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Effect of Non-Genetic Factors on Reproductive and Growth Performance of Abera Sheep under Community Based Breeding Program in SNNPRS Ethiopia

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Abstract

The study was conducted in Sidama Zone, Dara District Southern Ethiopia. The intention was to investigate the effect of non-genetic factors on reproductive and growth performance of Abera sheep in the District. For this study three years (2013-2015) performance data were obtained from Hawassa research center, Dara sub-site. Study identified age at first lambing (AFL) and lambing interval (LI) of the sheep were 9.6 and 12.9 months, respectively; while annual reproductive rate and litter size of the ewes were 1.9 and 1.5 heads. Average birth weight, weaning weight and 6 month weight of Abera sheep were 2.8, 12.3 and 18.5 kg, respectively; while pre and post weaning average daily weight gains were 106 and 40 g/day, respectively. Birth type, sex and year had significant ($p<0.05$) effect on birth weight (BWT), weaning weight (WWT) and six-months weight; whereas season and parity had significant ($P<0.05$) effect on BWT and WWT only. Sex and birth type had significant ($p<0.01$) effect on pre-weaning average daily gain whereas year, season and parity had significant effect on both pre and post-weaning average daily gain. There was within breed variability in growth traits, which were significantly influenced by non-genetic factors like birth type, sex, year, season and parity. Selection for further improvement to achieve higher lamb crop with superior growth performance should be prioritized as within population variability is raw material for improvement through selection. Molecular characterization should also be carried out to identify uniqueness of Abera sheep.

Keywords: Abera sheep; Growth performance; Reproductive performance

Introduction

Ethiopia is endowed with huge livestock resources of diversified genetic pools with specific adaptations to a wide range of agro-ecologies. Livestock is one of the most essential, complex and diverse subsectors of world agriculture and a primary means of poverty reduction in rural areas. The demand for livestock products is increasing due to the growing urban population, while farm areas are shrinking considerably as a result of an increase in the rural population and fragmentation of grazing land [1]. Small ruminants play significant role to satisfy the demand for livestock products under diminishing natural resources. They have lower feed requirements compared to cattle due to their small body size and they are able to survive and produce under poor environments on low cost feeds [2].

There are about 29.33 million heads of sheep in Ethiopia [3], and the majority of the population are found in the highlands and mid altitudes of Ethiopia where mixed crop production dominates with a quarter reared in the lowlands [4]. The role of sheep and their products differ from region to region and are largely dependent on ecology, economic factors and culture. Their contribution as a source of income, provision of quality nutrition and hedge against risk besides the cultural benefits they provide [5,6]. Though the contribution of sheep in Ethiopia is high, their productivity is constrained by lack of technical capacity, feed scarcity, diseases, poor infrastructure and lack of market information and planned breeding program and policies [7]. Sheep as livelihood of smallholder farmers of Ethiopia whether they are pastoralists or crop-livestock practitioners, utilizing these resources through efficient management by optimizing their genetic gain is crucial for both food security and sustainable development. Suitable breeding program is the option for sustainable improvements of animal stock and its potential to produce quality outputs. Recording is one of important tools, and hardly practiced in any livestock species in the country to identify the performance and management gaps [8,9].

Cognizant of this, the International Center for Agricultural Research in Dry Areas (ICARDA), the International Livestock Research Institute (ILRI) and the Austrian University of Natural Resources and Life Sciences (BOKU) in collaboration with the National and Regional Agricultural Research Systems in Ethiopia initiated new approach which has national and global interest is community-based breeding program in 2007. The program was mainly focused on indigenous genetic resources of sheep and traditional breeders were total involved in all steps of breeding program [10-12]. Southern Region Agricultural Research Institute (SRARI) was an active implementing partner of the community-based sheep improvement program and launched community based sheep breeding programs at different Zones in the region following the same approach. Abera sheep population in Dara District of Sidama Zone is one of the indigenous sheep genetic resources involved in the improvement program and recording reproductive and growth traits has been taking place since 2013.

