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Original Article

Comparative Growth and Reproductive Performance Evaluation of Crossbred (Black Head Ogaden and Hararghe Highland with Dorper) Sheep under Different Nutritional Management

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ABSTRACT
An experiment was conducted from September2011up to January 2012 to compare growth and reproductive performance of crossbred sheep at two levels of nutrition (grazing + concentrate supplementation at 0.9% of body weight [N1] and grazing + concentrate supplementation at 1.5% body weight [N2])). Concentrate mixture was prepared from wheat bran and noug seed cake at a ratio of 2:1. The experiment was laid out similarly as 2×2 factorial arrangement using Completely Randomized Design. The number of animals included in the experiment was 20. The mean initial body weight for Black Head Ogaden[BHO]*Dorper and Hararghe Highland[HH]*Dorper sheep was 22.08±0.93 and 21.91± 0.73 (mean±se), respectively. From this research the following results was found. Crossbred sheep fed high level of nutrition had significantly higher value of average daily body weight gain (110±4.66; than crossbred sheep fed low level of nutrition (94±2.18). Correlation coefficients(r) between body weight and other linear body measurements (r= 0.91) for HH*Dorper ram and (r=0.93) for BHO*Dorper ram. To predict body weight from other linear body measurements, heart girth was found to be the best predictor. Breed had a significant effect on semen volume. HH*Dorper rams had significantly higher semen volume (1.048±0.04) than BHO*Dorper rams (0.89±0.05). Nutrition had also a significant effect on sperm motility (P<0.001). Thus, crossbred rams fed high level of nutrition had higher motile sperm cells (4.29±0.105) than their contemporaries fed on low level of nutrition (3.33±0.24). The interaction of breed by nutrition had a significant effect on sperm concentration. HH*Dorper sheep fed N2(T4) had higher sperm concentration followed by HH*Dorper fed N1(T3)>BHO*Dorper fed on N2(T2) >BHO*Dorper fed on N1(T1). Breed had significant effect on sexual behaviour traits of crossbred ram. HH*Dorper rams had higher value of lip curl response (25.83±3.12) and mount duration (3.27±0.12) than BHO*Dorper rams (2.36±0.18) for mount duration and (12.5±4.11) for lip curl.
keywords: Body weight, concentration, growth, heart girth, morphology, semen, volume

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INTRODUCTION

Most of the developing countries of the world are found in the tropics (Balls, 2003). These countries are currently experiencing high increase in human population, dramatic urbanization, moniterization of economics and income change (Winrock, 1992; Peters, 1992). Thus, the major issues to be addressed for these countries include reduction of under nutrition, enhancing food security, combating poverty and achieving agricultural growth that would contribute to overall economic development and environmental protection (FAO, 1995; Pelant *et al*, 1999). Contribution from sustainable increase in livestock production would, therefore, desirable in order to meet food security and protein requirement of human population and thereby build vibrant society.

Tropical areas are endowed with a wide variety of indigenous small ruminant breeds that have evolved to adapt to the prevailing harsh environmental conditions and traditional husbandry systems (Baker and Rege, 1994; Lebbie and Ramsay, 1999). However, indigenous tropical small ruminants have low genetic potential for functional traits. Due to this reason tropical countries devised strategies to improve the productivity of indigenous small ruminants, especially sheep which crossbreeding with improved genotype had been recommended (Kiwuwa, 1992; Baker and Gray, 2003). Thus, crossbreeds are expected to have higher vigor and better performance compared to local breeds. On-station research conducted on crossbreeding of indigenous sheep with improved exotic genotype revealed increased body weight (Sisay *et al*., 1989; Demeke *et al*., 1995; Solomon, 2002). Consequently, Ethiopia had imported few improved temperate breeds such as Awassi, Hampshire, Corriedale and Dorper for crossbreeding with indigenous breeds. Even though the performance of F1 crossbreds was high under on-station improved management, they were as good as purebreds under low-input conditions (Ayalew, 2000; Hassen *et al*., 2002). Among these, the Dorper is able to withstand dehydration and quickly replenish body weight losses when water becomes available (Degen and Kam, 1992). This capacity of Dorper sheep enables it to adapt to drier regions where the availability of water proves to be a limitation. The breed also adapts to temperate regions, and has been extensively used in accelerated mating systems (Basson *et al*., 1969; Manyuchi *et al*., 1991; Schoeman and Burger, 1992). Dorper and Dorper crossbreds are present in all the above average sheep farms in Zambia (Stafford and Hansson, 1991). Dorper sheep, which is widely distributed in African countries and well recognized as meat type, has been selected and imported for crossbreeding endeavors. It is believed that such kind of technological interventions become effective if supported with appropriate management and provided as a package (Singh and Acharya, 1981). *Therefore, the current objective of this study was to evaluate growth and reproductive performance of Black Head Ogaden×Dorper and Hararghe Highland × Dorper crossbred ram under different nutritional management.*

MATERIALS AND METHODS

Description of The Study Area

The experiment was conducted at Haramaya University Sheep Farm. Haramaya University is located 515 km east of Addis Ababa, at latitude of 9° N and longitude of 42° E. The site is situated at 1950 meter above sea level and has a mean annual rainfall of 790 mm and a mean annual temperature of 16°C (Mishra *et al.,* 2004).

