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Impact of genetic selection and enhanced feeding on growth rate of Nilagiri and Sandyno sheep and their lambs

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ABSTRACT

Weaned ewe lambs born during 2009–2014 were ranked according to their breeding value ascertained by BLUP analysis for weaning weight. Ten weaned ewe lambs each in Nilagiri and Sandyno breeds, on the top of the ranking were selected each year and placed as a separate elite group and were supplemented with increased level of concentrate feed from weaning with 8 h of routine grazing. Weight at 6, 9 and 12 months was recorded. Weight at birth, weaning, 6th and 12th months of lambs born to elite ewes were recorded up to February 2020 lambing. The data were analyzed by least square analysis. The body weight at 6, 9 and 12 months of age were significantly higher in elite ewes (17.22±0.21, 22.17±0.24, 26.19±0.27 vs 14.29±0.10, 18.09±0.13, 21.38±0.14). Elite Sandyno lambs weighed significantly higher than elite Nilagiri lambs at all stages. Highest ADG was observed in Sandyno elite ewe lambs during 6 months to 9 months period (62.98±2.80 g). The ADG was significantly higher in elite ewes during this period and from 9 months to 12 months (54.79±1.85 and 44.38±1.61 vs 37.52±0.98 and 33.70±0.87). The average birth weight, weaning weight and weaning percentage of born elite Nilagiri lambs (2.88±0.15, 11.52±0.77 and 93.54% vs 2.63±0.15, 10.02±0.76 and 90.82%) and Sandyno lambs (3.41±0.17, 12.91±0.86 and 94.69% vs 3.04±0.17, 11.31±0.84 and 91.73%) were significantly higher. The survivability of twin lambs was significantly higher in born elite lambs. The findings will help in promoting genetic selection and improved nutritional management in sheep farms from weaning to improve growth rate, better lamb crop and good survivability. Marginal increase in the feed would bring a substantial improvement in the performance of the sheep.

Keywords: ADG, Breeding value, Ewes, Genetic selection, Growth rate, Parity, Weaning percentage

The main income of sheep farmers is from the sale of sheep for meat compared to wool, as there is nil or meagre market for wool. Live weight, age and nutrition have been reported to influence the productive performance of sheep (Gaskins *et al.* 2005, Aliyari *et al.* 2012). Similarly, puberty will be advanced by phenotypic and genetic selection for enhanced growth rate. This could be achieved through selection of ewes with high Breeding Values for post weaning weight (McGuirk 1968 and Nieto *et al.* 2013). As live weight at mating is related to fertility and reproductive rate in young ewes, increasing the premating weight could increase the pregnancy rate and multiple births (Nieto *et al.* 2013, Aktas and Dogan 2014, Aktas *et al.* 2015).

Genetic selection, weight at breeding, maintenance and feeding conditions of ewes during pregnancy have important impact on birth weight and weaning weight of lambs born (Gaskins *et al.* 2005, Gardner *et al.* 2007, Aktas and Dogan 2014). An increase in premating weight of ewes has resulted in proportional increase in birth and weaning weight of lambs (Gaskins *et al.* 2005, Gardner *et al.* 2007, Aliyari *et al.* 2012, Aktas and Dogan 2014). The growth rate and weight of Nilagiri and Sandyno ewes at yearling were comparatively low and thus have longer Age at first service and first lambing (Rajendran 2005, Anilkumar *et al.* 2011). The lambs born also had a lower body weight. The future breeding stocks in this Research station were selected based on breeding value of the weaned lambs. The Breeding values were ascertained by BLUP analysis for weaning weight. To increase the growth rate and weight of lambs born a study was carried out to find out the impact of enhanced feeding and genetic selection on growth rate of Nilagiri and Sandyno sheep and their lambs.