Production system identification studied by Shimelis [13] did not analyze reproductive and growth data. Uncontrolled mating was also commonly practiced in the study area before the start of community-

based breeding program; this will also accelerated inbreeding of population and should be shifted in to another system. Therefore community based breeding program (CBBP) is the option to be practiced for sustainable sheep genetic improvement in the study area. Indigenous knowledge of farmers in sheep breeding practices, selection criteria, and evaluation of productivity level of sheep population in their habitat is a prerequisite for genetic improvement in smallholder levels [10]. Unfortunately, there have been virtually no studies conducted to evaluate the reproductive and growth performance of Abera sheep under community based breeding program initiated in Dara district. Therefore, the present study was carried out with the following objectives.

Objective

- To evaluate the on-farm reproductive performance of sheep
- To evaluate growth performance of lambs till six months of age
- To provide feedback for future improvement of the sheep

Materials and Methods

Study area description

The study was conducted in Dara district of Sidama zone located at 85 km away from Hawassa to the south eastern part of the country in Southern Nations, Nationalities and Peoples' Regional State (SNNPRS). Longitude of 38º 38'-38º 51'E and latitude of 6º 36'-6º 54'N was geographical position of district with altitude ranging from 1200 to 2900 meters above sea level. Average annual maximum and minimum temperature of 28OC and 19OC respectively, with 1200-1700 mm ranges of total rain fall. From 33 Keble of the district, 10 Keble (30.3%) were dega, 16 Keble's (48.5%) were woynadega and 7 Kebles (21.2%) were kola. Mixed crop-livestock production system was agricultural practices of district. The District has livestock population of 102,885 heads of which 17,297 are cattle; 26,595 sheep; 13,440 goats; 40,817 chicken and 4,736 were equines as reported by Dara district Agricultural office report (DDAO, 2014).

Sampling procedure

The study area was selected purposively based on the existence of community based Abera sheep breeding programme. A total of 380 sheep with its record were considered for this study was evaluated for reproductive and growth performances.

Data collection methods

Secondary sources of information (reproductive and growth performance) data collected over the last three years (2013-2015) by South Agricultural Research Institute (SARI) were used.

Reproductive traits such as lambing interval (LI), age at first lambing (AFL), litter size (LS), annual reproductive rate (ARR), weaning rate, twinning rate, sex ratio, parity and mortality rate and growth traits (birth, weaning and six month body weight and pre and post weaning average daily weight gain) gathered by the research center since 2013 G.C. was also used for this analysis.

Data management and analysis

Data collected were entered in to computer, organized, summarized and analyzed using the Statistical Package for Social Sciences (SPSS) software version 16.0 for windows and Excel 2010. Data on growth performance were subjected to ANOVA for estimation of the magnitude of the effect of non-genetic factors. For this, least squares mean (LSM) from General linear model (GLM) procedures of SPSS was employed. Reproductive traits like lambing interval, age at first lambing and life time lambing were analyzed by descriptive statistics. Other parameters like pre-weaning mortality rate, weaning rate, twinning rate, litter size and annual reproductive rate were computed on percentage basis using their respective formula as indicated below.

$$ARR = ALS * 365 \div LI$$

Where:

ARR-Annual Reproductive Rate (lambs born per breeding ewes per year);
ALS-Average litter size;
LI-Lambing interval;
365- Days of one year

$$\text{Litter size} = \frac{\text{number of lambs born}}{\text{number of ewes lambing}} \times 100\%$$

$$\text{Weaning rate} = \frac{\text{no. of lambs weaned}}{\text{total number of ewes lambing}} \times 100\%$$

$$\text{Pre-weaning survival rate} = \frac{\text{no. of lambs weaned}}{\text{total no. of lambs born}} \times 100\%$$

$$\text{Pre-weaning ADG} = (\text{weaning weight} - \text{birth weight}) / \text{weaning age}$$

The effect of fixed factors like: year of birth (2013, 2014 and 2015), season of birth (dry and wet), sex of lambs (male and female), birth type (single and multiple) and parity (1 up to ≥ 6) was fitted in the statistical model below.

$$Y_{ijklm} = \mu + V_i + N_j + O_k + H_l + Z_m + E_{ijklm}$$

Where:

Y_{ijklm} =Weights at different ages and ADG of individual lambsμ=Over all mean

V_i=Fixed effect of sex of lams (i=male, female)

N_j=Fixed effect of litter size of lambs (j=single, multiple)

O_k=Fixed effect of season of lambs (k=dry, wet)

H_l=Fixed effect of year of lambs (l=2013, 2014 &2015)

Z_m=Fixed effect of parity of dam (m=1, 2, 3…≥ 6)
E_{ijklm}=Random/ error effect

Results and Discussion

Reproductive performance of Abera sheep

A total of 380 births were recorded between 2013 and 2015. The result pertaining to reproductive traits of Abera sheep are presented in Table 1. The number of ram lambs was slightly higher (53.4%) than that of ewe lambs in the study area giving sex ratio of 1:1.15 of female to male lambs slightly deviating from the expected 1:1 ratio. The sex ratio obtained from the present study, 1:1.15 is in agreement with those reported for Bonga sheep, 1:1.15 by Mestafe [14]. Twining rate of 36.7 %) reported by the current study is comparable with reported by Zewdu et al. [7] for Bonga sheep. Unintentional selection against twin bearers as practiced by the producers might be the reason for lowering

twining rate. High litter size is economically important trait that enhances sheep productivity in terms of producing more number of lambs. Prolificacy based selection can enhance twining rate of sheep and thus should be practiced and adopted by different communities.

Average weaning rate, 97.8% and pre-weaning mortality rate, 16.8% of the sheep flock were obtained from the current study (Table 1). Improved nutrition of ewes during gestation and at lambing can reduce lamb mortality as nutritional status affects the birth weight of the offspring as well as the milk production of the ewes.

Covering new born lambs with the basket for first few weeks can reduce lamb mortality from physical damage and protect lambs from chilling effects at night. Therefore, farmers should aware to improve nutritional status of breeding ewes during gestation and lambs should also cover with basket for the first few weeks of deliverance. Diseases associated with respiratory complexes like pneumonia were also suspected for lamb death in the study area. Service per conception, annual reproductive rate (ARR) and litter size/prolificacy (LS) of Abera sheep were 1.1, 1.9 and 1.5 heads, respectively (Table 1). ARR is defined as the number of lambs or kids weaned per ewe or doe of reproductive age per year. The effect of reproduction on sheep is best estimated by the annual reproductive rate (ARR). ARR for the current study, 1.9 lambs per breeding ewe per year falls with upper range of the 0.89-1.97 per head reported for tropical sheep [15]. Larger value, 1.96 than the current finding, 1.9 was reported by Addisu [16] for Doyogena sheep. Average litter size of sheep under the current study, 1.5 lambs per heads is within the range of tropical sheep breeds, 1.08 and 1.75 litter size reported by [8]. The finding of the current study is comparable to average litter size of 1.42 reported by Getahun [1] for Adilo sheep. Depending on management system and other environmental setups, there could be variation in litter size from place to place.

Abera sheep can give birth of about 9.5 lambs on an average in their life time (Table 1). Higher than, 13.5 lambs the current figure, 9.5 lambs was reported by Solomon [17] for Gumuz sheep and, 11.4 lambs by Mestafe [14] for the Bonga sheep. Average age at first lambing (AFL) and lambing interval (LI) of Abera sheep were 12.9 and 9.6 month respectively (Table 1). Age at first lambing (AFL) in the present study was almost comparable with reports by Yilmaz [18], 12.7 months, 122.9 months. Age at first lambing (AFL) is influenced by genetic (post weaning growth) and non-genetic (nutrition, disease and parasite infestation) factors resulting in wide variability within and between breeds and among different production system. Better management and planed nutrition for earlier maturity and thus for earlier age at puberty could help to shorten the age at first lambing.