Experimental Animals and Management

Before the beginning of the actual experiment, sheep house was cleaned and disinfected. The experimental pens, feeding and watering troughs were also carefully cleaned. Water was provided at all times. Supplementary feed was offered (every day at 04:30 p.m) after grazing throughout the experimental period. The experimental animals were randomly assigned to the two nutritional levels (0.9% and 1.5% of their body weight of concentrate supplementation). The experiment was started in October and lasted in May. All of the animals were routinely checked for any health problems and vaccinated against common diseases as well as dewormed and sprayed against internal and external parasites in the area every month.

Experimental Design, Treatments and Feeding Management

The experiment in the study was laid out similarly in 2×2 factorial arrangement (two level of nutrition and two types of breed) using Completely Randomized Design (CRD). The number of animals included in experiment was 20 (four treatment× five animals) with an average age of 6-8 month. The mean initial body weight was almost 22 for both breeds. The experimental animals were allowed to graze for 7.0 hrs per day and supplemented 0.9% and 1.5% of their body weight concentrate feed (mixture of wheat bran [66%], noug seed cake [33%] and salt [1%]). Concentrate feed offered was adjusted based on live body weight gain at every interval of 10 days. The treatment combination for the experiment was listed below.

Table 1: Treatment combinations

Breed	Nutrition(Diet)	Breed× Nutrition
BHO* Dorper Crossbred	Concentrate Supp. at 0.9% BW [N1]	T1
BHO*Dorper Crossbred	Concentrate Supp. at 1.5%BW [N2]	T2
HH*Dorper Crossbred	Concentrate Supp. at 0.9%BW [N1]	T3
HH*Dorper Crossbred	Concentrate Supp. at 1.5%BW [N2]	T4

BHO =Black Head Ogaden sheep; HH = Hararghe Highland sheep, Supp.=supplementation

Data Collection and Measurements

Body weight, body condition score and linear body measurements

Live body weight of ram lambs was recorded at 10 days interval, at 8:00 hrs in the morning before feeding. Average daily gain (ADG) was calculated as the difference between final live weight and initial live weight divided by the number of days of the feeding trial as described by Malau-Aduli *et al*. (2004).

$$ADG = \frac{(WF-WI) \times 1000}{D}$$

Where: ADG *g* = Average daily gain (gm); WI *kg* = Initial body weight; WF *kg* = Final body weight and D = number of days from starting to the end of the experiment (190), but if the number of days of the experimental period is long (above 90 days) a regression analysis was used by entering the data from initial until end of the experiment, if the data is available.

Body condition score was evaluated subjectively using the five point scale (ranging from 1=very thin, 2=thin, 3=average, 4=fat, 5=very fat/obese) according to Hassamo *et a*l. (1986). Sets of measurements were taken for the body measurements; Body length (BL), Rump height (RH), Wither height (WH), Heart girth (HG), Chest depth (CD), Forecanone length (FL) and Fore canone circumference (FC), Scrotum Circumference (SC). Most of these linear body measurements are measured using tailor measuring tape. Rump height, chest depth and wither height is measured by using a metal measuring tape.

Sexual behaviour of males

Sexual performance tests was initiated when the rams were approximately 10 months of age and was conducted on a 14 days interval for ten times. The study was conducted in between dry season and short rainy season. Sexual behavior was evaluated by placing each ram (with closing the genital part by leather material) in enclosed pen by using 1-2 estrous ewes and they must tied until the observations recorded for each ram throughout the 10-minute period.

The same pen was used for all tests and the order of testing was determined by random selection in order to eliminate test time as a variable. Estrous ewes were identified by observing ram behavior and those identified were immediately taken to the test pen for subsequent testing of ram sexual behaviors. The lip curl response, anogenital sniffing, vocalization, mount frequency and mount duration as sexual behaviors were observed and recorded as described by Kridli and Said (1999).

Semen collection and Evaluation

In order to collect semen from the experimental animals, rams must be trained using a naturally heat ewe (tied by rope). Semen samples were collected once per week by using Artificial Vagina (AV) and graduated test tube starting from April to May 2011 for seven weeks. The average age of the animals at the beginning of semen collection was 12½ months. Immediate after collection, semen volume was measured and sperm motility was assesed. Sperm mass activity was subjectively assessed by placing a drop of semen on a pre-warmed slide and using a 40×objective lens (scored from 0=no activity to 5= maximal activity). Sperm progressive individual motility (ranging from 0% = total immobility to 100% =high motility) was subjectively assessed on an extended drop of semen under a cover slide at 100× objective lense using a drop of an oil immersion (scored at 10% unit intervals) and physiological saline.

