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Evaluation of Growth Performance of Local and Dorper × Local Crossbred Sheep in Eastern Amhara Region, Ethiopia

Research Article

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ABSTRACT

The present study was performed to evaluate the on-station growth performance of local and Dorper × local crossbred sheep in eastern Amhara region, Ethiopia. Data on 302 lambs collected over a 4-year period (2009 to 2012) on local and Dorper × local crossbred sheep at Sirinka breeding, evaluation and distribution site were used in this study. Fixed effects considered were breed, lamb sex, birth season, birth type and birth year. Results revealed that breed was a significant source of variation that crossbred lambs consistently weighed more than the local sheep lambs at all ages. The mean birth weights of local and crossbred lambs were 2.36 ± 0.05 and 3.24 ± 0.04 kg, respectively. Sex was an important source of variation at weaning, six months and yearling of ages in which male lambs were superior over their female contemporaries. Lambs born in dry season were heavier than lambs born in wet season at six months (20.51±0.34 kg *vs.* 16.74±0.59 kg) and at yearling (31.12±0.38 kg *vs.* 27.72±0.82 kg). Single-born lambs were heavier ($P<0.0001$) than their multiple-born contemporaries. There was also significant ($P<0.0001$) difference on average daily gain of lambs between the crossbred (129.97±2.23 g/day) and local sheep (67.78±1.60 g/day) lambs from birth to weaning age. Males had higher pre-weaning average daily gain than females (125.83±3.38 *vs.* 116.93±3.13 g/day, $P<0.05$). Single-born lambs grew faster than their multiple contemporaries between birth to 30 days (179.85±3.15 *vs.* 127.27±6.82 g/day, $P<0.0001$) and birth to weaning (123.96±2.55 *vs.* 107.49±5.04 g/day, $P<0.0001$) of age. The crossbred lambs also gained higher (64.69±1.74 g/day) than the local sheep lambs (37.94±1.19 g/day) after weaning. Breed was found to have significant ($P<0.0001$) effect on overall growth rate, where crossbred lambs had higher growth rate than the local sheep lambs. There were generally crossbred lambs had better growth performance and higher growth rates than the local sheep lambs.

KEY WORDS Dorper crossbred, growth, local sheep, Sirinka.

INTRODUCTION

Sheep production in Ethiopia plays a very important role in contributing to the food security, domestic meat consumption and generating cash income as well as providing continuous service to the economic stability of smallholder farmers. Smallholder farmers depend on sheep for much of their livelihood, often largely than on cattle. Sheep serve as a bank account which can be drawn upon when cash money is needed. These sheep represent only 7% of the average total capital invested in livestock, but they account on average for 40% of the cash income and 19% of the total value of subsistence food derived from all livestock production (Hirpa and Abebe, 2008). Sheep also contributes 21% of the total ruminant livestock meat output of the country (Sebsbie, 2008). While contributing significantly to meat production of the country, present production levels are far below their potential and productivity per sheep is also very low (Tibbo, 2006). Apparently, improving the productivity of sheep is important in creating wealth and improving the living standard of smallholder farmers. At the same time, it is essential to meet the high meat demand of the country.

Hence, to improve productivity of the local sheep, cross-breeding with meat type Dorper breed imported from south Africa has been conducted at Sirinka Agricultural Research Center (SARC).

This research center had established sheep breeding, evaluation and distribution (BED) site with the objective to produce Dorper × local crossbred rams. Consequently, crossbred rams are distributed to smallholder farmers for breeding purposes. There are, however, no documented results on the growth performance of the crossbred sheep. This paper reports result of a study designed to evaluate the growth performance of local sheep and their crosses with Dorper under on station conditions in eastern Amhara region, Ethiopia.

MATERIALS AND METHODS

Study area

The study was conducted at Sirinka agricultural research center, BED site in eastern Amhara region, Ethiopia. Sirinka is located about 508 km northeast of Addis Ababa at the geographical location between 11 ˚45’00’’N latitude and 39 ˚36’36’’E longitude. The center is situated at an elevation of 1850 meters above sea level, a bi-modal type of rainfall receiving a mean annual rainfall at about 950 mm, in which the main rainy season “Meher” occurs from June to September and the short rainy season “Belg” runs from February to April (SARC, unpublished). The mean maximum and minimum temperatures of the area are 26^0c and 13 ˚C, respectively (SARC, unpublished).

