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Genetic analysis of certain biometrical measurements in Deccani sheep

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Abstract

The present study was done to evaluate a flock comprising of 300 Deccani lambs maintained at Livestock Research Station, Mahabubnagar, Telangana State for various genetic and non-genetic factors on certain biometrical measurements. Biometric traits pertaining to Rump Height (RH), Chest Depth (CD), Chest Width (CW), Hip width (HW), Fore-cannon bone length (CB) and Thigh circumference (TC) were included in this study. The data was recorded at birth, 15, 30, 45, 60, 75, 90, 180, 270 and 360 days of age. On RH significant effect of sex of lamb was seen only at 45, 75 and 90 days age; that of season of birth at all ages studied while the effect of ewe weight was significant only during 180, 270 and 360 days. On CD the sex of the lamb significantly influenced during all the pre-weaning ages but not during post-weaning stages; Significant influence of season of birth was observed at 0, 30, 180, 270 and 360 days; ewe weight at post weaning and that of parity at 75 and 90 days was observed. On CW significant effect of sex of lamb was observed at 15, 30, 45, 60, 75, 180, 270 and 360 days age and that of season of birth of lamb at 15, 30, 45, 180, 270 and 360 days. In the case of FC significant influence of sex of lamb was observed at 0, 15, 30, 45, 60, 75 and 360 days while the influence of season of birth and weight of ewe was significant at 180 days only. Significant effect of sex of lamb on HW was seen at all the studied ages. In the case of TC effect of sex was significantly evident on 30, 45 and 60 days while the effect of season of birth and ewe weight was evident on 180, 270 and 360 days.

Keywords: Biometry, measurements, Deccani, sheep, growth

Introduction

Deccani is an important dual purpose sheep breed of Southern peninsular region which are medium-sized animals with predominantly black coloured coarse wool. This breed is well-suited to the extreme semi-arid climatic conditions of this region and is capable of long-distance migration being traditionally reared by pastoral communities of the Telangana state. India presently ranks 2nd in the World and Telangana state ranks 1st in the country in terms of the sheep population. Physical body characteristics or linear biometrical measurements are less affected by the different physiological factors like gut fill, pregnancy etc., and allow for growth comparisons of different body parts at any stage of growth of the animal. Measurements of various body conformations are of value in judging the quantitative characteristics of carcass and are also helpful in developing suitable selection criteria for lambs. The improvement of the indigenous breeds and their genetic improvement plays a major emphasis and the present study was conducted to investigate the body growth performance in Deccani sheep breed lambs with these body measurements.

Materials and Methods

A total of 300 purebred Deccani lambs which were born to 15 sires were evaluated for body growth measurements pertaining to Rump Height (RH), Chest Depth (CD), Chest width (CW), Hip width (HW), Fore-cannon bone length (CB) and Thigh circumference (TC). The experimental animals were housed in permanent sheds made with mud floor and asbestos sheets roofing material. The lambs were managed under semi-intensive system by allowing grazing for 8 hours daily and additional green fodder @ 3 kg/lamb and concentrate feed with a CP of 18% was provided to the lambs @ 300 gm/lamb. The following biometrical measurements were recorded in centimetres (cm) using a measuring tape, at fortnightly intervals. Biometric traits pertaining to this study were recorded at birth, 15, 30, 45, 60, 75, 90, 180, 270 and 360 days of age for the following.

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Rump height (RH): It is the distance from the surface of a platform on which the lamb stands to the rump.

Chest depth (CD): It is the distance from backbone at the shoulder to the brisket between the front legs.

Chest width (CW): It is measured as the distance between the outer edges of right and left side of the sternum in between the forelimbs.

Fore-cannon bone length (CB): It is measured as the length of the metacarpal bone.

Hip width (HW): It is measured as the width or distance between the outer edges of the major hip bones on the right and left side.

Thigh circumference (TC): It is measured as the midpoint between the hock and pin bone on the right rear leg.

The data on biometrical traits were subjected to least squares analysis (Harvey, 1966) [6] to study the influence of various genetic and non-genetic factors such as season of birth, sex of the lamb, ewe weight at lambing and parity of the ewe at lambing. Significant differences between means were assessed by Duncan's Multiple Range Test (DMRT).

