing on birth and preceding body weight at later weight was highly significant (P<0.01) which indicated that lambs born from heavier mothers had

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Table 1. Body weights of Muzaffarnagari lambs (kg)

Particulars	Birth wt	3M wt	6M wt	9M wt	12M wt
Overall mean	3.61±0.01(2540)	15.32±0.08(2290)	23.26±0.07(2025)	26.60±0.06(1741)	30.15±0.06(1478)
Sex					
Male	3.68±0.02 (1178)	15.60±0.12 (1038)	24.19±0.10 (899)	27.36±0.09 (690)	31.05±0.11 (499)
Female	3.55±0.02 (1362)	15.03±0.11 (1252)	22.33±0.09 (1126)	25.83±0.07 (1051)	29.26±0.07 (979)
Season	NS	NS		NS	
S1(Mar-Apr)	3.62±0.02(1181)	15.30±0.12(1077)	22.82±0.10(972)	25.87±0.08(799)	30.17±0.09(712)
S2(Oct-Nov)	3.61±0.02(1359)	15.33±0.11(1213)	23.70±0.09(1053)	27.32±0.07(942)	30.13±0.08(766)
Period					
P1 (1992–94)	3.72±0.03(413)	16.97±0.20(387)	24.26±0.17(329)	26.13±0.15(265)	30.35±0.15(230)
P2 (1995–97)	3.88±0.03(387)	13.02±0.22(331)	23.16±0.18(290)	25.94±0.15(237)	28.47±0.16(193)
P3 (1998–00)	3.80±0.03(454)	14.47±0.19(414)	23.71±0.16(382)	26.05±0.13(316)	29.99±0.14(233)
P4 (2001–03)	3.37±0.02(666)	15.99±0.16(605)	22.89±0.13(549)	27.70±0.10(483)	31.50±0.10(458)
P5 (2004–06)	3.31±0.03(620)	16.13±0.17(553)	22.28±0.13(475)	27.16±0.10(440)	30.55±0.11(364)
Regression coefficient	Dwtl** 0.040±	BWtl** 2.75±	3M Wt** 1.09±	6M Wt** 0.861±	9M Wt**092±
average	0.00236.27±	0.1233.6±	0.0183.77±	0.01123.32±	0.01326.66±

** Significant (P<0.01). Figures in parentheses are number of observations.

Table 2. Average daily weight gain (ADG) of Muzaffarnagari lambs (g)

Particulars	ADG (0–3M)	ADG (3–6M)	ADG (6–9M)	ADG (9–12M)	ADG (3–12M)
Overall mean	131.10±0.98(2290)	84.39±0.75(1999)	39.07±0.61(1612)	40.45±0.67(1415)	53.56±0.38(1477)
Sex					
Male	135.59±1.44 (1038)	94.40±1.11 (886)	44.01±0.93 (663)	48.16±1.08 (4844)	62.30±0.61 (499)
Female	126.61±1.30 (1252)	73.38±0.98 (1113)	34.13±0.75 (949)	32.75±0.74 (931)	44.83±0.42 (978)
Season	NS				
S1(Mar-Apr)	130.39±1.43(1077)	78.81±1.09(966)	32.22±0.91(723)	41.76±0.94(686)	49.53±0.53(711)
S2(Oct-Nov)	131.81±1.32(1213)	89.97±1.01(1033)	45.92±0.77(889)	39.15±0.86(729)	57.59±0.48(766)
Period					
P1 (1992–94)	149.17±2.32(387)	96.80±1.80(328)	29.61±1.54(233)	39.92±1.60(215)	54.33±0.89(230)
P2 (1995–97)	109.59±2.51(331)	80.52±1.91(290)	30.57±1.50(236)	21.24±1.62(191)	45.79±0.93(193)
P3 (1998–00)	125.71±2.25(414)	88.33±1.68(380)	37.00±1.40(275)	41.51±1.56(216)	51.65±0.87(232)
P4 (2001–03)	135.50±1.85(605)	80.58±1.39(542)	53.04±1.08(443)	53.97±1.05(449)	61.40±0.60(458)
P5 (2004–06)	135.52±1.93(553)	75.72±1.51(459)	45.11±1.10(425)	45.63±1.93(344)	54.62±0.67(364)

significantly higher weights at birth and also gained higher weights at subsequent ages. This might be due better pre-natal environment received by foetus during pregnancy and availability of more milk to lambs for suckling.

Overall least squares means with standard errors of average daily gains during 0–3, 3–6, 6–9, 9–12 and 3–12 age group are given in Table 2. In comparison to present findings, Lal *et al*. (2000) and Mandal *et al.* (2003) in Muzaffarnagari, and Dey and Poonia (2005) in Nali sheep reported lower ADG during pre-weaning (0–3 month) and post-weaning (3–12 month) growth periods, respectively. Results revealed that average daily gain was the highest during 0–3 month (pre-weaning period) followed by post-weaning period (3–12 month age), 3–6, 9–12 and 6–9 month age group. Sex of lamb showed highly significant (P<0.01) effect on all the average daily gains. Similarly Lal *et al*. (2000) and Mandal *et al.* (2003) in Muzaffarnagari, and Dey and Poonia (2005) in Nali sheep also observed highly significant influence of sex and lambing year on pre-weaning (0–3 month) and post-weaning (3–12 month) ADG. The significant difference of ADG in two sex and in different lambing years were attributable to the same reasons as were for body weights.