Description of the breeds

The local sheep kept at the station locally named as “Tumelie”. The community of the study area believed that the local sheep was a cross between Wollo and Afar sheep population. Gizaw (2008) classified this sheep population as Afar sheep breed and recently Lemma (2009) grouped in the rift valley sheep. According to Lemma (2009), the local sheep characterized as; well-developed fat-tail curved upward at the tip, small sized, the coat usually covered with short and coarse hair and homogenous in their colour and commonly plain white, light-brown and red, polled, and straight head with pads of fat on both sides of the nose and short ears. The Dorper sheep was developed from a Dorset Horn ram and a Blackhead Persian ewe in the harsh dry regions of south Africa (Richard, 2010). This large body sized and a meat type sheep known as a hardy adaptable breed suited to harsh environments (Schoeman, 2000).

Dorper became renowned for the following outstanding breed qualities: hardiness, adaptability, good mothering, high fertility, sexual virility, good carcass and attractive physical appearance (Olivier and Cloete, 2006).

Animals’ management

The local ewes were herded together, separately from breeding rams. During mating ewes kept together with their respective sire groups. Lambs weaned at 3 months of age and after weaning male lambs separated from female lambs and grazed in their separate sex groups, until they distributed to sheep producers.Concentrate supplementation was provided based on their age group and physiological status. Lactating ewes and rams supplemented with 400 g/day of concentrate and non-lactating ewes supplemented with 200 g/day of concentrate. Lambs had no access to feed other than their dam’s milk before weaning.

After weaning, however, they are supplemented with 100 g/day of concentrate until they are able to graze actively. All animals received appropriate treatment for common health problems as per the recommendations of the research center. They were treated regularly for internal and external parasites. Vaccinations to prevalent diseases of the area were given once in a year. All animals were dipped for ticks and mites with Diazinon 60% and also regularly drenched for internal parasites with albendazole and tetramizole. Sick animals were attended to and the date and cause of sickness recorded.

Data source and collection

On-station data, collected as part the program on “local sheep improvement program via crossbreeding at SARC, BED site” undertaken from 2009 to 2013, were used for this study. All the flocks included in the crossbreeding program and lambs at birth were identified using individual identification plastic ear tags. Data collected on growth include birth weight, lamb sex, type of birth and lambing date. Body weight was taken on the day of lambing and every 7 days interval up to 90 days of age using a salter scale balance (50 kg capacity with 200 g precision) for lambs and on a monthly interval thereafter.

Data management and analysis

Analysis of variance of fixed effects was employed using the general linear model (GLM) procedure of Statistical analysis system (SAS, 2003). The fixed effects considered in the model were breed (local and Dorper crossbred), lamb sex (male and female), birth season (dry and wet), birth type (single and multiple) and birth year (2009, 2010, 2011 and 2012). The fixed effect season of birth was defined as dry (January to June) and wet (July to December). Growth rate for each period was computed as:

$ADG_{t2-t1} = \{(W_{t2}-W_{t1}) / (t2-t1)\}$

Where:
ADG_{t2-t1}: weight gain between periods t_1 and t_2.
W_{t2}: weight at age t_2.
W_{t1}: weight at age t_1 and t_2 - t_1 age.

In the preliminary analysis the two-way interactions were not significant, and therefore, excluded. Lamb birth weight and ewe postpartum body weight was considered as a co-variate for weight at different ages and average daily body weight gains, but it found not significant and excluded from the model.

When analysis of variance declared significance, least squares means were separated using Tukey-Kramer test. The statistical model used was:

$$Y_{ijklm} = \mu + B_i + G_j + S_k + T_l + Y_m + e_{ijklm}$$

Where:
Y_{ijklm}: the observation on weight and weight gain at different ages.
μ: overall mean.
B_i: fixed effect of breed (i=local, Dorper×local crossbred).
G_j: fixed effect of lamb sex (j=male and female).
S_k: fixed effect of lamb birth season (k=dry and wet).
T_l: fixed effect of lamb birth type (l=single and multiple).
Y_m: fixed effect of lamb birth year (m=2009, 2010, 2011 and 2012).
e_{ijklm}: effect of random error.