Lambing interval (LI) is also one of the determinant factors in sheep reproductive performance. Generally, there was a reduced trend of lambing interval between successive parturitions as parity advanced, except when there was abortion and other reproductive problems. The shorter lambing interval gives better opportunity to increase lifetime productivity of ewes by increasing the number of lamb crops. This leads to an increased reproductive efficiency of sheep. The average lambing interval (LI) found in this study 9.6 month was higher than the previous finding 8.7 month by Shimelis [13] for Sidama ewes. Higher than what has been found under the current study, 12.1 months was reported by Samuel [19]. The trait may vary depending on management variation, breed type and environmental factors among the others. There may be feed shortage for early weaning of lambs as it may results in reduction of reproductive efficiency of sheep. Shortage of grazing area due to increased demand of land for crop production may also be another constraint.

Parameters	Mean ± SE
Lambing interval (months)	9.6 ± 0.24
Age at first lambing (months)	12.9 ± 0.26
Age of sexual maturity for breeding ram (months)	7.9 ± 0.2
Sex ratio (female to male)	01:01.1
Litter size	1.5 ± 0.003
Pre-weaning mortality rate (%)	16.8
Weaning rate (%)	97.8
Twinning rate (%)	36.7
Annual reproductive rate (in head)	1.9
SE=Standard Error of the mean	

Table 1: Reproductive traits for Abera sheep.

Growth performance of Abera sheep

The overall average body weights at different ages of sheep are summarized in Table 2. Birth weight, weaning weight and six month weight of Abera sheep were 2.8, 12.3 and 18.4kg, respectively. All non-genetic factors (sex, birth type, season, year and parity) had significant effects on birth weight of Abera sheep. The birth weight obtained under the current study (2.8 Kg) was almost comparable with birth weight (2.89 Kg) reported for the Bonga sheep. The 12.3 Kg average weaning weight (at 90 day) of Abera sheep reported by present study was comparable to 12.23 kg reported by Getahun [1] for Arsi-Bale, Arsi Zone. Larger value than the current finding, 15.5 kg was also recently reported by Mestafe [14] for Bonga sheep. Weaning weight of lambs is an indicator for both maternal aptitude of their dams and pre-weaning growth potential of the lambs. Good mothering ability and lactation potential of ewes has significant effects on weaning weight of lambs. This could be associated with heavier weight of lambs at birth and pre-weaning growth performance of lambs. Average six month (180 day) weight, 18.5 kg obtained from present study is lower as compared with 22.2 kg reported for Bonga sheep by Mestafe [14]. This may be due to youngness of genetic improvement program in the study area and would further be improved by continuing within population selection in breeding program.

There was encouraged pre-weaning average daily weight gain, 106gm/day as post weaning average daily weight gain of lambs, 40 gm/day was lower and needs further improvement. The result of pre-weaning average daily gain (ADG) found in the present study, 106 g/day was comparable with 107.1g/day reported by Mengistie [17] for Washara sheep. Average pre-weaning daily weight gain and weaning weight of lambs were affected by the mothering ability of the dam [8]. This is particularly important during the growth stages of lambs when there is more dependent on the milk production of the ewe rather than on forage. The growth rate of lambs decreased with the advancement of age as seen from the present result which is 40g/day for latter age (Table 2). Girma [8] reported, this could be due to the decrease of maternal effect of dams on the growth performance of their progeny. The drop in growth rate after weaning of lambs also could be due to the weaning shock as reported.