Results and Discussion

In the case of rump height present investigation revealed significant effect of sex of lamb at 45, 75 and 90 days (Table 1) wherein the male lambs had significantly higher rumps of 47.00 ± 0.41 , 51.21 ± 0.36 and 53.26 ± 0.38 cm than female lambs measuring 46.05 ± 0.42 , 49.84 ± 0.37 and 51.25 ± 0.38 cm at 45, 75 and 90 days, respectively. Similar findings were reported by different authors in exotic sheep (Cam *et al.*, 2010; Basem *et al.*, 2011; Muhammad *et al.*, 2014 and Jafari *et al.*, 2014) [4, 3, 8, 7] of Makuie, Nigerian, Awassi, Chios and Karayaka breeds. Though non-significant all the male lambs had higher RH than the female lambs at all ages. Similar significant reports were also recorded in Karayaka, Makuie, Nigerian, Awassi and Chios sheep breeds by Cam *et al.* (2010) [4], Basem *et al.* (2011) [3], Jafari *et al.* (2014) [7] and Muhammad *et al.* (2014) [8]. The season of birth of lamb was significant at all ages studied where lambs born during season II had significantly higher RH than lambs born during season I. The effect of ewe weight was significant only during post weaning period (Table 2) where lambs born to ewes weighing < 25 kg (61.14 ± 0.49 , 65.78 ± 0.48 and 68.87 ± 0.48 cm) and those born to ewes weighing between 25-30 kg (60.43 ± 0.50 , 64.86 ± 0.49 and 68.15 ± 0.49 cm) had significantly higher RH than those born to ewes weighing > 30 kg (57.26 ± 1.00 , 61.65 ± 0.98 and 65.36 ± 0.97 cm) at 180, 270 and 360 days of age, respectively. The effect of parity was not significant on this trait at all the ages studied. Published literature revealed a RH range of 55.7 ± 0.57 to 64.1 ± 4.7 cm at 360 days of age (Cam *et al.*, 2010; Jafari *et al.*, 2014 and Muhammad *et al.*, 2014) [4, 7, 8] in Makuie, Karayaka and Nigerian sheep mainly attributed to the genetic differences among the breeds.

For chest depth the sex of lamb significantly influenced all the pre-weaning periods (Table 3) but not the post-weaning ages (Table 4). Similar findings were reported by Cam *et al.* (2010) [4] in Karayaka and Muhammad *et al.* (2014) [8] in Nigerian sheep. Males had significantly deeper chest than females during pre-weaning growth period. Though non-significant, during the post-weaning period also similar trend continued.

Sexual dimorphism was also reported by Cam *et al.* (2010) [4] in Karayaka, Muhammad *et al.* (2014) [8] in Nigerian and Stojiljkovic *et al.* (2015) [10] in Karakachan sheep. Significant influence of season of birth with higher CD was observed in season II lambs at birth, 30, 180, 270 and 360 days. Lambs born to ewes weighing 25-30 kg were having significantly deeper chest when compared to those born to ewes weighing less than 25 kg and above 30 kg at 180, 270 and 360 days. Lambs borne to 4th parity ewes had significantly deeper chest followed by those born to 3rd, 2nd and 1st parity ewes at 75 and 90 days. Reports on exotic sheep revealed a range of 13.39 ± 9.8 to 28.23 ± 4.5 cm at 360 days as reported by Cam *et al.* (2010) [4] in Karayaka, Adejoro *et al.* (2013) [1] in Yankassa & West African Dwarf Sheep and Muhammad *et al.* (2014) [8] in Nigerian sheep breeds. Stojiljkovic *et al.* (2015) [10] in Karakachan sheep reported the CD as 33.63 ± 1.41 in males and 30.40 ± 2.07 cm in females.

The chest width was significantly influenced by sex of lamb at 15, 30, 45, 60, 75, 180, 270 and 360 days (Table 5&6) age wherein males had significantly higher CW than females. Similar report was given by Stojiljkovic *et al.* (2015) [10] in Karakachan sheep while Cam *et al.* (2010) [4] reported a non-significant effect of sex in Karayaka sheep. Significant influence of season of birth of lamb was at 15, 30, 45, 180, 270 and 360 days while the effects of ewe weight and parity were non-significant. Reports on exotic sheep revealed a CW of 18.5 ± 0.29 cm in Karayaka sheep (Cam *et al.*, 2010) [4] and a range of 21.58 ± 1.51 to 23.00 ± 3.00 cm in Karakachan sheep (Stojiljkovic *et al.*, 2015) [10].