RESULTS AND DISCUSSION

Growth performance of local sheep and their crosses with Dorper

Factors affecting weights at birth and at different ages of the local sheep and their crosses with Dorper and their least squares mean and standard errors of birth weight and weight at different ages are presented in Table 1.

Birth weight

The birth weight for local sheep and their crosses with Dorper were 2.36 ± 0.05 kg and 3.24 ± 0.04 kg, respectively. The birth weight of the local sheep were comparable to some of the indigenous sheep breeds; Horro sheep 2.43 kg (Awgichew, 2000), Blackhead Somali sheep 2.5 kg Farta sheep 2.5 kg (Mekuriaw, 2011) and lighter than from Afar 2.7 kg Gumuz 2.79 kg (Abegaz, 2007) and Washera sheep 2.69 kg (Taye *et al.* 2009; Mekuriaw, 2011). The birth weight of the crossbred sheep, however, was heavier than the birth weight of the indigenous sheep breeds.

Breed was significant (P<0.0001) source of variation for birth weight in which the crossbred lambs had heavier weight than the local lambs. Similar results were reported for birth weight of Menz sheep and their crosses with Awassi (Hassen *et al.* 2004). Birth weight was significantly (P<0.001) affected by sex. Male lambs weighed heavier than those female lambs at birth (3.19±0.05 kg *vs.* 3.02±0.05 kg, P<0.01). This is consistent with literatures (Awgichew, 2000; Tibbo, 2006; Taye *et al.* 2009). Type of birth was also significant (P<0.0001) for birth weight. Single born lambs were heavier than their multiple-born contemporaries (3.20±0.04 kg *vs.* 2.55±0.11 kg). Other authors have also obtained similar results for Gumuz (Abegaz, 2007) and Washera sheep (Taye *et al.* 2009; Mekuriaw, 2011).

This difference could be due to competition of foetus in the uterus for space, as in all placental mammals, the maternal uterine space has a restricted capacity to gestate offspring, and as litter size increases, individual birth weights decline (Gardner *et al.* 2007). Birth year was a significant (P<0.001) source of variation for birth weights. Lambs born in 2009 were lighter than the following years. Similar observation was made by Hassen *et al.* (2004). In this study, the effect of birth year on birth weight was attributed to the year to year variations in feeding management of ewes during pregnancy.

So, one possible explanation for the differing birth weight at different years might be associated with the amount and quality of forage available for pregnant ewes for consumption. In years of low forage availability, pregnant ewes gained more concentrate supplementation, thus birth weight was affected indirectly through the condition of the mother.

Weight at specific ages

Factors affecting weights of the local sheep and their crosses with Dorper at different ages (weights at one month, three month, six month, nine month and yearling age) are presented in Table 1. The local sheep lambs mean weight at weaning (8.53 kg), six month (11.92 kg) and yearling age (22.38 kg) were comparable to Horro sheep (Tibbo, 2006), Menz sheep (Gizaw, 2002; Tibbo, 2006) and Farta sheep (Mekuriaw, 2011). While lighter than Afar sheep and Washera sheep (Taye *et al.* 2009; Mekuriaw, 2011). The crossbred lambs, however, were weighed heavier than the local sheep lambs at all ages. The influence of breed was significant (P<0.0001) to lambs weight at all ages. The crossbred lambs were heavier than the local sheep lambs at all ages. Similar observation was reported to the local × Awassi crossbred sheep in the highlands of Ethiopia (Gizaw, 2002; Hassen *et al.* 2004).

Table 1 Least squares means (±SE) for birth weight (kg) and weight at different ages (kg) for local sheep and their crosses with Dorper sheep