MATERIALS AND METHODS

The study was conducted at Sheep Breeding Research Station, Sandynallah, The Nilgiris district. Ewe lambs of Nilagiri (429) and Sandyno (708) breeds, born during the year 2009–2014 main lambing seasons were selected for the study. Weaned lambs of the respective birth years were ranked according to their breeding value ascertained by BLUP analysis for weaning weight. Ten weaned ewe lambs

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Table 1. Proximate analysis and feed ingredients of the creep feed

Feed content		Proximate analysis	
Ingredient	In kg	Moisture	11.36%
Maize	122.000	Crude protein	19.19%
DORB	63.500	Crude fibre	6.83%
Soya	54.000	Ether extract	2.64%
Salt	4.000	Total ash	8.48%
Calcite	6.000	Acid insoluble ash (Sand and Silica)	2.00%
NSP enzyme	0.125	Calcium	1.50%
Sodium bicarbonate	0.250	Phosphorus	0.85%
Ultra TM	0.250	Salt	1.37%
		Gross energy	3667 Kcal/kg

on the top of the ranking were selected each year and placed as a separate elite group (group A) in each breed (77 Nilagiri and 67 Sandyno ewes). These elite animals were maintained as a separate flock and supplemented with concentrate feed (Table 1) at 200 g daily from weaning to 6 months of age. After 6 months the elite animals were fed with 300 g throughout their lifetime, along with 6–8 h of routine grazing in *kikuyu* grass dominated pasture. The grasslands of the farm are covered with many short coarse species of grass such as *Themeda* sp., *Bromus* sp. *Paspum* sp., *Paspalidum* sp. etc.

The contemporary group (group B) of ewe lambs in the respective breeds was supplemented with 150 g of concentrate till they attain one year of age. After one year they are entirely based on pasture alone. Concentrate feed will be provided to pregnant ewes during the last month of pregnancy and to lambed ewes. Animals were weighed at 6, 9 and 12th months of age to assess the body weight gain.

The adult ewes of both breeds and groups were teased with apronized rams and those ewes found in estrum were hand mated with suitable rams and were maintained as separate flock till lambing. The lambs born were identified with their mother and are ear tagged. The lambs are weaned at 3 months of age. The birth weight, weaning weight, 6 months weight and yearling weight were recorded up to February 2020 lambing. Least square procedure (Harvey 1990) was used to study the effect of level of nutrition and genetic selection on the growth performance of the elite animals and their progenies. The linear statistical model was used for analysis of various traits. The differences between the least square means for subclasses under a particular effect were tested by Duncan's multiple range test modified by Kramer (1957). The survivability and mortality percentage of lambs were compared by Chi square test of significance.

RESULTS AND DISCUSSION

The performance of sheep is based on its genetic potential and expression of its characteristics depends on providing sufficient nutrition and other managemental condition (Gaskins *et al.* 2005, Aliyari *et al.* 2012, Aktas and Dogan 2014). The ewe lambs were selected based on the Breeding value. The weaning weight of selected elite Nilagiri (11.60±0.22 vs 8.40±0.12 kg) and Sandyno (12.83±0.27 vs 9.27±0.13 kg) ewe lambs were significantly higher than the contemporary lambs. Average body weight of Nilagiri and Sandyno elite lambs at 6, 9 and 12 months of age were significantly higher than their contemporary lambs (Table 2).

Hogget weight and ADG: The Hogget weight was significantly higher (P<0.01) in elite Sandyno ewes in comparison to elite Nilagiri lambs (18.17±0.29 vs

Table 2. Effect of genetic selection and nutrition on the growth rate of ewe lambs