Effect of fixed factors on body weight of Abera sheep at different ages

The results pertaining to effect of fixed factors on body weight of Abera sheep are presented in Table 2. The result as presented shows that growth and reproductive performance of sheep in the study area was affected by fixed factors like birth type, sex, and year of birth, seasons and parities. There was significance difference (P<0.05) in birth weight (BWT), weaning weight (WWT) and six month body weight (6MWT) between males and females (Table 2). The ram lambs had higher body weight than ewes from birth to six months of age. The variation in birth weight between the two sexes found in the present study was in agreement with those reported by Derbe [14,18,20]. The effect of sex on weaning weight also significant (P<0.05) as male lambs had higher weaning weight than female lambs. The superiority of male lambs over ewe lambs is by about 1.1 kg at weaning. The difference in weaning weight of ram lambs observed in the present study is in line with reports of [14]. Ram lambs were superior over ewe lambs by about 1.0 kg at six months of age and similar result was also reported by Mestafe [14]. The difference in body weight of ram lambs at different stage of growth reported by Momoh et al. [21] was in agreement with the current findings. Litter size also had significant effect on birth weight of sheep in the study area where single born lambs were heavier than their multiple counterparts (P<0.05). Similar result was reported by Momoh et al. [21-23]. This could be because of the finite capacity of the maternal uterus space to gestate offspring. This could be also because of intrauterine competition of the multiple born lambs both for space and nutrient as reported by Mousa [22]. Body weight at latter age was also significantly affected (P<0.05) by litter size. Single born lambs had significantly higher weaning weight (at 90 day) than multiples. Multiple born lambs (twine and triple) had lower body weight at weaning than single born lambs at the same ages. The significant effect of birth type on the body weight at weaning was because of competition among the multiples than singles for limited amount of milk of the dams. The current finding was in agreement with results reported by Mestafe et al. [14,22]. Singles were heavier at six month of age i.e. they maintained their superiority at birth still 180 days. It was single born lambs which were heavier about 2 kg than multiple born lambs at this stage. The significant variation of six month weights due to birth type in the current study is in agreement with Mestafe et al. [14,21].

There was significant variation in birth weight during the three years (2013, 2014 and 2015) considered in the current study (Table 2). Significantly higher (P<0.05) birth weight was observed in 2015 and the least was in 2013. The result of the current finding is similar to that reported by Mestafe [14]. There was variation (P<0.05) in body weight of lambs at latter age among the year of birth. Accordingly, higher weaning (90 day) weights of lambs were observed in 2015. Observed weaning weight between 2013 and 2014 was almost similar i.e. there was no significant variation in weaning weight between year 2013 and 2014. Variation in weaning weight found in present study among the years of birth was in agreement with Mestafe [14]. Significant variation in body weight at six months of age due to year of birth found in the present study was in agreement with results reported by Berhanu et al. [24]. Higher six month weight in the present study was observed in 2015. The higher six month weight associated with the year 2015 was may be due to the effect of the community based selection.

Season also had significant (P<0.05) effect on birth weight where higher birth weight was observed in dry season (Table 2). The result of this study is in agreement with reported by Derbe [20] in Alaba special Woreda. Higher birth weight in dry season under the current study could be due to the better body condition and body reserves of the dams at the end of the big rainy season. In addition, relatively better available feed in the early dry season could further contribute for the foetus development [25].

On the contrary, lambs born in the small rainy and subsequent big rainy seasons had significantly lower (P<0.05) birth weights. The observed lower birth weights in small rainy season might partly be attributed to the critical feed shortage at the end of the dry season which negatively affected the dams and thereby the foetus development. The incidence of parasite infestation also impairs growth of lambs in the big rainy season. The effect of seasonal differences in birth weight due to differences in ambient temperature and maternal pre-natal effects during gestation was reported by Yilmaz et al. [18]. Seasonal variation also had significant (P<0.05) effect on body weight of sheep at latter age; specially on weaning weight. Lambs born in dry season were superior in weaning weight over those lambs born in wet season (P<0.05). This might be due to the availability of feed particularly crop leftover that may favored dams milk production. Significant effect of seasonal variation on weaning weight was reported by Momoh [21] which in line with the present result. The effect of parity was found significant (P<0.05) on birth weight of Abera sheep. Significantly lower birth weight was observed at first parity and the higher birth weight at fifth parity. There was a declining trend in birth weight after fifth parity, indicating the maximum productive periods might be before the sixth party in the Abera sheep. This indicated that the dams should stay in a flock until the 6th parity and should then be culled. Lower birth weight at early parity is due to younger ewes are still growing and there is a competition between the fetus and the dam for nutrients, which has negative influence on birth weight [26]. Heavier birth weight could be obtained at late parities due to heavier dam weight and larger body size Awgichew [27] and physiological imprint in the uterus during the first pregnancy which will facilitate relatively greater foetal growth in the subsequent pregnancies (). Weaning weight of lambs also affected significantly (P<0.05) by ewes' parity. As parity of ewes increase, the weaning weight also rise which is in line with previous findings of [28] who found out that parity had significantly influenced weaning weight and dams with higher parity produced heavier lambs at weaning. Variation in weaning weight due to parity reported by Momoh [21] was also in consensus with the current result. This could be a reflection of enhanced mothering ability of ewes as age increases and failure of young ewes to provide sufficient nourishment for the growth of fetuses [29].