Source of variation	Birth (wt)		One month (wt)		Weaning (wt)		Six month (wt)		Nine month (wt)		Yearling (wt)	
	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall	302	3.11±0.04	292	8.29±0.12	280	14.07±0.23	257	19.33±0.32	179	23.37±0.34	177	29.85±0.41
CV (%)	302	16.17	292	17.73	280	18.41	257	17.73	179	14.18	178	12.36
Breed		****		****		****		****		****		****
Crosses	258	3.24±0.04^{a}	252	8.70±0.11^{a}	242	14.95±0.21^{a}	224	20.43±0.30^{a}	148	24.53±0.34^{a}	147	31.37±0.38^{a}
Local	44	2.36±0.05^{b}	40	5.69±0.08^{b}	38	8.53±0.14^{b}	33	11.92±0.23^{b}	31	17.79±0.21^{b}	30	22.38±0.35^{b}
Sex		**		NS		**		*		**		***
Female	146	3.02±0.05^{b}	141	8.09±0.17	134	13.59±0.30^{b}	128	18.86±0.45^{b}	90	22.81±0.42^{b}	88	28.99±0.49^{b}
Male	156	3.19±0.05^{a}	151	8.48±0.16	146	14.52±0.33^{a}	129	19.80±0.45^{a}	89	23.93±0.53^{a}	89	30.69±0.63^{a}
Birth season		NS		NS		**		****		*		*
Dry	198	3.26±0.04	192	8.69±0.13	182	14.98±0.23^{a}	177	20.51±0.34^{a}	111	24.17±0.37^{a}	111	31.12±0.38^{a}
Wet	104	2.82±0.06	100	7.51±0.21	98	12.39± 0.44^{b}	80	16.74±0.59^{b}	68	22.06±0.65^{b}	66	27.72±0.82^{b}
Birth type		****		****		****		Ns		NS		NS
Single	258	3.20±0.04^{a}	250	8.60±0.12^{a}	239	14.38±0.25^{a}	218	19.47±0.35	155	23.55±0.37	153	30.06± 0.44
Multiple	44	2.55±0.11^{b}	42	6.41±0.27^{b}	41	12.29±0.50^{b}	39	18.56±0.73	24	22.20±0.75	24	28.48±0.97
Birth year		**		***		****		****		NS		NS
2009	116	2.82±0.06^{b}	112	7.34±0.18^{c}	106	12.91±0.43^{c}	92	16.59±0.55^{c}	84	23.37±0.63	83	29.67±0.78
2010	66	3.39±0.07^{a}	66	9.10±0.19^{a}	63	14.81±0.29^{b}	61	20.15±0.41^{b}	58	23.19±0.41	58	29.85±0.43
2011	59	3.26±0.07^{a}	59	8.77±0.20^{b}	57	12.82±0.31^{c}	50	17.88±0.43^{c}	37	23.63±0.53	36	30.26±0.59
2012	61	3.20±0.08^{a}	55	8.73±0.28^{b}	54	16.83±0.46^{a}	54	24.43±0.54^{a}				

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
CV: coefficient(s) of variation and N: number of observations.
NS: non significant.
* (P<0.05); ** (P<0.01); *** (P<0.001) and **** (P<0.0001).

The least squares mean and standard error of weaning, six month and yearling weight for the crossbred lambs were 14.59 ± 0.21 kg, 20.43 ± 0.30 kg and 31.37 ± 0.38 kg, respectively. The present study results were higher than the estimates of Awassi crossbred sheep in the highlands of Ethiopia (Hassen *et al.* 2004).

Sex was an important source of variation at weaning, six month, nine month and yearling of age. Males were superior over their female contemporaries at all ages. The results obtained are in line with other studies by several authors (Tibbo, 2006; Taye *et al.* 2009). The present study results agree with Tibbo *et al.* (2004), who explained that the effect of sex has started at three months for Horro sheep. These results also agree partially with Hassen *et al.* (2002), who explained that sex has an effect to lambs weight after five months. This superiority of males over females could be due to hormonal differences in their endocrinological and physiological functions (Ebangi *et al.* 1996).

Birth season was also a significant source of variation for lambs' body weight at weaning, six month, nine month and yearling of age. Lambs born during the dry season were heavier than those lambs born in wet season at six month (20.15±0.34 kg *vs.* 16.74±0.59 kg, P<0.0001) and at yearling (31.06±0.44 kg *vs.* 27.72±0.82 kg, P<0.05). This difference could be due to the variability of feed availability between seasons. Regarding this differences, lactating ewes and lambs were supplied with high extra concentrate during the dry season, which resulted in better dam milk production for the lambs.

At the same time, in the dry season ewes and lambs had better chance to exercise freely in grazing areas, which helped the animals to be free from stress, while in the wet season they were restricted to stay in their barn area.