Parameter	Hogget weight			ADG- weaning to 6 months		
Breed	Elite	Contem	Overall	Elite	Contem	Overall
Nilagiri	16.27±0.29 (77)^{a}	13.45±0.18 (207)^{b}	14.89±0.16 (284)^{X}	49.78±2.66 (77)	45.45±1.62 (207)	47.46±1.51 (284)^{X}
Sandyno	18.17±0.29 (67)^{a}	15.15±0.11 (483)^{b}	16.63±0.14 (550)^{Y}	55.17±2.96 (67)	52.21±1.10 (483)	53.95±1.32 (550)^{Y}
Overall	17.22±0.21 (144)^{A}	14.29±0.10 (690)^{B}	15.76±0.11 (834)	52.52±1.99 (144)	48.89±0.98 (690)	50.70±1.11 (834)
Parameter	9 months weight			ADG- 6 to 9 months weight		
Breed	Elite	Contem	Overall	Elite	Contem	Overall
Nilagiri	20.51±0.31 (77)^{a}	16.88±0.21 (178)^{b}	18.79±0.18 (255)^{X}	47.04±2.40 (77)^{a}	33.60±1.58 (178)^{b}	41.08±1.45 (255)^{X}
Sandyno	23.88±0.35 (66)^{a}	19.37±0.14 (398)^{b}	21.47±0.16 (464)^{Y}	62.98±2.80 (66)^{a}	42.08±1.14 (398)^{b}	52.53±1.28 (464)^{Y}
Overall	22.17±0.24 (143)^{A}	18.09±0.13 (576)^{B}	20.13±0.13 (719)	54.79±1.85 (143)^{A}	37.52±0.98 (576)^{B}	46.15±1.04 (719)
Parameter	Yearling weight			ADG- 6 to 9 months weight		
Breed	Elite	Contem	Overall	Elite	Contem	Overall
Nilagiri	24.21±0.36 (74)^{a}	20.03±0.24 (169)^{b}	22.24±0.21 (243)^{X}	40.84±2.09 (74)^{a}	33.51±1.39 (169)^{b}	37.83±1.27 (243)
Sandyno	28.22±0.39 (66)^{a}	22.83±0.17 (356)^{b}	25.33±0.19 (422)^{Y}	48.20±2.40 (66)^{a}	34.43±1.03 (356)^{b}	41.25±1.11 (422)
Overall	26.19±0.27 (140)^{A}	21.38±0.14 (525)^{B}	23.78±0.15 (665)	44.38±1.61 (140)^{A}	33.70±0.87 (525)^{B}	39.04±0.91 (665)

16.27±0.29). Similarly, the elite ewes (17.22±0.21 vs 14.29±0.10) weighed significantly (P<0.01) higher than the contemporary lambs. However, the increase in ADG in the elite lambs was not significant. The average daily gain in lambs from 3 months to 6 months was significantly higher (P<0.01) in Sandyno lambs than Nilagiri lambs (47.46±1.51 vs. 53.95±1.32). Addition of only 50 g of concentrate may have resulted in a marginal increase in the daily gain in body weight in elite lambs. However, the significant difference in weaning weight was reflected in significant difference in hogget weight between elite and contemporary lambs and among the breeds.

Nine months body weight and ADG: Highest ADG was observed in Sandyno elite ewe lambs during this period (62.98±2.80). Significantly higher (P<0.01) growth rate was observed during this period in elite ewes (54.79±1.85 vs 37.52±0.98). Similarly, the 9 months weight was also significantly higher (P<0.01) in elite ewes of both breeds (22.17±0.24 vs 18.09±0.13). Based on the increase in body weight the feed was increased to 300 g after 6 months in elite animals, which may have contributed to the increased growth and resulted in higher ADG and increased 9-month body weight in both elite Nilagiri and Sandyno lambs.

Yearling weight: The yearling weights of elite ewes in both breeds were significantly higher (P<0.01) than their contemporaries (26.19±0.27 vs 21.38±0.14). The ADG was also significantly higher in elite ewes (P<0.01). The yearling weight of Nilagiri and Sandyno ewes achieved in the present study was higher than the body weight reported for both the breeds (Rajendran 2005 and Anil Kumar *et al.* 2011). The elite Nilagiri (24.21±0.36) and Sandyno ewes (28.22±0.39) have attained 120 to 125% of the body weight of contemporary ewes. The growth rate was the lowest during this period in both elite and contemporary ewes.

Among the three stages in elite ewes the ADG was highest during 6–9 months and significant reduction was observed during 9–12 months. In contemporary ewes there is a gradual reduction in ADG from 3–12 months. ADG during 6–9 and 9–12 month was same In Nilagiri contemporary ewes. However, there is 20% reduction in the ADG in Sandyno contemporary ewes from 6–9 to 9–12 month. The lambs selected were from the main lambing season (February and March) and hence the 9–12 months period was during winter and early summer, where all the pasture grass will be dry due to ground frost and they depend heavily on the concentrate and corn silage. The reduction in quality of pasture may be the major reason for the reduction in the growth rate during this period, which was more pronounced in contemporary ewes.