Sperm concentration was measured in Neubauer haemocytometer counting chamber after diluting semen with distilled water in the ratio of 200:1 and taking 10 µL using phase contrast microscope at 40× objective lens. Sperm cells lying inside the 5 counting chamber that formed a diagonal line on the grid were counted and the average multiplied by 5 to obtain the concentration of sperm cells in the semen sample (x 10^6) per ml (Loskutoff and Crichton, 2001). Sperm morphology was done in two ways; semen with formal saline) and after staining of the slides. For either of the approaches, formalin-fixed sperm samples were collected from the experimental animals at the time of collection. Two hundred spermatozoa in both the stained and formalin fixed samples were counted using a phase-contrast microscope at 100× with an oil-immersion objective lens. After evaluating two times the average of the result was taken for analysis. The staining chemicals employed are eosine-nigrosine (sodium citrate, eosine, nigrosine, distilled water).

Chemical analysis of feeds

Chemical analysis of concentrates carried out at Haramaya University animal nutrition laboratory. For further chemical analysis, a composite sample was taken from the bulk samples. Part of the sample was dried in a forced draft oven at 105 ^{O}C overnight for dry matter determination. The other part of the samples was dried at 60^{O}C to a constant weight for chemical analysis. Oven dried feed samples were thoroughly mixed by feed type and ground to pass through 1 mm sieve size. The sample of feed offered was analyzed for DM, Ash and nitrogen according to the procedure AOAC (1990). Nitrogen (N) content of the feed was determined by Kjeldahl method and crude protein was estimated as N×6.25. The neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) contents were analyzed according to the procedure of Van Soest *et al.* (1991).

Statistical Analysis

The experiments on post weaning growth and reproductive performance of crossbred sheep were laid out in a 2×2 factorial arrangements with two types of breed group (BHO*Dorper and HH*Dorper) and two levels of nutrition (concentrate supplementation at 0.9% and 1.5% of the live body weight). Data on this traits were analyzed using in Statistical Analysis

System (SAS, 2003). Data on sperm concentration, however, was transformed into log scale, while sperm mass motility was transformed into square root before analysis.

RESULTS AND DISCUSSION

Chemical Composition of Experimental Feeds

Chemical composition of the experimental feeds is presented in Table 2. The CP content of noug seed cake to in this study was found to be 29.6%. This is comparable to 30.9, 30.4 and reported by Belay (2008) and Temesgen (1995) respectively. The CP content of wheat bran was close to the value of 16.5% reported by Solomon *et al (*2004), 16.4% reported by Tekeba (2005) and 16.7% reported by Zemichael (2007). The CP content of the mixture of noug seed cake and wheat bran was in between the values recorded for noug seed cake and wheat bran. This is comparable to 23.6 % reported by Belay (2008) but higher than 21.95% reported by Tesfaye (2009). The ADF content of noug seed cake was with 29.7% reported by Zewdie (2010). The NDF content of noug seed cake was found to be 34%. This result is comparable with 33.1% reported by Zewdie (2010). The ADL content of the mixture of noug seed cake and wheat bran was 5.48%. This is comparable to 5.8% reported by Tesfaye (2009). The NDF and ADF content of wheat bran was agreement with Fentie (2007) who reported 44.15% and 12.4% of NDF and ADF, respectively.

Average Body Weight of Crossbred Rams

Mean initial, final body weight and average daily body weight gain of Dorper*HH and Dorper*BHO sheep is presented in Table 3. Nutrition had a significant effect ($p<0.01$) on average daily weight gain of male crossbred sheep. Thus, animals, which were supplemented high level of nutrition had significantly higher value of average daily body weight gain (110±4.66gm/day) than animals fed on low level of nutrition (94±2.18gm/day). Abule *et al.* (1998) reported that native goats supplemented with concentrate mixture (comprising of 69% wheat bran, 30% noug Cake and 1% salt) were able to grow by 71.8 g/d. Similar result was reported by Tsegay, (2010), where supplementation of mixtures of wheat bran and noug seed cake (2:1) was improved average body weight gain of both BHO*Dorper (63.89) and HH*Dorper (69.44) g/d. However, the reported values were smaller than the result of the present study, which might be due to increased amount of feed offered according to increased body weight until the end of the experiment. Further, as expected, the current ADg reported for crossbred rams is larger than what has been reported for indigenous Menz (60.7±1.5 g/day) and Horro (60.3 ± 1.9 g/day) sheep grazing on native pasture and supplemented with concentrate at 150-200 g/d (Ewnetu, 1999).

Live body weight, body condition and linear Measurements

The body weight and linear body measurements of HH*Dorper and BHO*Dorper sheep at different nutritional level are presented in table 4. Breed and nutrition had no significant effect on in the above mentioned linear measurement traits and body condition scoring values.