Type of birth was significant on lambs' weight up to weaning age and its influence was not observed thereafter. Apparently, single-born lambs were heavier (P<0.0001) at one month and weaning age than their multiple-born contemporaries. The results obtained are in agreement with other studies (Tibbo, 2006; Yilmaz *et al.* 2007; Taye *et al.* 2009; Mekuriaw, 2011). Benyi *et al.* (2006) also reported that the superiority of single-born lambs in weight and growth rate increased only up to weaning and declined thereafter and thus multiple-born had comparable growth rate as singles after weaning. Part of this difference can be explained by the carry-over effect of the heavier weight of single-born lambs at birth (Duguma *et al.* 2002) and the fact that single born lambs are the sole users of their dam milk (Tibbo, 2006).

Year of birth had a significant (P<0.0001) influence on lambs body weight at one month, weaning and six months of age. In line with these results, other authors also reported the significant effect of year on lamb weight (Tibbo *et al.* 2004; Mekuriaw, 2011). Concurrently, lambs born in the first year were lighter than those lambs born in the later years. The effect of birth year to lambs body weight may be due to the variation in the quality and quantity of feed access across years and availability of their dam milk. As mentioned above, in years of low forage availability lambs were supplemented with concentrate. Accordingly, this on-station management and feeding variations between years has a profound influence on body weight of lambs.

Growth rate of local sheep and their crosses with Dorper

Factors affecting pre and post-weaning growth rates and overall growth rate are presented in Table 2.

Pre-weaning growth rate

The overall average daily gain of the local sheep and their crosses with Dorper from birth to 30 days was 172.29 ± 3.07 g/day and from birth to weaning age was 121.56 ± 2.31 g/day. Report by Mekuriaw (2011) revealed much lower estimates for Washera and Farta sheep under station and on farm conditions. The present results are also higher than the estimates of Menz and Horro sheep under station conditions (Tibbo, 2006).

Pre-weaning average daily gain performance of lambs was significantly (P<0.0001) affected by breed. The crossbred lambs (182.20±3.10 g/day) gained higher than the local sheep lambs (109.83±2.50 g/day) from birth to one-month age. Similarly, crossbred lambs (129.97±2.23 g/day) gained higher than the local sheep lambs (67.78±1.60 g/day) from birth to weaning age. Both genotypes of lambs grew rapidly during birth to one month then gained consistently and at a decreasing rate. Overall, the crossbred lambs gained higher than the local sheep lambs at all ages, while the differences tended decreasing with age. Such findings are consistent with those found in the literature. Hassen *et al.* (2002), after evaluating growth performances of local and crossbred breeds in Ethiopia, reported that lambs showed rapid growth at early ages, and then gained at a decreasing rate. Pre-weaning average daily gain performance of the local sheep lambs, however, were comparable to the local Menz sheep (Awgichew, 2000; Tibbo, 2006), Washera and Farta sheep under station and on farm conditions (Mekuriaw, 2011).

Sex had significant effects on lambs pre-weaning average daily gain performance from birth to weaning age. Males grew faster than females (125.83±3.38 *vs.* 116.93±3.13 g/day, P<0.05). These results also agree with those of Tibbo (2006) and Taye *et al.* (2009), who found that sex had significant effect on pre-weaning average daily gain performance of lambs. Contrary to this, Benyi *et al.* (2006) reported that the sex of lambs did not affect growth rates during the pre-weaning period. The superiority of males on pre-weaning average daily gain was apparently the result of their superior birth weights. These observations are consistent with Tuah and Baah (1985), who explained that males are significantly heavier than females at birth because in sheep the rate of skeletal growth *in utero* is faster in males than in females and this result in males being heavier than females at birth and therefore growing faster up to weaning. Benyi *et al.* (2006), has been noted that these differences are brought about by the action of the male hormone testosterone, which is produced in large quantities in males whereas in females oestrogens and progesterone predominate.