Effect of genetic selection and nutrition on the growth rate of lambs produced: Elite ewes of Nilagiri (325/74) and Sandyno (358/66) have produced on an average 4.39 and 5.42 lambs in their life time. The average birth weight of born elite Nilagiri (2.88± 0.15 vs 2.63±0.15) and Sandyno lambs (3.41±0.17 vs 3.04±0.17) were significantly heavier (P<0.01) than lambs produced by contemporary ewes (Table 3). Gaskins *et al.* (2005), Kenyon *et al.* (2011) and Pettigrew *et al.* (2019) observed significant effect of dam's weight at mating on birth weight. Increase in birth weight of born elite lambs may be due to the higher body weight and condition of the elite dam at breeding. The advantage of higher birth weight was carried up to weaning stage possibly through higher milk yield. The elite ewes have produced more number of twins. Generally, birth weight of the twin lambs will be less than single lambs (Anilkumar *et al.* 2009, Aktas *et al.* 2015), in spite of having more twins the birth weight was significantly higher in born elite ewes of both breeds. In addition, 25% of the born elite lambs were produced by maiden ewes. Lambs produced by first time lambing ewes will be lower in birth weight and survivability (Gardner *et al.* 2007, Anilkumar *et al.* 2009 and Aktas *et al.* 2015). In the present study no significance difference was observed among the lambs born to elite Nilagiri ewes of different parity (1st to 5th parity – Table 3). However, there is significant difference (P<0.05) in birth weight based on parity in elite Sandyno ewes. The lambs produced by 4th parity elite ewes were the heaviest (3.60± 0.09) and lambs born to maiden Sandyno ewes were the least (3.14±0.09 (Table 4). In spite of the difference the birth weight of lambs born were marginally higher than the reported average birth weight of Sandyno lambs (Rajendran 2005, Anil Kumar *et al.* 2011).

Weaning weight and survivability: The number of lambs weaned were comparatively higher in born elite Nilagiri (93.54 vs 90.82%) and Sandyno (94.69 vs 91.73%) lambs (Table 5). The survivability of the twin and triplet lambs produced were significantly higher in Nilagiri (X^2=3.958, P=0.047) and Sandyno lambs (X^2=3.958, P=0.047). Increased nutrition of selected ewes with high breeding value have increased the growth rate and there by increased the body condition. The increase in body weight and body reserves may have resulted in higher birth weight of lambs and increase in milk production. All of these may have contributed for the higher survivability even in twin and

Table 3. Growth rate of lambs born to elite and non-elite ewes (NBE)

Breed	Weight	Birth weight	Weaning weight	Hogget weight	Yearling weight
Nilagiri	Born Elite	2.88±0.15^{a} (325)	11.52±0.77^{a} (304)	16.00±0.24^{a} (218)	23.71±0.32^{a} (164)
	NBE	2.63±0.15^{b} (1722)	10.02±0.76^{b} (1564)	14.77±0.17^{b} (870)	22.27± 0.23^{b} (533)
	Overall	2.75± 0.15 (2047)	10.77±0.76 (1868)	15.38±0.17 (1088)	22.99±0.23 (697)
Sandyno	Born Elite	3.41±0.17 (358)	12.91±0.86 (339)	17.38±1.09 (258)	26.31±0.36 (202)
	NBE	3.04± 0.16^{a} (1722)	11.31±0.84^{a} (1885)	16.18±1.07^{a} (1100)	25.80±0.29^{a} (646)
	Overall	3.23±0.17^{b} (2413)	12.11±0.85^{b} (2224)	16.78±1.07^{b} (1358)	26.06±0.29^{a} (848)

Table 4. Effect of parity of elite ewes on the birth weight and weaning weight of lambs

