Sheep & Goat Research Journal
Volume 20, 2005

Post-weaning Growth and Carcass Traits of St. Croix White and Dorper X St. Croix White Lambs Fed a Concentrate Diet in the U.S. Virgin Islands

R.W. Godfrey[1] and A.J. Weis

Agricultural Experiment Station, University of the Virgin Islands, St. Croix.

[1] Corresponding author RR 1, Box 10,000, Kingshill, VI 00850.
Phone: 340-692-4042; Fax: 340-692-0435; e-mail: rgodfre@uvi.edu.

Summary

Growth and carcass traits of St. Croix White (STX; n = 22) and Dorper X St. Croix White (DRP; n = 18) lambs fed a concentrate ration were evaluated. Starting two weeks after weaning (63 d of age) lambs were fed a commercial diet at 4 percent BW•hd^{-1}•d^{-1}. Lambs were slaughtered at a BW of 30 kg. Carcass weight, fat thickness over the 12th rib, rib eye area (REA), percent KPH and leg circumference were measured. Days on feed was greater (P < 0.01) for STX than for DRP lambs (153.2 ± 6.8 d vs. 118.9 ± 7.4 d, respectively). Total weight gained was greater (P < 0.04) for STX than for DRP lambs (16.1 ± 0.5 kg. vs. 14.6 ± 0.5 kg, respectively). The ADG of DRP lambs was higher (P < 0.01) than that of STX lambs (125.1 ± 4.7 g/d vs. 108.1 ± 4.3 g/d, respectively). Carcass weight was not different (P > 0.10) between breed type (12.6 ± 0.2 kg). The REA of DRP lambs was greater (P < 0.02) than that of STX lambs (10.4 ± 0.4 cm^2 vs. 9.0 ± 0.4 cm2, respectively). Fat thickness was not different (P > 0.10) between DRP and STX lambs (1.5 mm ± 0.2 mm). Percent KPH was higher (P < 0.001) in STX than in DRP lambs (3.6 ± 0.3 percent vs. 2.2 ± 0.3 percent, respectively). Leg circumference was greater (P < 0.007) for DRP than for STX lambs (37.3 ± 0.4 cm vs. 35.7 ± 0.4 cm, respectively). Cost of gain was higher (P < 0.05) for STX than DRP lambs (4.08 ± 0.02 S/kg. vs. 3.73 ± 0.02 $/kg, respectively). Sales of DRP resulted in greater (P < 0.03) net revenue than sales of STX in each market. Dorper X St. Croix White crossbred lambs fed a concentrate ration are economically feasible due to lower cost of gain, higher ADG and revenue.

Key words: Hair Sheep, Lambs, Crossbreeding, Growth, Carcass.

This manuscript submitted as part of the Hair Sheep Workshop sponsored by the National Sheep Industry Improvement Center and the NCERA-190 research project, June 21-23, 2005 at Virginia State University.

Introduction

The Caribbean sheep industry is based on breeds of hair sheep that can be traced back to African seed stock (Shelton, 1991). The predominant breed in the U.S. Virgin Islands is the St. Croix White with a small number of Barbados Blackbelly. Carcass weight of hair sheep lambs raised under a variety of conditions in the tropics has been reported to range from 4.6 kg to 18.1 kg (Martinez et al., 1991; Wildeus and Fugle, 1991; Hammond and Wildeus, 1993; Godfrey and Collins, 1999). Attempts to produce larger carcasses from hair sheep have primarily focused on crossbreeding. McClure et al. (1991) evaluated a composite breed consisting of one-quarter to one-half hair and three-quarters to one-half wool breeds and found that the crossbred lambs had lighter carcasses than straightbred wool lambs, but they were heavier than straightbred St. Croix White lambs. In our laboratory it was found that Suffolk X St. Croix White lambs had higher ADG than St. Croix White lambs but lower feed efficiency of the crossbreds and the high cost of imported feed eliminated any economic advantage of the growth and size of the Suffolk-sired lambs (Godfrey and Collins, 1999).