Significant influence of sex of lamb was observed on fore-cannon bone length at 0, 15, 30, 45, 60, 75 and 360 days (Table 7&8) while the influence of season of birth of lamb and ewe weight was significant at 180 days. Males had significantly longer FC bone than females due to the influence of sex hormones on growth and such similar reports were also given by Muhammad *et al.* (2014) [8] in Nigerian sheep. The present findings are in accordance with the findings reported by Adejoro *et al.* (2013) [1] in Yankassa, West African Dwarf Sheep and Muhammad *et al.* (2014) [8] in Nigerian sheep which ranged from 12.06 ± 0.41 to 32.51 ± 3.6 cm.

The hip width was significantly influenced by sex of lamb at 0, 15, 30, 45, 60, 75, 90, 180, 270 and 360 days (Table 9&10) while the effects of season of birth, weight of ewe and parity of ewe were non-significant at all ages studied. Significantly wider hips in males were also reported by Basem *et al.* (2011) [3], Farhad *et al.* (2013) [5] and Stojiljkovic *et al.* (2015) [10] in Awassi, Chios, Mehrabani, Zandi, Shaal, Macoei and Karakachan sheep and by Rani *et al.* (2014) [9] in Nellore sheep but Afolayan *et al.* (2006) [2] in Yankasa sheep reported a non-significant effect of sex. Afolayan *et al.* (2006) [2] in Yankasa yearling sheep reported a HW of 17.35 ± 0.17 cm while Rani *et al.* (2014) [9] in Nellore yearlings reported a HW of 20.44 cm. However, higher range of 18.07 ± 0.24 to 21.56 ± 0.24 cm was reported by Farhad *et al.* (2013) [5] and Stojiljkovic *et al.* (2015) [10] in Iranian breeds of Mehrabani, Zandi, Shaal, Macoei and Karakachan sheep.

The thigh circumference was significantly influenced by sex of lamb at 30, 45 and 60 days (Table 11); season of birth and ewe weight on 180, 270 and 360 days age (Table 12) while the effect of ewe parity was not significant. Jafari *et al.* (2014) [7] in Makuie sheep reported significant effect of sex while Cam *et al.* (2010) [4] reported non-significant effect of sex in Karayaka sheep. However, Jafari *et al.* (2014) [7] and Cam *et al.* (2010) [4] studies revealed a TC range from 32.7 ± 3.3 to 74.5 ± 0.84 cm in Makuie and Karayaka sheep.

Table 1: Least-squares mean RH (cm) in Deccani lambs during pre-weaning period

Effect	n	RH0		RH15		RH30		RH45		RH60		RH75		RH90	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Overall	301	39.50	0.38	42.90	0.37	44.62	0.37	46.53	0.34	48.76	0.33	50.53	0.30	52.25	0.31
Sex of lamb															
Male	153	40.01	0.46	42.54	0.45	45.02	0.44	47.00 ^a	0.41	49.18	0.40	51.21 ^a	0.36	53.26 ^a	0.38
Female	148	38.98	0.47	41.65	0.45	44.22	0.45	46.05 ^b	0.42	48.35	0.40	49.84 ^b	0.37	51.25 ^b	0.38
Season of birth															
I (Jan-June)	112	38.83 ^b	0.52	41.40 ^b	0.51	43.90 ^b	0.50	44.83 ^b	0.47	48.22 ^b	0.45	50.04 ^b	0.41	51.77 ^b	0.43
II (Jul-Dec)	189	40.17 ^a	0.41	42.79 ^a	0.40	45.34 ^a	0.40	47.22 ^a	0.37	49.31 ^a	0.36	51.01 ^a	0.32	52.73 ^a	0.34
Ewe weight															
<25 kg	140	39.85	0.42	42.33	0.40	44.77	0.40	46.75	0.37	48.91	0.36	50.67	0.33	52.49	0.34
25 to 30 kg	133	39.61	0.43	42.04	0.42	44.57	0.41	46.56	0.38	48.65	0.37	50.40	0.34	52.05	0.35
>30 kg	28	39.03	0.89	41.91	0.86	44.53	0.85	46.27	0.79	48.73	0.76	50.52	0.70	52.22	0.73
Parity															
1	96	39.81	0.54	42.24	0.52	44.55	0.51	46.30	0.48	48.42	0.46	50.23	0.42	51.99	0.44
2	71	38.62	0.59	41.27	0.57	43.87	0.56	45.85	0.52	48.20	0.51	49.77	0.46	51.37	0.48
3	105	39.73	0.49	42.38	0.47	44.71	0.47	46.61	0.43	48.62	0.42	50.41	0.38	52.21	0.40
4	29	39.84	0.89	42.49	0.87	44.35	0.86	47.35	0.80	49.81	0.77	51.70	0.70	53.43	0.37