Relationship between body weight and other body measurements

Correlation coefficients (r) obtained among live weight and other body measurements of BHO*Dorper and HH*Dorper sheep is presented in Table 5. Correlation coefficients between body weight and other body measurements estimated for crossbreds of BHO and HH sheep were positive and highly significant ($p<0.001$). The correlation coefficient of scrotum circumference for both crossbred sheep was also significant ($p <0.001$) and positive. The high correlation coefficient among different body measurements and body weight would imply that these measurements can be used as indirect selection criteria to improve live weight

(Khan *et al*., 20006; Solomon, 2008).The high correlation coefficient recorded for body weight and other body measurements in the present study suggests that either of these variables or their combination could provide a good estimate for predicting live weight of BHO*Dorper and HH*Dorper sheep. Body weight can be estimated from height at wither (for male BHO*Dorper, r=0.92) and heart girth (for HH*Dorper, r= 0.92). Generally heart girth had consistently showed the highest correlation coefficient with body weight (r=0.91) crossbreds of BHO with Dorper sheep and (r=0.92) crossbreds of Hararghe highland with Dorper sheep. The highest association between heart girth and body weight compared to other linear measurements was in agreement with earlier findings (Atta and EL Khidir, 2004; Thiruvenkanadan, 2005; Afloyan, *et al*., 2006; Fassae *et al*., 2006; Solomon, 2008). This would imply that heart girth is the best variable for predicting live weight than other measurements. Scrotum circumference had positive and strong correlation with body weight for BHO*Dorper (r=0.8) and for HH*Dorper (r=0.81) sheep. The strong association between scrotum circumference and body weight in the current study is in agreement with the results reported for Afar sheep (Tesfaye, 2008). Decrease in SC resulted in increase in morphologically abnormal sperm (Soderquist and Hulten, 2006). But the observed highly significant correlation between body weight and scrotum circumference in this particular study suggests that selection for scrotum circumference would lead to males with high potential for sperm production.

Prediction of body weight from other body measurements

In order to predict body weight from linear measurements, stepwise multiple regressions was carried out where other body measurements were added, one at time, to heart girth. In estimation of body weight from body measurements in female sheep nine body measurements were utilized. Similarly for male sheep ten body measurements were considered in both of the two breeds. The independent parameters or regressors were body length, wither height, heart girth, rump height, chest depth, canone circumfrence, canone length, hip width, body condition and scrotum circumference also added only for males.

The coefficient of determination (R^2) indicated that heart girth succeeded in describing more variation in body weight than other linear body measurements in both crossbreds of BHO and HH with Dorper sheep. It was more important than other linear body measurements to predict body weight. Therefore, in both of the two breeds, live body weight could be fairly estimated from heart girth measurements. In both breeds, second to heart girth, body length was more precisely predicted body weight. The better association of body weight with heart girth was possibly due to relatively larger contribution to body weight of heart girth which consists of bones, muscles and viscera (Thiruvenkadan, 2005). To predict body weight using heart girth, the following regression equations were suggested for each breed and sex:

For crossbred of Black Head Ogaden and Dorper ram; $y= -50.24 + 1.15\ x$

For crossbreds of Hararghe Highland and Dorper ram; $y=-52.49 +1.18x$. Where y and x are body weight and heart girth, respectively.

Effect of breed and nutrition on semen attributes

Animal production depends on superior females and males whose andrological normality will have a major impact on the fertility of the flock (Mekasha et al., 2007). In this study, semen production characteristics of BHO*Dorper and HH*Dorper male sheep was compared at two nutritional management and the result is presented in table 7. The result showed that breed has a significant effect ($p < 0.01$) on semen volume, where HH*Dorper sheep (1.04 ml) had higher volume than crossbreds of BHO*Dorper sheep (vol=0.89ml). Nutrition had also a significant effect on sperm mass motility ($p< 0.001$). Crossbred sheep, which were maintained on high plane of nutrition, had higher sperm mass motility (4.29) compared to their contemporaries maintained at low level of nutrition. The interaction effect of breed by nutrition had a significant effect on sperm concentration. HH*Dorper sheep fed high level of nutrition (T4) had higher value of sperm concentration than BHO*Dorper fed high level of nutrition (T3) and BHO*Dorper fed low level of nutrition (T1). But animals in T4 were not significantly different from HH*Dorper sheep fed low level of nutrition (T2). Likewise, T2 is not significantly different from T3 and also T3 is not significantly different from T1.

Effect of breed and nutrition on sperm morphology

Sperm morphology of BHO*Dorper and HH*Dorper male sheep is presented in Table 8 Animals kept at high plane of nutrition (supplemented with concentrate at 1.5% of body weight) had numerically higher number of normal spermatozoa compared to their contemporaries maintained at low level of nutrition. This indicates that provision of adequate nutrient is necessary for optimum production of spermatozoa (spermatogenesis) and sperm maturation. Braden *et al.,* (1974) also reported that dietary energy level significantly affects the daily sperm production and testes weight in mature Merino rams. However, the same author reported that feeding with high protein level was shown to have no effect on sperm morphology. Similarly, Brown (1994) demonstrated that overfeeding of sires can have serious detrimental effects on their future reproductive capacity. Labuschagne *et al.,* 2002) also reported the detrimental effects of high energy diets on the fertility of young bulls. Similar findings were also reported in young Dorper rams **(**Fourie *et al*., 2003). The relatively higher tail defects observed for rams in high plane of nutrition might be due to cold shock and/or routine laboratory semen evaluation procedures.