Variables	N	BWT	N	WWT	N	6-MWT
Overall	380	2.8 ± 0.015	221	12.3 ± 0.1	154	18.5 ± 0.15
CV (%)		11.03		13.8		10.3
Sex		*		*		*
Male	202	2.8 ± 0.03b	119	12.7 ± 0.18b	82	19.0 ± 0.27b
Female	178	2.7 ± 0.03a	102	11.6 ± 0.19a	72	18.0 ± 0.25a
Birth type		*		*		*
Single	234	2.8 ± 0.03b	129	12.7 ± 0.2b	83	19.4 ± 0.3a

Multiple	146	2.7 ± 0.02a	92	11.7 ± 0.18a	71	17.4 ± 0.2b
Year		*		*		*
2013	19	2.6 ± 0.05a	18	11.7 ± 0.3a	17	16.9 ± 0.3a
2014	130	2.8 ± 0.02b	130	12.1 ± 0.1a	119	18.7 ± 0.1b
2015	231	2.9 ± 0.03c	73	12.7 ± 0.2b	18	20.1 ± 0.4c
Season		*		*		NS
Dry	284	2.9 ± 0.03a	129	12.7 ± 0.18b	71	18.0 ± 0.3a
Wet	96	2.7 ± 0.03b	92	11.7 ± 0.20a	83	18.7 ± 0.2a
Parity		*		*		NS
1	26	2.5 ± 0.03a	21	11.0 ± 0.3a	20	18.0 ± 0.4a
2	38	2.7 ± 0.04b	30	12.0 ± 0.2b	21	18.2 ± 0.4 a
3	52	2.8 ± 0.036b	33	12.5 ± 0.25b	23	18.1 ± 0.4 a
4	51	2.9 ± 0.037c	23	13.0 ± 0.3c	14	19.2 ± 0.5 a
5	94	3.1 ± 0.027c	34	13.5 ± 0.26ab	18	19.4 ± 0.4 a
≥ 6	46	2.8 ± 0.04b	29	11.6 ± 0.3b	24	18.7 ± 0.4 a

Mean values with different superscripts (a, b, c, ab) across columns are significantly different (P<0.05), *=P<0.05, BWT=Birth Weight, WWT=Weaning Weight, 6MWT=Weight at six months, N=number of observations, SE=Standard Error of the mean, CV=Coefficient of variance.

Table 2: Least square means (± SE) and effect of fixed factors on BWT, WWT and 6-MWT (kg) of Abera sheep.

Effect of fixed factors on average daily gain (ADG) of Abera sheep

The effect of fixed factors on pre and post weaning average daily (ADG) of Abera sheep was presents in Table 3. All fixed factors had significant (P<0.01) effect on pre-weaning average daily gain (Pre-WADG). Except sex and birth type, all fixed factors also had significant (P<0.01) effect on post-weaning average daily gain (Post-WADG).

Ram lambs gained significantly higher (P<0.01) ADG than ewe lambs before weaning. About 11.1 grams more weight per day was gained by ram lambs than ewe lambs in their pre weaning ages. Significant difference (P<0.01) between the two sexes in pre-weaning ADG was obtained under the present study which is in accordance with reported finding by Baneh et al. [30]. Single born lambs were superior (P<0.01) than multiples at pre-weaning growth rate (Pre-WADG). Significant effect of birth type on average daily weight gain of lambs reported by Getahun et al. [1,30] are comparable with the present result. The variation in pre-weaning growth rate by birth type of lambs could be due to competition for milk of dam in multiple births. The variation in pre and post weaning growth rate due to years were also significant (P<0.01). This could be explained by the variations in management, health, feeding, climatic condition and herdsman skills. The variation in growth rate of lambs before weaning stage due to years observed in the current finding was similar with the findings of different scholars Mestafe et al. [23,25]). Weight gain per day of Abera sheep was higher in dry season than wet season. Variation in weight gain before weaning stage due to season found in present study was in line with reported results [14,25]. Likewise, variation in weight gain after weaning stage by season observed in present study was in accordance with reported finding by Awigichew [8].