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.05$)

Table 2: Least-squares mean RH (cm) of Deccani lambs during post-weaning period

	RH180			RH270			RH360		
	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	286	59.61	0.44	264	64.10	0.43	262	67.45	0.43
Sex of lamb									
Male	140	59.79	0.53	132	64.37	0.52	130	67.81	0.51
Female	146	59.43	0.54	132	63.82	0.53	132	67.10	0.53
Season of birth									
I (Jan-June)	112	58.27 ^b	0.60	90	63.02 ^b	0.61	90	66.32 ^b	0.60
II (Jul-Dec)	174	60.96 ^a	0.47	174	65.17 ^a	0.45	172	68.60 ^a	0.45
Ewe weight									
<25 kg	134	61.14 ^a	0.49	121	65.78 ^a	0.48	119	68.87 ^a	0.48
25 to 30 kg	124	60.43 ^a	0.50	116	64.86 ^a	0.49	116	68.15 ^a	0.49
>30 kg	28	57.26 ^b	1.00	27	61.65 ^b	0.98	27	65.36 ^b	0.97
Parity									
1	88	59.65	0.63	76	64.00	0.64	76	67.37	0.37
2	67	59.72	0.69	62	64.23	0.67	62	67.60	0.67
3	102	59.93	0.55	97	64.55	0.54	95	67.92	0.54
4	29	59.15	1.01	29	63.62	0.96	29	66.94	0.96

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.05$)

Table 3: Least-squares mean CD (cm) in Deccani lambs during pre-weaning period

Effect	n	CD0		CD15		CD30		CD45		CD60		CD75		CD90	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Overall	301	19.15	0.35	21.30	0.28	23.35	0.25	24.64	0.24	25.82	0.24	27.42	0.26	29.06	0.28
Sex of lamb															
Male	153	19.75 ^a	0.43	21.82 ^a	0.33	23.93 ^a	0.29	25.48 ^a	0.29	26.71 ^a	0.29	28.15 ^a	0.32	29.49 ^a	0.34
Female	148	18.55 ^b	0.43	20.77 ^b	0.34	22.78 ^b	0.30	23.80 ^b	0.29	24.94 ^b	0.30	26.69 ^b	0.32	28.63 ^b	0.35
Season of birth															
I (Jan-June)	112	18.61 ^b	0.48	20.96	0.38	22.94 ^b	0.34	24.34	0.33	25.67	0.33	27.07	0.36	28.75	0.38
II (Jul-Dec)	189	19.68 ^a	0.38	21.64	0.30	23.77 ^a	0.26	24.94	0.26	25.97	0.26	27.75	0.28	29.37	0.30
Ewe weight															
<25 kg	140	18.96	0.38	21.30	0.30	23.51	0.27	24.61	0.26	25.58	0.27	27.21	0.29	28.77	0.31
25 to 30 kg	133	18.96	0.40	21.28	0.31	23.41	0.28	24.54	0.27	25.64	0.27	27.47	0.29	29.22	0.32
>30 kg	28	19.52	0.82	21.32	0.64	23.14	0.57	24.77	0.55	26.25	0.57	27.57	0.61	29.20	0.65
Parity															
1	96	19.36	0.49	21.15	0.39	22.90	0.34	24.23	0.34	25.42	0.34	26.73 ^b	0.37	28.27 ^b	0.39
2	71	18.45	0.54	20.87	0.43	23.11	0.38	24.26	0.37	25.36	0.38	26.86 ^b	0.40	28.37 ^b	0.43
3	105	19.573	0.45	21.70	0.35	23.79	0.31	24.83	0.30	25.96	0.31	27.52 ^b	0.33	29.33 ^{ab}	0.36
4	29	19.22	0.82	21.47	0.65	23.61	0.57	25.24	0.56	26.56	0.57	28.55 ^a	0.61	30.26 ^a	0.66

