Effect of Crossbreeding Indigenous Sheep with Awassi and Corriedale Sires on Reproductive Performance under Smallholder Production System in Ethiopia

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Summary

The objective of this study was to evaluate the effect of crossbreeding on reproductive performance. A village based sheep crossbreeding project has been implemented since 1998 in three villages in the South Wollo, Menz and Chacha districts in Ethiopia. Crossbred rams (3/4 Awassi x 1/4 Local) were supplied to a group of farmers aiming to upgrading the indigenous genotype through backcrossing. The combined levels of location and genotype, year, season and parity had significant effects on the reproductive performance of ewes. Generally, local genotypes showed better ($p<0.05$) reproductive performance except for number of lambs weaned per ewe per year. The interaction of genotype and location was significant for age at first lambing and lambing interval. In Wollo, Corriedale x local crossbred ewes had similar reproductive performance to that of the local breed. The variation in reproductive performance among locations indicated the importance of delineating crossbreeding areas depending on environmental situation and farmers' capacity.

Key words

Awassi, Corriedale, sheep, crossbreeding, reproductive performance, smallholder

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Aim

Crossbreeding using fast growing sire lines has been suggested as rapid way of breed improvement and has been applied in the tropics to exploit breed complementarity. However many attempts have failed due to introduction of breeds not adapted to tropical conditions (Philipsson et al., 2011). A crossbreeding project using exotic Awassi and Corriedale sire is currently underway in the highlands of Ethiopia in three different locations to improve meat and wool production. Increasing the number of lambs marketed per ewe per year is a major way to improve the efficiency of meat production in sheep. Evaluating the performance, particularly related to reproduction of crossbred animals at each stage of the project is essential. So far reproductive performances of crossbreds under farmers' situation have not been evaluated. Thus this paper is aimed at evaluating the effect of crossbreeding on the reproductive performance of ewes.

Material and methods

Community-based sheep crossbreeding has been implemented since 1998 in three villages of Wollo, Menz and Chacha districts in Ethiopia in the framework of a project run by Debre Berhan Agricultural Research Center (DBARC). In this crossbreeding scheme, high grade exotic crossbred (3/4 Awassi x 1/4 Menz and 3/4 Corriedale x 1/4 Menz) rams were distributed to farmers and used to upgrade the indigenous sheep breeds throgh repeated backcrossing. The Awassi crossbred rams were distributed in all the three sites while Corriedale crossbred rams were distributed only to the Wollo site. In 1998, three Awassi crossbred rams were distributed to each of the three locations and eight 8 Corriedale crossbred rams disributed to Wollo site only. In 2001 additional (n=10) Awassi crossbred rams were distributed to each site. Rams were borrowed to a group of farmers to use it in common by rotating within and among groups. A crossbred ram used for one year in a group was then transfered to another group to control inbreeding. However farmers usually wanted to use better ram repeatedely and some farmers resisted to rotate ram as planned.

Data on reproductive performances collected from 1998 to 2008 from a total of 71 farmers (26 in Wollo, 18 in Chacha and 27 in Menz) were used in this analysis. For the analysis ewes were categorized as local, Awassi x local and Corriedale x local crossbred. Crossbred ewes having 37.5% and above exotic blood level were considered as crossbred and the few ewes having less than 37.5% exotic blood level were excluded from the analysis. A total of 6228 lambing (2339 in Menz, 2185 in Chacha and 1704 in Wollo) records were used for the analysis. Data were analyzed using GLM procedure of SAS version 9.2 (SAS, 2008). Three locations (Menz, Chacha and Wollo) and two genotypes (Local and Awassi crossbred) plus one additional genotype (Corriedale crossbred) in Wollo site combined resulted in 7 levels of location and genotype combinations (Table 1). Then the combined levels of location and genotype, year of lambing, season of lambing and parity of the ewe were fitted as class variables and the reproductive performances as dependant variable. The effects of genotype and location and their interactions were evaluated using the 6 contrasts as indicated in Table 1. The first contrast was to assess the effect of Awassi crossbreeding. The second was to compare Menz vs (Chacha + Wollo) locations. The reason to compare Menz vs (Chaca + Wollo) is that the crossbred rams that were produced using Menz local breeds have 25% of Menz local genes and thus the progeny in Menz can experience a lower heterosis effect with respect to Wollo and Chacha. The third contrast was to compare the locations Chacha and Wollo. The fourth contrast was to see the interaction of 2 genotypes (Awassi and Local genotypes) and two locations (Menz and Chacha + Wollo). The fifth contrast was used to test the interaction of 2 genotypes and 2 locations (Chacha and Wollo). The last contrast was to see the effect of Corriedale genotype (Wollo Corriedale vs Wollo Local).