The introduction of Dorper sheep into the United States has led to a high level of interest in this breed in the U.S. Virgin Islands for use in crossbreeding programs. The Dorper breed was developed in South Africa by crossing Black Head Persian with Dorset Horned sheep (Milne, 2000). The Dorper sheep was initially selected for use in arid areas of South Africa. St. Croix has a semi-arid environment with an annual rainfall of 1100 mm with the majority of the precipitation occurring during the months of September though December (Godfrey and Hansen, 1996).

There is little information in the literature describing the growth performance of Dorper X hair crossbred lambs, especially under tropical conditions. Notter et al. (2004) reported that Dorper sired lambs had slightly greater backfat thickness and larger loin eye area than Dorset sired lambs. The dams of those lambs were wool ewes, and they were not reared under tropical conditions. Snowder and Duckett (2003) determined that lambs produced by Dorper terminal sires on wool-breed ewes were suited for U.S. lamb production due to the enhanced growth rate, feed efficiency and carcass traits of the lambs.

The Dorper was selected for use in crossbreeding with the Caribbean hair sheep in this project due to its heavy muscling and the fact that it was developed for use in arid, tropical areas and its coat is more typical of hair than wool. The objectives of this study were to evaluate the growth and carcass traits of St. Croix White and Dorper X St. Croix White lambs fed a concentrate ration during the post-weaning period.

Materials and Methods

St. Croix White (STX) ewes were bred to black headed Dorper (n =2) and St. Croix White (n = 2) rams to produce STX and Dorper X St. Croix White (DRP) lambs. All lambs were weaned at an age of 63 ± 3 d. For two weeks after weaning, lambs were fed a commercial pelleted diet at 2 percent BW•hd^{-1}•d^{-1} (PMI, Mulberry, FL) and had *ad libitum* access to guinea grass (*Panicum maximum*) hay, water and mineralized salt. Male lambs were surgically castrated one week after weaning. At the end of the two-week adjustment period, the lambs (n = 40) were allotted by gender and sire breed and placed into pens (3.1 X 6.1 meters). The final distribution was seven and eight DRP and STX ewe lambs and 11 and 14 DRP and STX wethers, respectively. Lambs were fed the pelleted diet at 4 percent BW• hd^{-1}•d^{-1} and had *ad libitum* access to guinea grass hay, water and mineralized salt. Feed refusals from each pen were weighed daily. Lambs were weighed each week, and the amount of feed offered was adjusted accordingly.

Lambs were slaughtered at 30 kg BW, which is the preferred size for the local market. Cold carcass weight, rib eye area measured between the 12th and 13th rib (REA), fat thickness over the 12th rib, percent KPH and rear leg circumference were recorded. Dressing percent was also determined.

Total weight gain and ADG were determined for individual lambs within each pen. Cost of gain (U.S. $/kg) was calculated on a per pen basis using the total amount (kg) and cost of feed (U.S. $0.50/kg) provided to each pen and the total weight gain of each pen (kg). Even though all lambs were slaughtered and were sold in only two of the markets, net carcass value was calculated for each of the three market outlets available in the U.S. Virgin Islands. If animals had been sold live, for religious slaughter, the price would have been $2.21/kg live weight. Commercial sale of the carcasses to a local supermarket was at the rate of $3.96/kg carcass weight and sale of carcasses to individual consumers was at the rate of $4.41/kg carcass weight. Net-carcass value was determined as the gross-sale price for each market described minus the cost of feed and slaughter fees (fixed at $6/hd).

Data were analyzed using General Linear Model procedures (SAS, 1999). Body weight during the feeding period was analyzed using repeated measures procedures. The model consisted of breed, gender, days on feed and the appropriate interactions. Carcass and economic traits were analyzed using breed, gender and the interaction in the model. All data are reported as least squares means ± SEM.