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.05$)

Table 4: Least-squares mean CD (cm) of Deccani lambs during post-weaning period

	CD180			CD270			CD360		
	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	286	35.69	0.37	264	40.19	0.37	262	43.55	0.36
Sex of lamb									
Male	140	35.76	0.45	132	40.29	0.44	130	43.77	0.44
Female	146	35.62	0.46	132	40.09	0.46	132	43.32	0.45
Season of birth									
I (Jan-June)	112	34.72 ^b	0.52	90	39.38 ^b	0.52	90	42.68 ^b	0.51
II (Jul-Dec)	174	36.66 ^a	0.40	174	41.01 ^a	0.39	172	44.41 ^a	0.38
Ewe weight									
<25 kg	134	36.57 ^a	0.42	121	40.96 ^a	0.41	119	44.17 ^a	0.41
25 to 30 kg	124	36.72 ^a	0.43	116	41.13 ^a	0.42	116	44.56 ^a	0.42
>30 kg	28	33.78 ^b	0.86	27	38.49 ^b	0.84	27	41.91 ^b	0.82
Parity									
1	88	34.85	0.54	76	39.22	0.55	76	42.56	0.54
2	67	35.84	0.59	62	40.50	0.58	62	43.95	0.57
3	102	35.69	0.47	97	40.20	0.46	95	43.51	0.46
4	29	36.38	0.86	29	40.95	0.83	29	44.17	0.82

Means with similar superscripts in a column within the effect do not differ significantly ($p>0.05$)

Table 5: Least-squares mean CW (cm) in Deccani lambs during pre-weaning period

Effect	n	CW0		CW15		CW30		CW45		CW60		CW75		CW90	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Overall	301	6.18	0.19	7.48	0.17	8.79	0.16	9.88	0.16	10.79	0.18	12.11	0.19	13.29	0.22
Sex of lamb															
Male	153	6.38	0.23	7.85 ^a	0.20	9.29 ^a	0.19	10.29 ^a	0.19	11.21 ^a	0.21	12.43 ^a	0.23	13.52	0.26
Female	148	5.99	0.24	7.10 ^b	0.21	8.28 ^b	0.19	9.46 ^b	0.20	10.37 ^b	0.22	11.79 ^b	0.23	13.05	0.26
Season of birth															
I (Jan-June)	112	5.88 ^b	0.26	7.11 ^b	0.23	8.35 ^b	0.23	9.58 ^b	0.22	10.56	0.24	11.91	0.26	13.04	0.29
II (Jul-Dec)	189	6.49 ^a	0.21	7.85 ^a	0.18	9.22 ^a	0.17	10.17 ^a	0.17	11.01	0.19	12.31	0.21	13.53	0.23
Ewe weight															
<25 kg	140	6.12	0.21	7.35	0.18	8.76	0.17	9.82	0.17	10.57	0.19	11.91	0.21	13.17	0.24
25 to 30 kg	133	6.04	0.22	7.30	0.19	8.61	0.18	9.72	0.18	10.58	0.20	11.93	0.21	13.10	0.24
>30 kg	28	6.39	0.45	7.78	0.39	8.99	0.37	10.09	0.37	11.22	0.41	12.49	0.44	13.58	0.50
Parity															
1	96	6.44	0.27	7.66	0.24	8.83	0.22	9.87	0.23	10.82	0.25	12.06	0.27	13.09	0.30
2	71	5.86	0.29	7.21	0.26	8.64	0.25	9.65	0.24	10.51	0.27	11.84	0.29	12.85	0.33
3	105	6.22	0.25	7.48	0.21	8.84	0.20	9.94	0.20	10.87	0.23	12.19	0.24	13.32	0.27
4	29	6.21	0.45	7.55	0.39	8.84	0.37	10.03	0.37	10.95	0.42	12.34	0.44	13.88	0.50

Means with similar superscripts in a column within the effect do not differ significantly ($p\geq 0.05$)