Table 1. Location by genotype combinations and contrasts

Contrast	MeAw	MeLo	ChAw	ChLo	WoAw	WoLo	WoCo
1 - Aw vs Lo	+1	-1	+1	-1	+1	-1	0
2 - Me vs (Ch +Wo)/2	+2	+2	-1	-1	-1	-1	0
3 - Ch vs Wo	0	0	+1	+1	-1	-1	0
4 - Interaction 1x2	+2	-2	-1	+1	-1	+1	0
5 - Interaction 1x3	0	0	+1	-1	-1	+1	0
6 - WoCo vs WoLo	0	0	0	0	0	+1	-1

Me – Menz; Aw – Awassi; Lo – Local; Ch – Chacha; Wo – Wollo; Co – Corriedale

Results

Least square means and standard errors of reproductive performances of local and crossbred ewes in different locations are presented in Table 2.

Age at first lambing

Age at first lambing was significantly ($p<0.05$) affected by location/genotype combined levels, year and season. Age at first lambing for local ewes (472.7 days) was significantly lower than the Awassi crossbred ewes (553.2 days). The pooled mean of Chacha and Wollo (481.5 days) was lower ($p<0.05$) than the mean of Menz ewes (576.5 days). Wollo ewes showed lower age at first lambing than ewes in Chacha (461.6 vs 501.4 days). The interaction of the two genotypes (Local and Awassi crossbred) and the two locations (Menz and Wollo + Chacha) was significant whereas the interaction of the two genotypes mentioned above and two locations (Wollo and Chaha) was not significant. Corriedale ewes in Wollo were not significantly ($p>0.05$) different from Local ewes in Wollo.

Lambing interval

Lambing interval was affected ($p<0.05$) by location/genotype combined levels, year of lambing, season of lambing and parity of ewe. Lambing interval of Local ewes (247.6 days) was lower ($p<0.05$) than the lambing interval of Awassi crossbred ewes (286.3 days). Ewes in Menz had longer lambing intervals compared to the average mean lambing interval of Chacha and Wollo (294.7 vs 253.1 days). The interaction of the two genotypes (Local and Awassi crossbred) and the two locations (Menz and Wollo + Chacha) was significant ($p<0.05$) whereas the interaction of these two genotype mention and two locations (Wollo and Chaha) was not significant ($p>0.05$). Wollo Corriedale x Local crossbred ewes had similar lambing interval with Local breeds.

Table 2. Least square means (LSM) and standard error (SE) of reproductive performances of local and crossbred ewes by location and genotype

Location-Genotype	LSM (SE)				
	AFL	LI	EPPWT	NLBEY	NLWEY
Chacha Local	462.9(17.3)	255.8(8.6)	27.4(0.28)	1.71(0.05)	1.18(0.05)
Chacha Awassi cross	540.0(19.6)	279.7(12.1)	30.0(0.36)	1.62(0.06)	1.05(0.08)
Menz Local	522.3(17.4)	260.0(8.7)	23.1(0.28)	1.58(0.05)	1.00(0.05)
Menz Awassi cross	630.7(20.9)	329.4(15.1)	26.9(0.42)	1.45(0.08)	1.01(0.09)
Wollo Local	434.1(21.2)	227.1(9.2)	27.9(0.30)	1.94(0.05)	1.12(0.06)
Wollo Awassi cross	489.1(24.1)	249.7(18.0)	33.9(0.50)	1.78(0.10)	1.00(0.12)
Wollo Corriedale cross	469.4(21.7)	224.9(11.8)	31.9(0.36)	1.86(0.06)	1.17(0.08)
MSE	90.4	99.37	3.55	0.51	0.72

AFL – Age at first lambing; LI – Lambing interval; EPPWT – Ewe postpartum weight; NLBEY – Number of lambs born per ewe per year; NLBWEY - Number of lambs weaned per ewe per year; MSE – Mean square error.