Table.2. Chemical Composition of the experimental feeds

Item (DM%)	Agro-industrialbyproducts			Pasture harvested at different seasons		
	WB	NSC	WB + NSC	Earl dry season	Dry season	Short rainy season
DM	91	94	92.2	92	91.5	92
ASH	4.6	9	8.5	11.1	8.7	8.6
ADF	14	28	20.4	51.5	54	47.8
NDF	44	34.5	39	82.5	83	78.5
ADL	4	10.4	5.8	9	9.6	8.5
CP	16.9	29.6	23.5	5.4	6.3	10

DM=dry matter, ADF= acid detergent fiber, NDF= neutral detergent lignin, ADL=acid detergent lignin, CP= crude protein, NSC= Nouge Seed Cake, WB=Wheat Bran

Table 3: Effect of breed, nutrition and their interaction on body weight change of male crossbred sheep

Variables	IWT means ±SE	FWT means ±SE	ADG means ±SE
BREED	Ns	Ns	Ns
BHO*Dorper(B)	22.08 ±0.93	38.56± 0.81	107±6.11
HH*Dorper(H)	21.91± 0.73	37.43 ± 1.16	100.5±4.22
NUTRITION	Ns	Ns	**
N1(low)	22.27 ±0.79	36.16±0.98	94^{b} ± 2.18
N2(high)	21.74 ± 0.82	39.29±0.97	110^{a}±4.66
BREED*NUTRIT(T)	Ns	Ns	Ns
T1(BHO*Dorper on N1)	22.83 ±1.48	37.16 ±1.48	95.84 ± 3.50
T2(HH*Dorper on N1)	22.00 ±1.00	35.66 ± 1.31	93.12 ± 2.85
T3(BHO*Dorper on N2)	21.64± 1.28	39.4±0.85	113.76 ± 8.39
T4(HH*Dorper on N2)	21.83 ± 1.17	39.20 ±1.73	108 ±5.70

Table 4: Effect of breed and nutrition on body weight and linear body measurement

Variables	Parameter (means ±se)										
	BW	BL	BC	HG	HAT	CD	RH	HIW	FC	FL	SC
BREED	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**ns**	**Ns**	**Ns**	**ns**
BHO*Dorper	30.4 ±0.6	61.9 ±0.6	3.58 ±0.1	70.2±0.4	55.8 ±0.54	24.6 ±0.15	58.62 ±0.27	10.7 ±0.06	7.42±0.04	11.85± 0.05	25.34± 0.28
HH*Dorper	30.9±1	62.4 ±0.7	3.17 ±0.1	70.6 ±0.7	56.4±0.36	24.73±0.13	59.17±0.23	10.72±0.05	7.33±0.04	11.98±0.04	26.73± 0.21
NUT.	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**ns**	**Ns**	**Ns**	**ns**
N1(low)	29.68 ±1	61.5±0.7	3.11± 0.16	69.46±0.33	55.78±0.54	24.46 ±0.14	58.48±0.24	10.60 ±0.05	7.29 ±0.04	11.89 ±0.05	25.81± 0.25
N2(high)	31.53±0.7	62.7±0.6	3.52 ±0.12	70.54±0.36	56.58±0.31	24.85±0.14	59.33±3.64	10.86 ±0.06	7.43±0.04	11.96 ±0.04	26.47±0.24
BREED* NUTRT(T)	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**Ns**	**ns**	**ns**	**ns**	**ns**
T1	29.7±1.5	61.1±1.5	3.45± 0.13	69.4±0.9	55.05±1.05	24.22 ±0.20	57.63±0.34	10.69±0.08	7.35 ±0.07	11.73±0.07	25.107±0.36
T2	29.6±1.4	61.7±0.9	2.9±0.2	69.4 ±1.1	56.14±0.64	24.58 ±0.19	58.91±0.31	10.55± 0.07	7.26 ± 0.05	12.09 ±0.08	26.17±0.32
T3	30.7± 0.5	62.4 ±0.4	3.66±0.13	70.6±0.5	56.34±0.59	24.83 ±0.20	59.22±0.38	10.82 ± 0.09	7.46 ± 0.06	11.87 ±0.07	25.48±0.40
T4	32.1±1.3	63±1.1	3.4±0.2	71.7±0.7	56.45±0.31	24.87 ±0.19	59.43±0.35	10.89 ±0.08	7.40± 0.06	11.68±0.09	27.30±0.27