Table 6: Least-squares mean CW (cm) of Deccani lambs during post-weaning period

	CW180			CW270			CW360		
	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	286	17.20	0.23	264	21.80	0.22	262	25.09	0.21
Sex of lamb									
Male	140	17.64 ^a	0.27	132	22.31 ^a	0.26	130	25.83 ^a	0.25
Female	146	16.76 ^b	0.28	132	21.28 ^b	0.27	132	24.35 ^b	0.26
Season of birth									
I (Jan-June)	112	16.54 ^b	0.31	90	21.34 ^b	0.31	90	24.65 ^b	0.29
II (Jul-Dec)	174	17.86 ^a	0.24	174	22.26 ^a	0.23	172	25.52 ^a	0.22
Ewe weight									
<25 kg	134	17.66	0.25	121	22.19	0.24	119	25.44	0.23
25 to 30 kg	124	17.29	0.26	116	22.04	0.25	116	25.40	0.24
>30 kg	28	16.54	0.52	27	21.16	0.50	27	24.43	0.48
Parity									
1	88	17.70	0.23	76	22.17	0.33	76	25.47	0.31
2	67	17.19	0.26	62	21.90	0.34	62	25.36	0.33
3	102	17.03	0.29	97	21.48	0.27	95	24.86	0.26
4	29	16.88	0.52	29	21.63	0.49	29	24.66	0.47

Means with similar superscripts in a column within the effect do not differ significantly ($p\geq 0.01$)

Table 7: Least-squares mean FC (cm) in Deccani lambs during pre-weaning period

Effect	n	FC0		FC15		FC30		FC45		FC60		FC75		FC90	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Overall	301	10.36	0.16	11.35	0.14	12.43	0.14	13.02	0.12	13.76	0.13	14.61	0.13	15.71	0.15
Sex of lamb															
Male	153	10.94 ^a	0.19	11.93 ^a	0.17	12.91 ^a	0.16	13.56 ^a	0.15	14.36 ^a	0.16	15.08 ^a	0.16	15.89	0.18
Female	148	9.79 ^b	0.19	10.78 ^b	0.17	11.95 ^b	0.17	12.48 ^b	0.15	13.16 ^b	0.16	14.14 ^b	0.16	15.54	0.18
Season of birth															
I (Jan- June)	112	10.27	0.22	11.25	0.19	12.36	0.18	12.99	0.17	13.81	0.18	14.62	0.17	15.63	0.20
II (Jul-Dec)	189	10.46	0.17	11.45	0.15	12.50	0.15	13.04	0.13	13.71	0.14	14.60	0.14	15.80	0.16
Ewe weight															
<25 kg	140	10.54	0.17	11.51	0.15	12.48	0.15	12.95	0.14	13.70	0.15	14.49	0.14	15.71	0.16
25 to 30 kg	133	10.26	0.18	11.23	0.16	12.28	0.15	12.93	0.14	13.60	0.15	14.46	0.14	15.63	0.16
>30 kg	28	10.29	0.37	11.32	0.32	12.53	0.31	13.18	0.29	13.98	0.31	14.87	0.29	15.80	0.34
Parity															
1	96	10.74	0.22	11.58	0.19	12.55	0.19	13.06	0.17	13.78	0.18	14.49	0.18	15.50	0.20
2	71	10.14	0.25	11.22	0.22	12.30	0.21	12.92	0.19	13.63	0.21	14.55	0.20	15.59	0.22
3	105	10.40	0.20	11.42	0.18	12.38	0.17	12.94	0.16	13.63	0.17	14.57	0.16	15.72	0.19
4	29	10.18	0.37	11.18	0.33	12.48	0.31	13.17	0.29	14.01	0.31	14.82	0.30	16.03	0.34

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.01$)