Results and Discussion

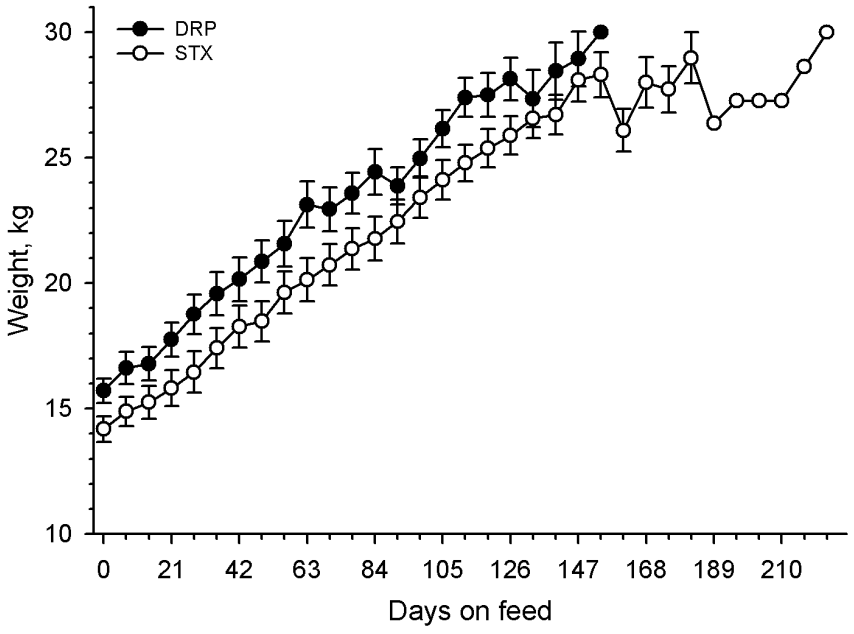
There was no effect of gender or the breed x gender interaction on any traits measured (P > 0.10) so only breed comparisons are reported. At the start of the

Table 1. Growth parameters of St. Croix White (STX) and Dorper X St. Croix White (DRP) lambs fed a concentrate diet.[a]

Breed	Days on feed	Total gain, kg	ADG, g/d
DRP	118.9 ± 7.4[b]	14.6 ± 0.5[d]	125.1 ± 4.7[b]
STX	153.2 ± 6.8[c]	16.04 ± 0.5[e]	108.1 ± 4.3[c]

[a] Lambs were provided feed (18.8% CP on DM basis) at 4% BW•hd^{-1}•d^{-1}.
[b,c] Means within a column with different superscripts are different (P < 0.01).
[d,e] Means within a column with different superscripts are different (P < 0.04).

Figure 1. Weight of St. Croix White (STX) and Dorper X St. Croix White (DRP) lambs during the feeding trial. Lambs were slaughtered at a BW of 30 kg. The DRP lambs were heavier than the STX lambs during the feeding trial (P < 0.04).



feeding trial the DRP lambs weighed more (P < 0.007) than the STX lambs (15.8 ± 0.5 kg. vs. 13.8 ± 0.5 kg, respectively). The number of days on feed to reach market weight (P < 0.01) and total weight gained (P < 0.04) were greater for STX than for DRP lambs (Table 1). Average daily gain was higher (P < 0.01) for DRP than for STX lambs (Table 1). The DRP lambs were heavier (P < 0.04) than the STX lambs at all times during the feeding trial (Figure 1).