There was also significant (P<0.01) variation in growth rate of lambs due to parity before and after weaning stages. Variation in pre-weaning weight gain due to the parity found under the present study was in agreement with that reported by Awigichew [8] and Surafel et al. [29]. Significant effect of parity on post-weaning weight gain reported by Surafel et al. [29] was also in line with present result [30-41].

Variables	N	Pre-weaning ADG	N	Post-weaning ADG
Overall	221	106.0 ± 1.1	154	40.0 ± 1.4
CV (%)		15.9		45.2
Sex		**		NS
Male	119	110 ± 1.9b	82	37.4 ± 2.6
Female	102	98.9 ± 2.0a	72	40.8 ± 2.6
Birth type		**		NS
Single	129	110 ± 2.1b	83	41.9 ± 2.8
Multiple	92	99.8 ± 2.0a	71	36.0 ± 2.2
Year		**		**
2013	18	100.1 ± 3.6a	17	27.1 ± 3.8a
2014	130	103.9 ± 1.6a	119	42.7 ± 1.4b
2015	73	109.5 ± 2.1b	18	49.5 ± 4.3c
Season		**		**
Dry	129	109.3 ± 1.95b	71	48.3 ± 2.0b
Wet	92	100.4 ± 1.96a	83	25 ± 3.2a
Parity		**		**
1	21	93.8 ± 3.4a	20	31.8 ± 4.6a
2	30	105.8 ± 2.8b	21	36.9 ± 3.8a
3	33	107.0 ± 2.7b	23	39.5 ± 3.6a
4	23	111.8 ± 2.7c	14	43.1 ± 4.1b
5	34	117.7 ± 3.2c	18	51.6 ± 3.0c
≥ 6	29	99.0 ± 2.9b	24	49.0 ± 3.6b

Mean values with different superscripts (a, b, c) across columns are significantly different (P<0.01), **=P<0.01, LSM= Least square means, SE=Standard Error of

the mean, N=Number of observations, ADG=Average daily weight gain, g/day=grams per day, CV=Coefficient of variance.

Table 3: Least square means (± SE) and effect of fixed factors on average daily gain (g/day) of Abera sheep.

Conclusion and Recommendation

The results of the current study on effect of non-genetic factors on reproductive and growth performances of Abera sheep showed that lambing interval and age at first lambing were 9.6 and 12.9 months respectively, while the mortality and twining rates were 16.8% and 36.7%, respectively. Average litter size, annual reproductive rate and life time lambing were also 1.5, 1.9 and 9.5 heads, respectively. The average birth, weaning and six month weights were 2.8 kg, 12.3 kg and 18.5 kg, respectively while pre and post weaning average daily weight gain were 106 g/day and 40 g/day, respectively. All non-genetic factors investigated here had significant effect on the growth traits on one or other age groups. From the results of current study it was understood that the age at first lambing and lambing interval were longer and there was also higher within breed variability in growth traits considered under this study. Greater variation within the population indicates, there is a great possibility for genetic improvement through selection among the Abera sheep. Lamb mortality before weaning can also be reduced by improving nutritional status of ewes during gestation and lamb deliverance as well as protecting lambs from any physical damage. Therefore, farmers should keep the new born lambs covered with basket for the first few weeks to reduce young mortality from physical damage and protect lambs from chilling effects at night. Pre-weaning average daily weight gain of Abera sheep was encouraged and the drop in post-weaning weight gain could be due to the weaning shock; farmers need to give lambs with feed that can substitute the mother's milk. Further selection among the flock for desired reproductive and growth traits to achieve higher lamb crop with superior growth performance should be prioritized. Molecular characterization is needed to identify uniqueness of Abera sheep flocks.

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