BC=body condition, HG=heart girth, BL=body length, HAT=wither height, CD= chest depth, RH=rump height, BW=body weight, HIW= hip width, FC= fore canone circumference, FL=fore canone length, SC=Scrotum circumference. T1=Black head ogaden *Dorper sheep fed low level of nutrition, T2=Hararghe highland sheep fed low level of nutrition, T3= Black head ogaden *Dorper sheep fed high level of nutrition, T4=Hararghe highland *Dorper sheep fed high level of nutrition, N1=low level of nutrition, N2=high level of nutrition, B=Black head ogaden*Dorper, H=Hararghe highland *Dorper , NUT= nutrition

Table 5:Correlation coefficients of body weight and linear body measurements for male HH*Dorper (H) (bellow diagonal) and for male BHO*Dorper (B) (above diagonal)

B(M)	BW	BL	BC	HG	HAT	CD	RH	HIW	FL	FC	SC
H(M)		***	***	***	***	***	***	***	***	***	***
BW		0.86	0.66	0.91	0.918	0.84	0.88	0.79	0.87	0.88	0.8
BL	0.91		0.59	0.85	0.86	0.85	0.82	0.78	0.83	0.85	0.75
BC	0.6	0.55		0.62	0.6	0.55	0.62	0.52	0.57	0.50	0.64
HG	0.92	0.89	0.58		0.91	0.88	0.91	0.85	0.84	0.84	0.81
HAT	0.83	0.83	0.3	0.85		0.89	0.92	0.85	0.86	0.91	0.80
CD	0.82	0.83	0.42	0.89	0.89		0.90	0.81	0.79	0.87	0.71
RH	0.77	0.78	0.23	0.82	0.94	0.87		0.86	0.81	0.83	0.76
HIW	0.79	0.77	0.56	0.77	0.69	0.68	0.64		0.80	0.81	0.76
FL	0.72	0.75	0.17	0.75	0.88	0.8	0.91	0.61		0.83	0.75
FC	0.89	0.91	0.61	0.88	0.76	0.76	0.71	0.79	0.64		0.73
SC	0.81	0.8	0.55	0.8	0.75	0.79	0.71	0.65	0.63	0.75	---

B=BHO*Dorper,
H=HH*Dorper, BC=body condition, HG=heart girth, BL=body length, HAT=wither height, CD= chest depth, RH=rump height, W=body weight, HIW= hip width, FC= fore canone circumference, FL=fore canone length, *** = P <0.001

Table 6: Prediction of body weight from other linear body measurements crossbred male sheep

Equation male HH*Dorper	Inter	Parameter										
a + βx	A	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	R^2	MSE
HG	-52.49	1.18									0.84	2.4
HG+BL	-52.76	0.64	0.61								0.89	2.01
HG+BL+ HAT	54.38	0.61	0.59	0.09							0.89	2.01
HG+BL+ HA+CD	-58.54	0.71	0.60	0.28	-0.59						0.89	1.97
HG+BL+BHAT+CD+RH	-58.12	0.72	0.58	0.51	-0.52	-0.24					0.9	1.95
HG+BL+ HAT +CD+ RH+ HIW	-59.22	0.65	0.52	0.47	-0.47	-0.22	0.87				0.90	1.91
HG+BL+ HAT CD+ RH+ HIW+SC	-56.72	0.62	0.47	0.44	-0.59	-0.19	0.86	0.25			0.91	1.86
HG+ BL+ HAT+ CD+ RH +HIW +SC +FC	-56.41	0.56	0.38	0.45	-0.53	-0.19	0.74	0.24	1.08		0.91	1.85
HG+BL+ HAT+ CD+ RH+ HIW+SC+FC+FL	-56.35	0.56	0.39	0.46	-0.54	-0.16	0.74	0.24	1.03	-0.17	0.91	1.86
For BHO*Dorper												
HG	-50.24	1.15									0.84	2.38
HG+BL	-50.91	0.71	0.5								0.78	2.09
HG+BL+ HAT	-54.63	0.63	0.45	0.22							0.89	1.94
HG+BL+ HA+CD	-56.8	0.69	0.47	0.34	-0.4						0.88	2.05
HG+BL+HAT+CD+RH	-56.47	0.70	0.46	0.44	-0.35	-0.12					0.88	2.05
HG+BL+ HAT +CD+RH+HIW	-56.83	0.66	0.44	0.42	-0.33	-0.13	0.50				0.88	2.04
HG+BL+ HAT CD+RH+HIW+SC	-54.82	0.63	0.42	0.38	-0.34	-0.12	0.49	0.118			0.88	2.03
HG+BL+HAT+CD+ RH+HIW+SC +FC	-54.03	0.55	0.3	0.31	-0.35	-0.04	0.21	0.14	1.96		0.89	1.98
HG+BL+ HAT+ CD+ RH+ HIW + SC+FC+FL	-54.19	0.55	0.3	0.3	-0.35	-0.06	0.21	0.14	1.98	0.17	0.89	1.98

B=BHO*Dorper, H=HH*Dorper, BC=body condition, HG=heart girth, BL=body length, HAT=wither height, CD= chest depth, RH=rump height, W=body weight, HIW= hip width, FC= fore canone circumference, FL=fore canone length