Birth season was found significant (P<0.001) for lambs pre-weaning growth rate. Lambs born in the dry season had higher average daily gain than those born in the wet season. These results are consistent with Benyi *et al.* (2006) and Mekuriaw (2011), who reported that lambs born in the dry season had higher growth rate than those born in the wet season. The weight gain advantage of lambs born in the dry season may be due to the variation in the quality and quantity of feed access within years and seasons in the breeding site. As mentioned above, during low feed availability ewes and lambs were supplemented with concentrate feed. In fact, a variation in management and feeding between seasons has a profound influence on daily weight gain of lambs. Another reason for the higher growth rates of lambs born during the dry season compared with those born during the wet season may be explained by the fact that lambs born during the latter part of the dry season spent a greater part of their pre weaning life in the wet season when feed was abundant for both the lambs and their dams, hence lambs could have faster growth rate. The situation was reversed for lambs born during the latter part of the wet season, resulting in lower growth rates. These results contradict with familiar literature reports that lambs born during the wet season are generally heavier and grow faster owing to abundance of feed than those born during the dry season. Type of birth was a significant (P<0.0001) source of variation for lambs pre-weaning growth rate. Single-born lambs grew faster than their multiple contemporaries between birth to 30 days (179.85±3.15 *vs.* 127.27±6.82 g/day) and birth to weaning (123.96±2.55 *vs.* 107.49±5.04 g/day) of age. These effects of birth type are in agreement with several findings (Hassen *et al.* 2002; Tibbo, 2006; Taye *et al.* 2009; Mekuriaw, 2011). Lambs pre-weaning growth rate was found significantly (P<0.001) different between lambs year of birth. Lambs born in 2010 (190.11±5.43 g/day), 2011 (183.84±5.97 g/day) and 2012 (184.73±7.44 g/day) grew faster than those lambs born during 2009 (149.59±4.48 g) between birth to one month age. Similarly, lambs born in 2012 (151.52±4.49 g/day) and 2010 (126.30±3.90 g/day) gained better than those lambs born in 2009 (111.68±4.39 g/day) and 2011 (106.19±3.29 g/day) between birth to weaning age. Numerous studies documented the important influence of year for sheep growth rates (Tibbo, 2006; Mekuriaw, 2011). The weight gain advantage of lambs between years may be due to the variation in the quality and quantity of feed availability within years.

Table 2 Least squares means (±SE) for growth rates (g/day) of Local sheep and their crosses with Dorper

Source of variation	Birth to 30 days		Birth to 90 days		90 to 180 days		Birth to 360 days	
	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall	292	172.29±3.07	281	121.56±2.31	256	61.25±1.62	177	73.13±1.06
CV (%)	292	24.42	281	22.51	256	35.31	177	13.57
Breed		****		****		****		****
Crosses	252	182.20±3.10^{a}	243	129.97±2.23^{a}	223	64.69±1.74^{a}	147	76.91±1.01^{a}
Local	40	109.83±2.50^{b}	38	67.78±1.60^{b}	33	37.94±1.19^{b}	30	54.62±1.01^{b}
Sex		Ns		*		Ns		***
Female	141	168.28±4.49	135	116.93±3.13^{b}	127	59.62±2.11	88	70.84±1.28^{b}
Male	151	176.03±4.19	146	125.83±3.38^{a}	129	62.85±2.46	89	75.39±1.66^{a}
Birth season		**		***		***		Ns
Dry	192	181.24±3.48^{a}	183	130.02±2.42^{a}	176	64.27±1.96^{a}	110	76.23±1.02
Wet	100	155.10±5.59^{b}	98	105.75±4.48^{b}	80	54.59±2.78^{b}	67	68.03±2.11
Birth type		****		****		Ns		Ns
Single	250	179.85±3.15^{a}	240	123.96±2.55^{a}	217	59.87±1.79	153	73.51±1.17
Multiple	42	127.27±6.82^{b}	41	107.49±5.04^{b}	39	68.95±3.48	24	70.67±2.34
Birth year		***		****		****		***
2009	112	149.59±4.48^{b}	106	111.68±4.39^{c}	91	50.43±2.89^{c}	82	73.40±2.04^{a}
2010	66	190.11±5.43^{a}	64	126.30±3.90^{b}	61	60.24±3.12^{b}	58	72.47±1.10^{b}
2011	59	183.84±5.97^{a}	57	106.19±3.29^{c}	50	57.16±2.28^{c}	37	73.56±1.58^{a}
2012	55	184.73±7.44^{a}	54	151.52±4.49^{a}	54	84.42±1.69^{a}		

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
CV: coefficient(s) of variation and N: number of observations.
NS: non significant.
* (P<0.05); ** (P<0.01); *** (P<0.001) and **** (P<0.0001).