Parity	Birth weight		Weaning weight	
	Nilagiri	Sandyno	Nilagiri	Sandyno
Overall	2.85± 0.04 (326)	3.37± 0.07 (321)	11.43±0.18 (305)	12.88±0.34 (306)
Parity-1	2.75±0.06^{NS} (79)	3.14±0.09^{c} (67)	10.84±0.32^{d} (72)	12.42±0.45^{c} (59)
Parity-2	2.92±0.07^{NS} (72)	3.43±0.09^{b} (67)	11.28± 0.33^{c} (70)	12.80±0.43^{b} (65)
Parity-3	2.86± 0.07^{NS} (69)	3.45±0.09^{b} (65)	11.74± 0.33^{b} (64)	14.10±0.47^{a} (58)
Parity-4	2.82±0.08^{NS} (55)	3.60±0.09^{a} (58)	12.15± 0.37^{a} (50)	12.87±0.46^{b} (59)
Parity-5 & above	2.92± 0.08^{NS} (51)	3.35±0.09^{b} (64)	11.38± 0.39^{c} (49)	12.19±0.47^{c} (61)
Male	2.92±0.05^{a} (167)	3.48±0.07^{a} (168)	11.45±0.22^{NS} (157)	13.02±0.37^{NS} (163)
Female	2.78±0.05^{b} (159)	3.25±0.07^{b} (153)	11.40±0.24^{NS} (148)	12.73±0.37^{NS} (143)
Single	3.02±0.03^{a} (252)	3.41±0.03^{a} (303)	11.95±0.17^{a} (235)	13.13±0.16^{a} (289)
Twin	2.28± 0.06^{b} (74)	2.74±0.13^{b} (18)	9.94±0.31^{b} (70)	10.63±0.65^{b} (17)

triplet lambs and resulted in heavier lambs with high weaning percentage.

The average weaning weight and hogget weight of lambs was significantly higher in born elite Nilagiri (11.52±0.77 and 16.00±0.24 vs 10.02±0.76 and14.77±0.17) and Sandyno lambs (12.91±0.86 and 17.38±1.09 vs 11.31±0.84 and 16.18±1.07). The yearling weight of the born elite Nilagiri lambs was significantly higher (23.71±0.32 vs 22.27±0.23). However, the yearling weight was non-significantly higher in Sandyno lambs (26.31±0.36 vs 25.80±0.29). Average weaning weight, hogget weight and yearling weight of lambs produced by contemporary ewes were similar to those observed by Rajendran (2005) and Anilkumar *et al.* (2011). The effect of selection of ewes and additional nutrition have even increased the growth performance of their progenies even though the lambs born are all maintained with similar nutritional levels shows that the effect of selection is extended to the next generation and if an additional quantity of feed are provided, the performance is going to be further enhanced.

In conclusion genetic selection and providing higher level of nutrition improves the growth rate, yearling weight of the ewes. It also increases the birth weight, weaning weight and survivability of lambs produced. For the sheep farmers, these findings, will help in promoting genetic selection and improved nutritional management from weaning to improve growth rate and better lamb crop and survivability. The cost of extra feeding was well compensated by the increased body weight, more number of heavier lambs with increased weaning percentage. Marginal increase in the feed would bring a substantial improvement in the performance of the sheep.

Table 5. Weaning percentage (Survivability) of born elite lambs and lambs born to contemporary ewes (NBE)

Breed		Single	Twins	Total
Nilagiri	Born elite	93.47 (229/245)	93.75^{a} (75/80)	93.54^{a} (304/325)
	NBE	91.96 (1293/1406)	85.71^{b} (270/315)	90.82^{b} (1563/1721)
	Total	92.19 (1522/1651)	87.34 (345/359)	91.25 (1867/2046)
Sandyno	Born elite	94.63 (317/335)	95.65^{a} (22/23)	94.69^{a} (339/358)
	NBE	92.25 (1750/1897)	85.44^{b} (135/158)	91.73^{b} (1885/2055)
	Total	92.61 (2067/2232)	86.74 (157/181)	92.17 (2224/2413)

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