Table 3. Contrasts for different group of genotype and location and p values for reproductive traits

Contrasts	P-values				
	AFL	LI	EPPWT	NLBEY	NLWEY
1 - Aw vs Lo	<0.0001	<0.0001	<0.0001	0.0015	0.1135
2 - Me vs (Ch +Wo)/2	<0.0001	<0.0001	<0.0001	0.0001	0.1071
3 - Ch vs Wo	0.0018	0.0066	<0.0001	0.0001	0.3458
4 - Interaction 1x2	0.0036	0.0421	0.2932	0.9969	0.2005
5 - Interaction 1x3	0.9414	0.4275	<0.0001	0.4947	0.9546
6 - WoCo vs WoLo	0.1692	0.4066	<0.0001	0.3605	0.1690

AFL – Age at first lambing; LI – Lambing interval; EPPWT – Ewe postpartum weight; NLBEY – Number of lambs born per ewe per year; NLBWEY - Number of lambs weaned per ewe per year; Aw – Awassi; Lo – Local; Me – Menz; Ch – Chacha; Wo – Wollo; WoCo – Wollo Corriedale; WoLo – Wollo Local.

Ewe postpartum weight

Ewe postpartum weight was significantly ($p<0.05$) affected by location/genotype, year of lambing, season of lambing and parity of the ewe. Generally Awassi x Local crossbred ewes had higher weight at postpartum than locals (30.3 vs 26.2 kg). Ewe postpartum weight in Menz (25.0 kg) was lower than that of pooled Wollo and Chacha ewes (29.8 kg). Ewes in Wollo were heavier postpartum than ewes in Chacha. There was no interaction between genotype and location (Menz and Wollo + Chacha) however the interaction of genotype and location (Wollo and Chacha) was significant. In Wollo, post partum weight of Corriedale crossbred ewe was higher ($p<0.05$) than Local ewes of Wollo.

Number of lambs born and weaned per ewe per year

Number of lambs born per ewe was affected ($p<0.05$) by location/genotype, year, season of lambing and parity. Local ewes had more lambs (1.74) per year than Awassi crossbred ewes (1.62). Ewes in Chacha and Wollo sites were also able to produce more lambs (1.76) compared with ewes in Menz (1.51). Ewes in Wollo had more lambs per year than ewes in Chacha (1.86 vs 1.67 lambs). Number of lambs born per ewe per year of Corriedale x Local crossbred ewes in Wollo was similar ($p>0.05$) with Local ewes. Genotype, location and the interaction of the two had no effect ($p>0.05$) on number of lambes weaned per ewe per year.

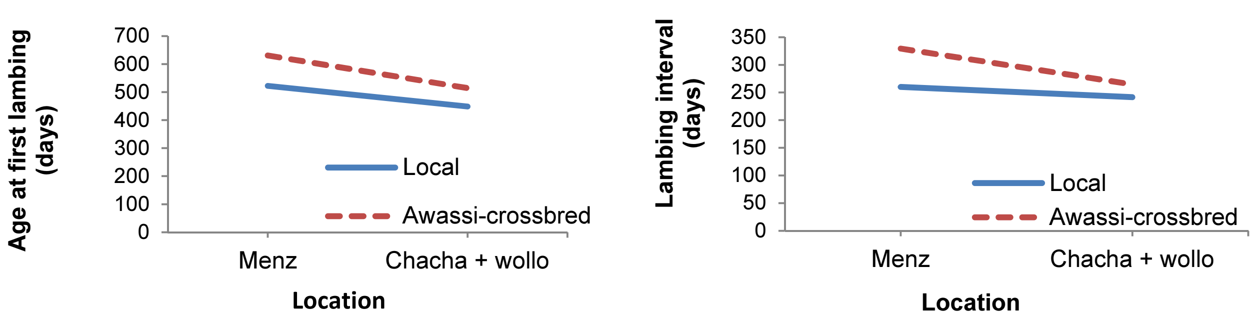

Figure 1. Location by genotype interaction for age at first lambing (left) and lambing interval (right)