In the breeding site, crop residue and grazing were the major feed sources of the animals. This small grazing land was restricted from grazing during the wet season when the farmland covered by research trials. As discussed earlier, during this period ewes and lambs were supplemented with concentrate feed. The level of concentrate supplementation varied between the sheep type and availability of other feed sources. Concentrate supplementation was also provided during the dry season. In fact, such variation between years and seasons has a profound influence on daily weight gain of lambs.

Post-weaning growth rate

The overall average daily weight gain from weaning to six months was 61.25 ± 1.62 g/day. Because of the weaning shock that lambs undergo (since they are transferred from a highly nutritious milk feed plus some grazing to sole grazing) the growth rate during this period was lower when compared to their pre weaning growth rate (Taye *et al.* 2009). The present study results were higher than those of Washera sheep (Taye *et al.* 2009).

There was significant difference between the two breeds (P<0.0001) on post-weaning growth rate. The crossbred lambs gained higher (64.69±1.74 g/day) than the local sheep lambs (37.94±1.19 g/day) between 90 to 180 days of age. As discussed above, a noticeable difference was observed between the two breeds that the crossbred lambs gained higher than the local lambs at pre weaning ages, this in turn would affect the lamb's later growth performance positively.

Birth season was found to produce significant difference (P<0.001) for post-weaning growth rate. Lambs born during the dry season (64.27±1.96 g/day) gained higher than their counterparts born during the wet season (54.59±2.78 g/day). These results are in line with other findings (Mekuriaw, 2011). As indicated earlier, variations between seasons on lambs' growth rate could be due to the management differences in the breeding site.

Birth year was a significant source of variation (P<0.0001) for post-weaning growth rate. Lambs born in 2012 (84.42±1.69 g/day) grew faster than those lambs born in 2009 (50.43±2.89 g/day), 2010 (60.24±3.12 g/day) and 2011 (57.16±2.28 g/day). Likewise, this difference could be due to the management variations and feed availability between years. In agreement to this result, similar birth year effects were reported (Hassen *et al*. 2002).

Overall growth rate

The overall average daily weight gain from birth to yearling was (73.13±1.06 g/day). The present study results were higher than the estimates of Washera (Taye *et al*. 2009; Mekuriaw, 2011), Menz and Horro sheep lambs (Awgichew, 2000).

Breed was found to have statistically significant (P<0.0001) effect on overall growth rate of the local sheep and their crosses with Dorper. The crossbred lambs gained higher than the local sheep lambs. Sex had also significant (P<0.001) influence on lambs overall growth rate. Male lambs grew faster than female lambs (75.39±1.66 *vs*. 70.84±1.28 g/day).

Birth year was also found to be significant source of variation (P<0.001) for overall growth rate. The variation could partly be associated with the management difference and the feed availability between years and seasons that affects the level of concentrate supplementation. Since, concentrate supplementation was higher during insufficient green feed availability to provide the dietary requirement of lactating ewes and lambs.

CONCLUSION

Results of the growth performance evaluation on the local sheep and their crosses with Dorper indicate that, the growth performance of the crossbred lambs is better than the local sheep lambs. The pre-weaning and post-weaning growth rates of the crossbred lambs are also higher than the local sheep lambs. The crossbred lambs are generally heavier, grow faster, large body sized and has good body conformation as compared with the local sheep. Therefore, the high growth performance of the crossbred lambs shows the possibility of using Dorper sheep as a terminal sire to improve the productivity of the local sheep through crossbreeding. To fully understand the extent of genotype × husbandry system interactions, further investigation under farmers' management conditions is being proposed.

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REFERENCES

Abegaz S. (2007). *In situ* characterization of Gumuz sheep under farmer's management in north-western lowlands of Amhara region. MS Thesis. Haramaya Univ., Ethiopia.

Awgichew K. (2000). Comparative performance evaluation of Horro and Menz sheep of Ethiopia under grazing and intensive feeding condition. Ph D Thesis. Humboldt Univ., Germany.

Benyi K., Norris D., Karbo N. and Kgomo K.A. (2006). Effects of genetic and environmental factors on pre-weaning and post-weaning growth in west African crossbred sheep. *Trop. Anim. Health Prod.* **38,** 547-554.