Previous work in our lab has shown that crossbred (Suffolk X St. Croix White) lambs yielded heavier carcasses than St. Croix White lambs after 100 d on feed (Godfrey and Collins, 1999). This is in contrast to the present study where there was no difference in carcass weight between the STX and DRP lambs. In the previous study the crossbred lambs were heavier than the St. Croix White lambs at slaughter (34 kg vs. 29 kg, respectively), while there was no difference between breed types in slaughter weight in the present study. This is due to the fact that the lambs in the present study were slaughtered at a target weight (30 kg) and the lambs in the previous study were slaughtered after a specific number of days on feed. The ADG of the STX lambs in the present study (108 g/d) is lower than the ADG of St. Croix White lambs fed green chopped guinea grass and a coconut meal supplement (133 g/d) during a nine-week feeding trial in a previous study (Hammond and Wildeus, 1993). In a second part of the study by Hammond and Wildeus (1993) when molasses was added to the feed an even higher ADG of 142 g/d was achieved. Based on lab analysis (Dairy One, DHI Forage Testing Laboratory, Ithaca, New York) the pelleted feed used in the present study contained 18 percent CP and the hay contained 5 percent, on a DM basis. The higher ADG of the St. Croix White lambs in the study by Hammond and Wildeus (1993) is most likely due to a combination of the higher CP level in the coconut meal supplement (23 percent on a DM basis) and the guinea grass (8 percent on a DM basis; Wildeus et al., 1988). Average daily gain of the St. Croix White and Suffolk X St. Croix White lambs in a previous study (Godfrey and Collins, 1999) was higher than that of the STX and DRP lambs in the current study as well. The CP of the concentrate feed in both studies was similar (18 percent and 19 percent) but the type of hay in the diets was different. In the previous study coastal bermuda grass hay was fed, and in the present study guinea grass hay was fed. There was no nutritional analysis conducted on the coastal bermuda grass hay but it was probably higher than the 5 percent CP in the guinea grass hay used in the present study, which may account for some of the difference in ADG.

Carcass weight, either hot or cold, was not different (P > 0.10) between STX and DRP lambs (Table 2). The DRP lambs had greater leg circumference (P < 0.007) and REA (P < 0.02) and lower KPH (P < 0.001) than STX lambs (Table 2). There was no difference (P > 0.10) in external fat thickness or dressing percent between DRP and STX lambs.

The only differences in the carcass traits of the DRP and STX lambs were in the amount of KPH and muscle of the carcass. The STX lambs had a higher percent KPH fat than the DRP lambs,

Table 2. Carcass traits of St. Croix White (STX) and Dorper X St. Croix White (DRP) lambs.[a]

	Breed	
	DRP	**STX**
Hot carcass wt, kg	12.9 ± 0.2	12.9 ± 0.2
Cold carcass weight, kg	12.6 ± 0.2	12.6 ± 0.2
Leg circumference, cm	37.3 ± 0.4[b]	35.7 ± 0.4[c]
Rib eye area, cm^2	10.4 ± 0.4[d]	9.0 ± 0.4[e]
Kidney-pelvic fat, %	2.2 ± 0.3[f]	3.6 ± 0.3[g]
Backfat, mm	1.5 ± 0.2	1.4 ± 0.2
Dressing percent, %	41.3 ± 0.6	41.8 ± 0.6

[a] Lambs were slaughtered at a BW of 30 kg.
[b,c] Means within a row with different superscripts are different (P < 0.007).
[d,e] Means within a row with different superscripts are different (P < 0.02).
[f,g] Means within a row with different superscripts are different (P < 0.001).

Table 3. Economics of raising St. Croix White (STX) and Dorper X St. Croix White (DRP) lambs on concentrate feed.

	Breed	
	DRP	STX
Cost of gain, $/kg	3.73 ± 0.02[d]	4.08 ± 0.02[e]
Net Price		
Live market[a], $	11.77 ± 2.08[f]	0.67 ± 1.90[g]
Commercial market[b], $	-4.39 ± 2.48[f]	-15.95 ± 2.50[g]
Individual market[c], $	1.16 ± 2.53[f]	-10.42 ± 2.55[g]