Table 7: Effect of Breed and nutrition on semen traits of crossbred rams (BHO*Dorper and HH* Dorper)

Variables	**Parameters(means ±se)**			
	VOL.(ml)	PIM (%)	MM	CONC.(10^9/ml)
BREED	**	Ns	Ns	Ns
B	$0.89^{b} \pm 0.05$	85.05±2.01	4.16 ±0.17	4.68± 0.31
H	$1.048^{a} \pm 0.04$	71.84±6.4	3.66 ±0.18	5.83± 0.28
NUTRITION	Ns	Ns	*	Ns
N1	0.92 ± 0.056	71.2±8.62	$3.33^{b} \pm 0.24$	5.07 ± 0.36
N2	1.04 ± 0.036	81.9±2.28	$4.29^{a} \pm 0.105$	5.61 ± 0.24
BRE*NUT(T)	Ns	Ns	Ns	*
T1	0.83 ± 0.11	88.2±2.5	3.52 ± 0.40	$4.29^{c} \pm 0.58$
T2	0.96 ± 0.06	62.7±11.6	3.24 ± 0.30	$5.47^{ab} \pm 0.46$
T3	0.92 ± 0.05	83.1±2.6	4.54 ± 0.08	$4.91^{bc} \pm 0.36$
T4	1.13 ± 0.046	80.9±3.7	4.09 ± 0.17	$6.2^{a} \pm 0.31$

P/IM=progressive motility, MM= mass motility, CONC= concentration, VOL=Volume, ,T1=Black head ogaden*Dorper fed low level of nutrition, T2=Hararghe highland fed low level of nutrition, T3= Black head ogaden *Dorper fed high level of nutrition, T4=Hararghe highland *Dorper fed high level of nutrition N1=low level of nutrition, N2=high level of nutrition, B=Black head ogaden*Dorper, H=Hararghe highland *Dorper , NUT= nutrition, T1=BHO*Dorper + Concentrate Supp at 0.9% BW; T2= BHO*Dorper + Concentrate supplementation at 1.5% BW; T3=HH*Dorper+concentrate supplementation at 0.9% BW; T4=HH*Dorper + concentrate supplementation at 1.5% BW.

Table 8: Effect of breed, nutrition and their interaction on sperm morphology of crossbred rams

Variables	Normal sperm (%)	Mid piece defect (%)	Head defect (%)	Tail defect (%)
BREED	Ns	Ns	Ns	Ns
B	67.13±3.61	1.57±0.23	3.14±0.46	23.00±2.70
H	65.86±2.38	1.93± 0.17	3.86±0.35	25.40±2.26
NUTRITION	Ns	Ns	Ns	Ns
N1	62.51±3.56	1.72±0.18	3.45 ±0.36	21.06 ±2.64
N2	69.51±2.20	1.84±0.21	3.67± 0.42	27.20 ±2.26
BREED*NUTRITION (T)	Ns	Ns	Ns	Ns
T1	59.86 ±7.68	1.28 ±0.36	2.57±0.72	18.55±4.52
T2	63.84± 3.79	1.94 ±0.19	3.89 ±0.39	22.32 ±3.28
T3	71.49 ±3.38	1.74 ±0.29	3.49±0.59	25.66±3.33
T4	67.87 ±2.91	1.91±0.29	3.83±0.59	28.48±3.09

Table 9: Effect of breed and nutrition on sexual behavior of male crossbred (BHO*Dorper and HH*Dorper) Sheep

Variables		Means Sexual Traits (±SE) in %				
	N	ANS	LIR	MF	MD(sec)	VOC
BREED		Ns	*	ns	*	Ns
B	8	81.25 ± 5.15	12.5^{b}±4.11	16.26 ±1.3	2.36^{b}±0.18	63.75 ±4.97
H	12	78.33 ± 4.57	25.83^{a}±3.12	19.75±0.83	3.27^{a}±0.127	72.5 ±5.52
NUTRITION		Ns	Ns	ns	Ns	*
N1	9	75.55 ± 4.44	22.22±4.93	17.28±1.06	2.96 ±0.175	78.88^{a} ±6.3
N2	11	82.72 ± 4.87	19.09±3.42	19.22 ±1.005	2.86 ±0.138	60.9^{b} ±3.42
BREED*NUT(T)		Ns	Ns	ns	Ns	*
T1	3	80 ±11.54	10 ±5.77	13.86 ±2.45	2.23^{b} ±0.37	63.33^{b}± 12.02
T2	6	73.33±4.21	28.33±5.4	19 ±0.97	3.33^{a} ± 0.17	86.66^{a} ± 5.57
T3	5	82 ±5.83	14 ± 6	17.7 ±1.47	2.44^{b} ±0.18	64^{b} ± 5.09
T4	6	83.33 ±8.02	23.3 ±3.3	20.5^{a}±1.36	3.216^{a} ± 0.19	58.33^{b} ± 4.77