Table 8: Least-squares mean FC (cm) of Deccani lambs during post-weaning period

	FC180			FC270			FC360		
	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	286	19.64	0.19	264	24.30	0.19	262	27.64	0.19
Sex of lamb									
Male	140	19.67	0.23	132	24.52	0.23	130	27.95 ^a	0.23
Female	146	19.62	0.23	132	24.07	0.23	132	27.34 ^b	0.24
Season of birth									
I (Jan-June)	112	19.28 ^b	0.26	90	24.08	0.27	90	27.45	0.28
II (Jul-Dec)	174	20.01 ^a	0.20	174	24.51	0.20	172	27.84	0.21
Ewe weight									
<25 kg	134	20.05 ^a	0.21	121	24.61	0.21	119	27.73	0.22
25 to 30 kg	124	20.09 ^a	0.21	116	24.57	0.21	116	27.79	0.22
>30 kg	28	18.80 ^b	0.43	27	23.71	0.43	27	27.41	0.44
Parity									
1	88	19.45	0.27	76	24.06	0.28	76	27.66	0.29
2	67	19.85	0.30	62	24.67	0.29	62	27.97	0.30
3	102	19.70	0.24	97	24.22	0.24	95	27.54	0.25
4	29	19.57	0.43	29	24.24	0.42	29	27.41	0.44

Means with similar superscripts in a column within the effect do not differ significantly ($P \geq 0.05$)

Table 9: Least-squares mean HW (cm) in Deccani lambs during pre-weaning period

Effect	n	HW0		HW15		HW30		HW45		HW60		HW75		HW90	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Overall	301	4.95	0.06	5.23	0.06	5.98	0.07	6.44	0.08	7.01	0.08	7.47	0.09	7.99	0.09
Sex of lamb															
Male	153	4.98	0.07	5.44 ^a	0.08	6.24 ^a	0.09	6.77 ^a	0.09	7.40 ^a	0.10	7.93 ^a	0.11	8.38 ^a	0.11
Female	148	4.93	0.08	5.01 ^b	0.08	5.72 ^b	0.09	6.10 ^b	0.09	6.62 ^b	0.09	7.02 ^b	0.11	7.60 ^b	0.11
Season of birth															
I (Jan-June)	112	5.00	0.09	5.22	0.08	5.96	0.09	6.41	0.11	6.98	0.11	7.46	0.12	8.01	0.12
II (Jul-Dec)	189	4.90	0.07	5.23	0.07	6.00	0.08	6.47	0.08	7.05	0.09	7.48	0.09	7.97	0.09
Ewe weight															
<25 kg	140	5.00	0.07	5.29	0.07	6.03	0.08	6.48	0.08	7.01	0.08	7.42	0.09	7.96	0.09
25 to 30 kg	133	4.97	0.07	5.20	0.07	5.94	0.08	6.36	0.09	6.95	0.09	7.46	0.10	7.98	0.10
>30 kg	28	4.89	0.14	5.19	0.15	5.97	0.17	6.48	0.18	7.08	0.18	7.55	0.21	8.03	0.21
Parity															
1	96	4.92	0.08	5.17	0.09	5.93	0.10	6.38	0.11	6.94	0.11	7.39	0.13	7.92	0.13
2	71	4.99	0.09	5.21	0.09	6.01	0.11	6.45	0.12	7.09	0.12	7.49	0.14	8.05	0.14
3	105	5.01	0.08	5.23	0.08	5.94	0.09	6.39	0.10	6.95	0.10	7.37	0.11	7.92	0.11
4	29	4.89	0.14	5.29	0.15	6.05	0.17	6.53	0.18	7.08	0.19	7.63	0.21	8.06	0.21

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.01$)

Table 10: Least-squares mean HW (cm) of Deccani lambs during post-weaning period

	HW180			HW270			HW360		
	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	286	10.90	0.11	264	14.43	0.10	262	17.23	0.09
Sex of lamb									
Male	140	11.58 ^a	0.13	132	14.99 ^a	0.13	130	18.07 ^a	0.11
Female	146	10.22 ^b	0.13	132	13.87 ^b	0.13	132	16.38 ^b	0.11
Season of birth									
I (Jan-June)	112	10.85	0.15	90	14.55	0.15	90	17.26	0.13
II (Jul-Dec)	174	10.95	0.11	174	14.32	0.11	172	17.19	0.09
Ewe weight									
<25 kg	134	10.80	0.12	121	14.36	0.12	119	17.16	0.10
25 to 30 kg	124	11.01	0.12	116	14.58	0.12	116	17.35	0.10
>30 kg	28	10.89	0.24	27	14.35	0.24	27	17.18	0.21
Parity									
1	88	11.05	0.16	76	14.38	0.15	76	17.26	0.13
2	67	10.92	0.17	62	14.51	0.16	62	17.28	0.14
3	102	10.88	0.14	97	14.35	0.13	95	17.17	0.11
4	29	10.78	0.24	29	14.48	0.23	29	17.19	0.20