Discussion

Age at first lambing observed in this study (434.1 to 630.7 days) seemed to be comparable with that reported in tropical systems reported between 431 and 572 days (Asare and Wilson, 1985; Armbruster et al., 1991; Galina et al., 1996). Lambing interval for local ewes found in this study ranged from 226.9 to 257.8 days is fairly comparable with that of reported for Ethiopian and Mexican sheep (Mukasa-Mugerwa et al., 1994; Galina et al., 1996). Local ewes were consistently better than Awassi crossbred ewes in all studied reproductive performances except number of lambs weaned per ewe per year. However the presence of interaction between genotype and location in age at first lambing and lambing interval suggests that similar genotypes performed differntly in different locations. For example the difference between locals and crosses in Menz and (Chacha + Wollo) was 54.5 and 23.4 days for lambing interval and 108.4 and 66 days for age at first lambing, respectively (Figure 1). Reduced performance in Menz location might be attributed to the environmental difference. Furthermore, the 75% Awassi rams for distribution were produced using the local sheep breed in Menz and thus the offspring in Chacha and Wollo benefited with more heterosis than offsprings in Menz.

The wide range of variability in reproduction performance was also observed for Awassi sheep in another studies (Younis et. al., 1978; Epstein, 1982) indicated the higher effect of management and environment on this trait (Galina et al., 1996; Al-Haboby et al.,1999; Gbangboche et al., 2006; Kremer et al., 2010; Mokhtari et al., 2010). Furthermore, low heritability for reproductive traits had been reported many times (e.g., Rosati et al., 2002; Mokhtari et al., 2010; Selvaggi et al., 2010). Thus focus should be given on improving the environment like ewe nutrition before mating, during late pregnancy and early lactation for the improvement of reproductive performance (Sendros et al., 1995). Variation in reproductive performance among location, season, year and management was also reported by Gbangboche et al. (2006) and Komprej et al. (2011) and these authors pointed out that better environments and management systems is required for crossbreeding program to be successful.

Productivity of sheep farming is dependent on both growth, lamb survival and reproductive performance of the breed. While the Awassi crossbred ewes were inferior in number of lambs born per ewe per year, they showed comparable performance in number of lambs weaned per ewe per year. This is due to the fact that crossbreds are heavier at birth (Hassen et al. 2002) and this contributed for better survival of the growing lambs (Tibbo, 2006). Better growth and survival of lambs produced from crossbred ewes in Wollo was also reported by Gizaw and Tesfaye (2009). Inbreeding depression is higher for traits of low heritability than the highly heritable traits. Thus, the use of limited number of crossbred rams in this project might also contribute for the lower reproductive performance of crossbred ewes. However the effect of inbreeding on reproductive performance needs further investigation in the context of the present study.

Conclusions

Reproductive performance of ewes is influenced by many of the non-genetic and genetic factors. Awassi crossbreds performed worse in reproductive performance than local ewes except in number of lambs weaned per ewe per year. However the inferiority of Awassi crossbred ewes in many of the reproductive performance is offset by their ability to raise their lambs to weaning age. Although not considered in this study, growth performance (another important paramter) should be considered in addition to reproductive performace for careful evalaution, choice and use of a breed. The variation in performance due to genotype, location and other environmental factors promoted the significance improving the management practices in the existing crossbreeding scheme. Developing appropriate exotic blood levels for each area and devising alternative crossbreeding systems that enable use of Local and Corriedale x local crossbred ewes as dam lines should be taken into consideration.

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