ANS=anogenitalsniffing, LIR=lipcurl response, MF=mount frequency, MD= mount duration, VOC=vocalization T1=Black head ogaden *Dorper fed low level of nutrition, T2=Hararghe highland fed low level of nutrition, T3= Black head ogaden *Dorper fed high level of nutrition, T4=Hararghe highland *Dorper fed high level of nutrition, N1=low level of nutrition,N2=high level of nutrition , B=black head ogaden *Dorper ,H=Hararghe highland *Dorper , NUT= nutrition

The Effect Of Breed And Nutrition On Sexual Behaviour

The result of sexual behavior of male BHO*Dorper and HH*Dorper sheep is presented in Table 9. Breed had a significant effect on lip curl response ($p < 0.05$) and mount frequency ($p<0.05$). Male HH*Dorper sheep had highest lipcurl response (19.75±0.83) and mount duration (3.27±0.12) than BHO*Dorper sheep lipcurl response (12.5±4.11) and mount duration (2.36±0.18). Generally, HH*Dorper rams were superior in sexual traits and they are the most active in sexual response than BHO *Dorper rams.

CONCLUSION

This study was evaluated the effect of breed and nutrition on post weaning growth and reproduction performance of crossbreed (BHO*Dorper and HH*Dorper) sheep. The two nutritional levels included supplementation with concentrate either at 0.9% or 1.5% of their body weight. Concentrates were composed of wheat bran and noug seed cake at a ratio of 2:1. In the study experiment were laid out similarly in 2×2 factorial arrangement (two breeds of sheep and two levels of nutrition) using Completely Randomized Design (CRD). The number of animals included were 20 (four treatment× five replications). The mean initial body weight of the animals was 22.08±0.93 and 21.91±0.73 kg (mean ± se). The age of the animals ranges from 6-8 month.

Evaluation of the post weaning growth and reproductive performance of crossbred sheep showed that breed, nutrition and their interaction had no significant effect ($p> 0.05$) on initial and final body weight of crossbred sheep. Nutrition, however, had a significant effect ($p<0.05$) on ADg of crossbred sheep. Thus, both male and female crossbred sheep, which were supplemented with concentrate at 1.5% body weight had significantly higher ADg of 110±4.66 g/d compared to their contemporaries supplemented with concentrate at 0.9% body weight (94± 2.18). Breed had a significant effect on body weight, body condition and heart girth. Black head Ogaden*Dorper sheep had higher body condition score (3.5 ±0.1) than Hararghe highland*Dorper sheep (3.1±0.1). The two breeds did not differ significantly ($p> 0.05$) in the other linear body measurements except measurements discussed above. Correlation coefficients between body weight and other measurements estimated for Black head Ogaden and Hararghe highland*Dorper sheep were positive and highly significant ($P<0.001$). Heart girth had consistently showed the highest correlation coefficient ($r=0.93$) for BHO*Dorper and for HH*Dorper ($r=0.91$) crossbreds. Based on this study, body weight could be better predicted using heart girth than other linear measurements as follows:

$y=-50.24+1.15x$ for BHO*Dorper and $y= -52.49+1.18x$ for HH*Dorper sheep, where y and x are body weight and heart girth, respectively. Breed had a significant effect ($p<0.01$) on semen volume. Hararghe highland*Dorper had significantly higher semen volume (1.048±0.04) than BHO*Dorper (0.89 ±0.05). Nutrition had a significant effect on sperm mass motility ($p<0.001$). Crossbred sheep which were fed high level of nutrition had higher mass motility (4.29 ± 0.10) than those animals fed low level of nutrition (3.33 ± 0.24). The interaction between breed and nutrition had a significant effect ($p<0.05$) on sperm concentration. Thus, HH*Dorper sheep fed high level of nutrition [T4] had higher sperm concentration followed by BHO*Dorper fed high level of nutrition [T3] and BHO*Dorper fed low level of nutrition [T1]. However, T2 was not significantly different from T4 and T3. Breed, nutrition and their interaction had no significant effect ($p>0.05$) on sperm morphology. Breed had also a significant effect ($P < 0.05$) on sexual activity of male crossbred sheep. Thus, the frequency of lip curl response (19.75 ± 0.83), and mount duration (3.27±0.127; $p < 0.05$) were higher for HH*Dorper rams than for BHO*Dorper rams (lip curl=12.5 ±4.11 and mount duration =2.36± 0.18).

In conclusion, this study demonstrated that Hararghe highland*Dorper sheep showed better reproductive performance (in response of sexual behavior, semen traits) than crossbreds of Black head Ogaden*Dorper sheep. However, Black head ogaden*Dorper sheep were better in growth performance. Thus, it can be recommended that crossbred animals should be supplemented with concentrate at higher level of nutrition (1.5% of body weight) to exploit the genetic potential of the genotype and thereby target export market. However, under small holder farming system supplementation with 0.9% of the body weight could be used for moderate gain provided that the quality and biomass yield of the grazing pasture would be optimum. ACKNOWLEDGEMENTS

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