[a] Sold as live animal to ethnic consumers for $2.21/kg body weight.
[b] Sold as carcass to local grocery stores at $3.96/kg carcass weight.
[c] Sold as carcass to individual consumers ate $4.41/kg carcass weight.
[d,e] Means with different superscripts within a row are different ($P < 0.05$).
[f,g] Means with different superscripts within a row are different ($P < 0.003$).

but there was very little fat deposited externally in either breed type. This pattern of fat deposition is in agreement with the results of Hammond and Wildeus (1993) and McClure et al. (1991). McClure et al. (1991) reported that hair sheep lambs were trimmer than wool lambs and deposited less fat externally. Results from our laboratory (Godfrey and Collins, 1999; Godfrey et al., 1999) have indicated that St. Croix White lambs tend to store fat in the body cavity as KPH and have very little external fat. In agreement with the present study, Dodson et al. (2005) reported that DRP lambs had higher KPH than STX lambs did, but there was no difference in back fat when lambs were raised on guinea grass pastures. The trimness of hair sheep carcasses may be useful when marketing the meat to consumers who are interested in purchasing trimmer cuts of meat for perceived dietary or health reasons. Notter et al. (2004) reported an increase in muscling in Dorper-sired lambs. The larger REA and leg circumference of the DRP lambs compared to the STX lambs in the present study is indicative of more muscling on the carcass.

The STX lambs had a higher ($P < 0.05$) cost of gain than DRP lambs (Table 3). In all three markets the STX lambs yielded a lower net return ($P < 0.003$) compared to the DRP lambs. The DRP lambs yielded a greater net price ($P < 0.003$) than STX lambs when they were sold as live animals or when the carcass was sold to an individual consumer (Table 3). When the carcasses were sold to a retail outlet neither group had a positive net return, but the DRP lambs yielded a smaller loss than STX lambs.

The lower net value of STX lambs in comparison to the DRP lambs in each of the markets is related to the cost of gain. The DRP lambs had higher ADG and lower days on feed, implying a greater efficiency, which contributed to the lower cost of gain and higher net value. In a previous study the higher cost of gain of the Suffolk-sired lambs contributed to them having lower economic returns compared to St. Croix White lambs even though they produced a heavier carcass (Godfrey and Collins, 1999). Because there is no local concentrate feed production, it has to be imported and this further impacts the cost of livestock production in the U.S. Virgin Islands. The cost of the feed in the present study, before shipping, was $.23/kg and the shipping added $.27/kg to the price. The high price of importing concentrated feed is the key factor in the low level of revenue reported in the present study. If the feed price, excluding shipping, is used in calculating net return, then the Dorper X St. Croix White lambs could yield net returns of $25 to $41 and the St. Croix White lambs could yield net returns $19 to $36, dependent on the market outlet. These figures are more attractive to the producer and could be realized if there was a local source of concentrated feed. Because of the low financial return obtained from growing lambs using a concentrated ration, it may not be feasible to utilize the Dorper X St. Croix White lambs, or any breed, in this type of system in the tropics. Even with the larger size and higher ADG of the Dorper X St. Croix White lambs they did not have a financial value that would support a sustainable operation based on economic analysis of sheep production in the U.S. Virgin Islands (Godfrey and D'Souza, 2001).

Conclusion

Because the crossbred lambs, sired by Dorper rams, were heavier than the straightbred hair lambs the potential exists for an increase in meat production. This weight advantage of Dorper-sired lambs allowed them to be marketed at a younger age and produce a carcass with more muscling than the straightbred hair lambs. The lower cost of gain for the Dorper-sired lambs may enhance their use under some intensive, island-management systems. While the best net value of Dorper-sired lamb carcasses was $11.77, the St. Croix White carcasses had a best net value of only $.67. This difference can be explained by the higher ADG and lower cost of gain of the Dorper-sired lambs. Further studies need to be conducted to determine if the heavier body weight of the crossbred lambs will be maintained when the lambs are raised on native pastures, instead of being fed a costly concentrated feed. In addition, further studies need to be done using a larger sampling of sires within each breed type so that inferences are not being made from a small sample size. By crossbreeding native hair sheep with the Dorper, it may be possible for sheep producers in the Caribbean to increase meat production on forage-based systems. As a precaution, Dorper rams should be limited to use as terminal sires in production systems that are raising lambs for meat and not for breeding stock. This is critical to maintain the purity of the germplasm of the indigenous hair sheep breeds in the Caribbean.