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.01$)

Table 11: Least-squares mean TC (cm) in Deccani lambs during pre-weaning period

Effect	n	TC0		TC15		TC30		TC45		TC60		TC75		TC90	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Overall	301	22.05	0.45	23.75	0.39	25.39	0.35	26.86	0.34	28.24	0.34	29.89	0.33	31.49	0.36
Sex of lamb															
Male	153	22.49	0.55	24.22	0.47	25.93 ^a	0.42	27.55 ^a	0.41	28.80 ^a	0.41	30.29	0.40	31.72	0.44
Female	148	21.60	0.56	23.28	0.48	24.86 ^b	0.43	26.17 ^b	0.42	27.68 ^b	0.41	29.49	0.41	31.26	0.44
Season of birth															
I (Jan-June)	112	21.63	0.62	23.36	0.54	24.99	0.47	26.49	0.47	27.88	0.46	29.50	0.45	31.02	0.49
II (Jul-Dec)	189	22.46	0.49	24.14	0.42	25.80	0.38	27.22	0.37	28.60	0.38	30.28	0.36	31.96	0.39
Ewe weight															
<25 kg	140	21.96	0.49	23.73	0.43	25.46	0.38	26.92	0.37	28.42	0.37	30.22	0.36	31.96	0.39
25 to 30 kg	133	21.79	0.51	23.55	0.44	25.22	0.39	26.67	0.38	28.02	0.38	29.91	0.37	31.65	0.41
>30 kg	28	22.39	1.05	23.97	0.91	25.50	0.81	26.99	0.79	28.29	0.78	29.53	0.77	30.86	0.84
Parity															
1	96	22.57	0.64	24.06	0.55	25.52	0.48	26.87	0.48	28.12	0.47	29.62	0.47	31.24	0.51
2	71	20.88	0.69	22.67	0.60	24.46	0.53	26.10	0.53	27.77	0.52	29.29	0.51	30.69	0.56
3	105	22.38	0.58	24.22	0.50	25.68	0.44	27.17	0.44	28.43	0.43	30.29	0.42	31.88	0.46
4	29	22.36	1.06	24.05	0.92	25.92	0.81	27.30	0.79	28.64	0.79	30.35	0.77	32.16	0.85

Means with similar superscripts in a column within the effect do not differ significantly ($p \geq 0.05$)

Table 12: Least-squares mean TC (cm) of Deccani lambs during post-weaning period

	TC180			TC270			TC360		
	n	Mean	SE	n	Mean	SE	n	Mean	SE
Overall	286	35.76	0.36	264	40.21	0.34	262	43.48	0.33
Sex									
Male	140	35.90	0.43	132	40.38	0.41	130	43.89	0.39
Female	146	35.63	0.45	132	40.03	0.42	132	43.08	0.41
Season									
I (Jan-June)	112	34.79 ^b	0.49	90	39.40 ^b	0.48	90	42.75 ^b	0.46
II (Jul-Dec)	174	36.73 ^a	0.39	174	41.01 ^a	0.36	172	44.21 ^a	0.35
Ewe Weight									
<25 kg	134	37.01 ^a	0.40	121	41.49 ^a	0.38	119	44.58 ^a	0.37
25 to 30 kg	124	36.80 ^a	0.41	116	41.25 ^a	0.39	116	44.35 ^a	0.38
>30 kg	28	33.49 ^b	0.82	27	37.89 ^b	0.77	27	41.51 ^b	0.75
Parity									
1	88	35.93	0.52	76	40.13	0.51	76	43.52	0.49
2	67	35.76	0.57	62	40.55	0.53	62	43.88	0.51
3	102	35.86	0.46	97	40.34	0.43	95	43.55	0.42
4	29	35.51	0.83	29	39.81	0.76	29	42.98	0.74

Means with similar superscripts in a column within the effect do not differ significantly ($P \geq 0.01$)

Conclusion

To conclude majority of the growth measurements studied were significantly influenced by the non-genetic factors such as sex of the lamb, season of birth of lamb, weight of ewe at lambing and parity of the ewe. Hence the role of management in sheep husbandry is important apart from genetics in order to get the best results.

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