Duguma G., Schoeman S.J., Cloete S.W.P. and Jordan G.F. (2002). The influence of non-genetic factors on early growth traits in the Tygerhoek Merino lambs. *Ethiopian J. Anim. Prod*. **2(1),** 127-141.

Ebangi A.L., Nwakalor L.N., Mbah D.A. and Abba D. (1996). Factors affecting the birth weight and neonatal mortality of Massa and Fulbe sheep breeds in a hot and dry environment. Cameroon. *Revue d'Elevage et de Medecine Veterinaire des Pays Tropicaux*. **49,** 349-353.

Gardner D.S., Buttery P.J., Daniel Z. and Symonds M.E. (2007). Factors affecting birth weight in sheep: maternal environment. *Reproduction*. **133(1),** 297-307.

Gizaw S. (2002). Genetic evaluation of Menz and Awassi × Menz crossbred sheep in Ethiopia. MS Thesis. Deemed Univ., Karnal, India.

Gizaw S. (2008). Sheep resources of Ethiopia: genetic diversity and breeding strategy. Ph D Thesis. Wageningen Univ., Netherlands.

Hassen Y., Sölkner J. and Fuerst-Waltl B. (2004). Body weight of Awassi and indigenous Ethiopian sheep and their crosses. *Small Rumin. Res.* **55,** 51-56.

Hassen Y., Sölkner J., Gizaw S. and Baumung R. (2002). Performance of crossbred and indigenous sheep under village conditions in the cool highlands of central-northern Ethiopia: growth, birth and body weights. *Small Rumin. Res.* **43,** 195-202.

Hirpa A. and Abebe G. (2008). Economic significance of sheep and goats. Pp. 2-24. in Sheep and Goat Production Handbook for Ethiopia. A. Yami and R.C. Markel, Eds. Addis Ababa, Ethiopia.

Lemma S. (2009). Phenotypic classification and description of indigenous sheep types in the Amhara national regional state of Ethiopia. MS Thesis. Haramaya Univ., Ethiopia.

Mekuriaw S. (2011). Performance evaluation of Washera, Farta and their crossbred sheep in western highlands of Amhara region, Ethiopia. MS Thesis. Bahir Dar Univ., Ethiopia.

Olivier J.J. and Cloete J.A.N. (2006). Evaluation of different breed crosses in the development of a white-wool mutton sheep. *South African J. Anim. Sci*. **14,** 105-109.

Richard K. (2010). Dorper Sheep and the Production of Lean Lamb in Arid Australia. International Specialised Skills Institute. Melbourne, Australia.

SAS Institute. (2003). SAS®/STAT Software, Release 9.1. SAS Institute, Inc., Cary, NC.

Schoeman S.J. (2000). A comparative assessment of Dorper sheep in different production environments and systems. *Small Rumin. Res*. **36,** 137-146.

Sebsbie A. (2008). Sheep and goat meat characteristics and quality. Pp. 325-340 in Sheep and Goat Production Handbook for Ethiopia. A. Yami and R.C. Markel, Eds. Addis Ababa, Ethiopia.

Taye M., Abebe G., Gizaw S., Lemma S., Mekoya A. and Tibbo M. (2009). Growth performances of Washera sheep under small holder management systems in Yilmanadensa and Quarit districts, Ethiopia. *Trop. Anim. Health Prod*. **42(4),** 659-667.

Tibbo M. (2006). Productivity and health of indigenous sheep breeds and crossbreds in the central Ethiopian highlands. Ph D Thesis. Swedish Univ. Agric. Sci., Uppsala, Sweden.

Tibbo M., Ayalew W., Awgichew K., Ermias E. and Rege J.E.O. (2004). On-station characterisation of indigenous Menz and Horro sheep breeds in the central highlands of Ethiopia. *FAO/UNEP Anim. Gene. Reso. Inf.* **35,** 61-74.

Tuah A.K. and Baah J. (1985). Reproductive performance, pre-weaning growth rate and pre-weaning lamb mortality of Djallonk´e sheep in Ghana. *Trop. Agric. Trinidad*. **68,** 66-70.

Yilmaz O., Denk H. and Bayram D. (2007). Effects of lambing season, sex and birth type on growth performance in Norduz lambs. *Small Rumin. Res*. **68,** 336-339.