Acknowledgements

This study was funded by USDA-TSTAR Caribbean Grant 2003-34135-14084-S. The authors would like to thank W. Gonzales and C. Diaz for assistance with animal care and management.

Literature Cited

Dodson, R.E., A.J. Weis, and R.W. Godfrey. 2005. Production traits of St. Croix White and Dorper X St. Croix White lambs grazing pasture during the dry and wet seasons in the US Virgin Islands. Sheep & Goat Res. J. 20:26-32.

Godfrey, R.W., H.A. Buroker, and B.M. Pannagl. 1999. Growth and carcass traits of St. Croix
White (SCW) and Barbados Blackbelly x SCW (BBSC) lambs in the tropics. J. Anim. Sci. 77(Suppl. 1):239. (Abstr.)

Godfrey, R.W., and J.R. Collins. 1999. Post-weaning growth and carcass traits of hair and wool x hair lambs in the US Virgin Islands. Sheep and Goat Res. J. 15:100-105.

Godfrey, R.W., and G. D'Souza. 2001. Hair sheep production in the U.S. Virgin Islands:
Management practices and economic analysis. University of the Virgin Islands, St. Croix.

Godfrey, R.W., and Hansen, P.J. 1996. Reproduction and milk yield of Holstein cows in the US Virgin Islands as influenced by time of year and coat color. Arch. Latinoam. Prod. Anim. 4:31-44.

Hammond, A.C., and Wildeus, S. 1993. Effects of coconut meal or fish meal supplementation on performance, carcass characteristics and diet digestibility in growing St. Croix lambs fed a tropical grass based diet. Sm. Rum. Res. 12:13 25.

Martinez, A., C. Burwell, K. Young, and J. Robinson. 1991. Response of lambs to concentrate feeding in Antigua. Pages 222-227 in Proc. Hair Sheep Res. Symp., University of the Virgin Islands St. Croix.

McClure, K.E., Parker, C.F. and N.A. Parrett. 1991. Feedlot performance and carcass characteristics of hair, wool and hair crossbred lambs fed high energy diets. Pages 252-256 in Proc. Hair Sheep Res. Symp., University of the Virgin Islands St. Croix.

Milne, C. 2000. The history of the Dorper sheep. Sm. Rum. Res. 36: 99-102.

Notter, D.R., S.P. Greiner, and M.L. Wahlberg. 2004. Growth and carcass characteristics of lambs sired by Dorper and Dorset rams. J. Anim. Sci. 82:1323-1328. The SAS System for Windows (v 8) 1999. Cary, NC: SAS Institute Inc.

Shelton, M. 1991. Hair sheep production under temperate and tropical conditions. Pages 65-84 in Proc. Hair Sheep Res. Symp., University of the Virgin Islands St. Croix.

Snowder, G.D., and S.K. Duckett. 2003. Evaluation of the South African Dorper as a terminal sire breed for growth, carcass, and palatability caharcteristics. J. Anim. Sci. 81:368-375.

Wildeus, S., and J.R. Fugle. 1991. Effects of supplementation on growth and carcass characteristics of hair sheep lambs grazing native tropical pasture. Pages 243-251 in Proc. Hair Sheep Res. Symp., University of the Virgin Islands St. Croix.

Wildeus, S., K.T. Traugott, C. Wildeus, and L.R. McDowell. 1988. Growth and lambing performance of hair sheep grazing native pastures during the dry season on St. Croix, Virgin Islands. Pages 109-113 in Proc. of the Caribbean Food Crop Soc.