The heritabilities estimates of body weights at birth (3, 6, 9 and 12 month age) are given in Table 3. In contrast to present findings Mandal *et al.* (2003) in Muzaffarnagari sheep, Nehra and Singh (2006) in Marwari sheep, and Akhtar *et al*. (2008) in Hisardale sheep reported lower estimates of heritability for body weights at various stages of growth, while higher estimates of heritability than present study were estimated by Sinha and Singh (1997) in the same breed. Kushwaha *et al*. (2009) estimated heritabilities in Chokla sheep and reported higher for birth and 3-month-weight and lower estimates for 6-9-and-12 month body weights. The heritability of body weights increased with the advancement in age from birth to 12 month of age. The

Table 3. Estimates of heritability (diagonal), genetic correlations (below diagonal) and phenotypic correlation (above diagonals) of different growth traits

Traits	Birth weight	3 month weight	6 month weight	9 month weight	12 month weight	PRWADG	POWADG
Birth weight	0.022±0.07	0.30	0.40	0.49	0.52	0.22	<0
3 month	0.52±0.12	0.173±0.025	0.65	0.62	0.58	0.93	<0
6 month	0.50±0.15	0.70±0.07	0.285±0.105	0.75	0.72	0.75	0.27
9 month	0.56±0.17	0.81±0.06	0.84±0.03	0.322±0.052	0.87	0.58	0.44
12 month	0.59±0.20	0.80±0.05	0.80±0.04	0.88±0.05	0.581±0.142	0.42	0.64
PRWADG	0.41±0.22	0.86±0.03	0.79±0.07	0.78±0.06	0.57±0.10	0.052±0.075	<0
POWADG	0.32±0.27	0.32±0.20	0.67±0.18	0.80±0.09	0.76±0.12	0.28±0.18	0.243±0.057

Correlation coefficients above 0.62 are significant at P<0.05 and above 0.81 are significant at P<0.01.

increasing trend of heritability with the age of lambs were also reported by Mandal *et al*. (2003) in this breed. The heritability of birth weight was low while it was moderate for 3, 6 and 9 month weight and high at 12 month age body weight. The low heritability estimate for the birth weight may be explained by the fact that ewes with poor nutritional level tended to produce insufficient milk at the earlier developmental stage and probably gave rise to the large fluctuations in the environmental effects resulting in the low heritability. The phenotypic correlations of birth weight with the body weights at subsequent ages varied from low to medium and were positive (0.30–0.52), and genetic correlation of birth weight with subsequent body weights ranged from 0.52 to 0.59, the positive and significant. The moderately high genetic correlations of birth weight with body weights at later stages i.e. 3, 6, 9 and 12 month age in this study indicated that selection for increased body weight would also result in genetic improvement in later stages of growth and will also be reflected in the pre- weaning and post-weaning growth stages. The phenotypic correlations of 3 month weight with the 6, 9 and 12 month body weights were also significant (P<0.01) and ranged from 0.58 to 0.65, but declined linearly with the increase in age. The genetic correlations of 3 month body weight with the body weights at subsequent ages showed a reverse trend. The 6 month body weight had a significant, high and positive phenotypic and genetic correlation with later stages body weights. Similarly 9-month-body weight also showed high and positive phenotypic and genetic correlation with 12-month body weight and these correlations were statistically significant (P<0.01). High and positive phenotypic correlation of 3 month weight with 6, 9 and 12 month body weights was also reported by Mandal *et al.* (2003) in the same breed. The heritability estimates of average daily weight gain were low (0.052±0.07) for pre-weaning and moderate for post-weaning age (0.243±0.06). In a study conducted by Sinha and Singh (1997) and Mandal *et al*. (2003) in this breed reported higher estimates of heritability of pre-weaning average daily gain. The phenotypic correlation of birth weight with pre-weaning average daily weight gain was low and positive (0.22) but significant (P<0.01). The phenotypic correlation of pre-weaning average daily gain with subsequent body weights ranged from medium to high and positive. Post-weaning average daily gain had no phenotypic correlation with birth and 3 month weight and with subsequent ages it varied from 0.27 to 0.64. The genetic correlations of post-weaning average daily weight gain with body weights ranged from medium to high (0.28–0.80), and were positive.

SUMMARY

Data on 2,540 Muzaffarnagari lambs born during 1992–2006 at CIRG were recorded to study growth traits and genetic and phenotypic parameters. Sex and period of lambing had highly significant influence on all the body weights and average daily weight gains except significant effect on 6-and-9-month body weights. Season of birth showed significant influence on 6-and-9-month weight and on all ADGs except ADG during 0–3 month age group. Male lambs gained higher weight than female lambs at all the growth stages while year of lambing did not show any definite trend. Dams' weight at lambing showed highly significant influence on birth and 3-month-body weight. Maximum growth of lambs (around 44%) was recorded during 0–3 month (pre-weaning) age followed by 3–6, 9–12 and 6–9 age groups. This period of growth may be considered very crucial and should be ensured with proper management, feeding and health care for better productivity. Moderate to high genetic correlations of birth weight with subsequent weights indicated that selection of animals at early age will bring genetic improvement at later growth stages.

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