Evaluation of Columbia, USMARC-Composite, Suffolk, and Texel rams as terminal sires in an extensive rangeland production system

David Notter[1], Greg Lewis[2], Michelle Mousel[2], Tim Leeds[2], Henry Zerby[3], Steve Moeller[3], David Kirschten[2], and Bret Taylor[2]

[1]Department of Animal and Poultry Science, Virginia Tech, Blacksburg; [2]USDA, ARS, U.S. Sheep Experiment Station, Dubois, ID; and [3]Department of Animal Science, The Ohio State University, Columbus

Introduction

Mating systems involving crossing of terminal sire sheep breeds with documented superiority for production characteristics such as growth rate, carcass muscling and leanness, and efficiency of feed utilization with well-adapted maternal breeds provide opportunity to increase lamb carcass value while maintaining acceptable environmental adaptation in the crossbred lambs. Large, lean terminal-sire breeds such as the Suffolk and Columbia have been most typically used in extensive rangeland conditions found in much of the western U.S.A. Relatively intense selection in these breeds for adult body weight and frame size led to correlated increases in growth rate but also concerns regarding fitness and survival rates to weaning in resulting crossbred lambs. Other less-extreme terminal-sire types of most moderate size have been increasingly promoted as alternatives, and interest in increasing muscling in terminal-sire types has increased.

An experiment was therefore carried out at the US Sheep Experiment Station (USSES), Dubois, ID to compare Columbia, USMARC Composite, Suffolk, and Texel sires in matings with Rambouillet ewes in an extensive rangeland production system. USMARC Composite rams were developed at the U.S. Meat Animal Research Center (USMARC), Clay Center, NE, in the early 1970s from crosses among Columbia (50%), Suffolk (25%), Hampshire (25%). The study included intensive characterization of ewe productivity and lamb survival, growth, composition, and efficiency of feed utilization. Matings to produce experimental animals were made in 2005, 2006, and 2007.

Experimental Procedures

Columbia, Suffolk, and Texel rams (n =22, 22, and 21, respectively) were sampled from industry and USSES flocks and Composite rams (n = 22) were obtained from USMARC. Approximately one half of Suffolk rams and one quarter of Columbia rams were obtained from flocks participating in the U.S. National Sheep Improvement Program and were selected for high estimated breeding values (EBV) for 120-day postweaning weight. Most rams were purchased as yearlings and transferred to USSES in the summer preceding their first use in breeding. A few older rams were used in 2006 and 2007 to provide

genetic connections between years. Ewes were selected from the USSES Rambouillet flock and were 3 to 7 years old at lambing. In each year, rams and ewes were joined in single-sire pens for 21 days beginning in mid-October. Ewes lambed in March and early April in outdoor lots under frequent surveillance.   Ewes and lambs were placed in small pens for 24 to 48 hours and then comingled in outdoor lots. Male lambs were castrated at birth. Ewes and lambs were moved to sagebrush steppe in late April and herded on subalpine range beginning in early July. Lambs were weaned in early August at approximately 132 days of age.

In each year, lambs were assigned, within sex and sire breed, to one of three replicated drylot pens and fed a series of diets over 6 to 7 weeks to facilitate transition from a preweaning forage diet to a high-energy (85% digestible) finishing diet. Feed was provided for free-choice intake in a single feeder in each pen to allow monitoring of feed intake, with a maximum of 16 lambs per pen. Lambs were weighed weekly and scanned every 2 weeks using ultrasound to estimate loin muscle area and backfat thickness. Wether lambs were also assigned to one of three groups to be harvested when the average of all wethers in the study reached 120, 135, or 150 lb. When wethers reached these endpoints, they were transported to The Ohio State University Meats Laboratory in Columbus for harvest. Measurements on chilled carcasses included loin muscle area and backfat and body wall thicknesses, and carcasses were fabricated into wholesale cuts. In addition, the rack, loin, and leg were closely trimmed and the leg was trimmed and deboned to estimate the yield of these high-value retail cuts.

Results and Discussion

Over the 3 years of the study, rams of the four terminal sire breeds were used in 1,018 matings with Rambouillet ewes. The matings resulting in 908 lambings and production of 1,834 lambs. Weaning weights were recorded for 1,306 lambs, 1,049 of these lambs were evaluated for postweaning performance, and 518 wether lambs were used for carcass evaluation.

Ewe reproduction and lamb survival

The fertility of adult Rambouillet ewes in this project averaged 95%, and the average number of lambs born per ewe lambing was 2.02. Numbers of lambs weaned per ewe exposed or per ewe lambing are shown in Figure 1. Production levels were broadly typical of commercial flocks in the region, with overall averages of 1.45 lambs weaned per ewe lambing and 1.38 lambs weaned per ewe exposed. No significant sire breed differences were observed for the percentage of ewes that lambed or for numbers of lambs born or weaned per ewe exposed or per ewe lambing.

Shed-lambing management protocols were designed to minimize death losses in the first 24 to 48 hours following lambing. However, ewes were subsequently managed under extensive conditions on

desert or mountain range with minimal shepherding until weaning. The adult Rambouillet ewes used in this study were moderately prolific, with approximately 17% triplet births. Essentially all triplet litters had one lamb orphaned or fostered and a few twin litters were also reduced to a single lamb in cases where the milk supply of the ewe appeared insufficient to raise twins. Approximately 6% of the lambs were born dead and approximately 14% of the lambs were orphaned or fostered to other ewes. The proportion of lambs that were orphaned or fostered was not affected by sire breed. After excluding orphaned and fostered lambs from the analysis, survival probabilities from birth to weaning for lambs produced by the different sire breeds are shown in Figure 2. Survival rates to weaning (including lambs that were dead at birth) were 92.5% for Suffolk-sired lambs, and were significantly superior to the survival rates recorded for Texel-sired lambs (86.4%) and Columbia-sired lambs (87.3%).

Our results, therefore, contradict previous studies that reported lower survival rates for Suffolk-sired crossbred lambs compared to lambs sired by Texel or Composite rams. These studies used prolific Romanov-crossbred ewes and included ewes lambing at 1 and 2 years of age, and ewes were not monitored during the night. By contrast, our ewes were 3 to 7 years old and were closely monitored at lambing. Rambouillet ewes are also known to have relatively long gestations; the average birth weight for lambs in this study was nearly 12 lb (Figure 3).

Lamb growth

Growth rates before and after weaning clearly favored Suffolk-sired lambs (Figure 3). Lambs sired by smaller-framed Texel rams were lightest at weaning and after 90 days in the feedlot. Columbia- and Composite-sired lambs were similar in weaning weight, but lambs sired by the larger-framed Columbia rams grew more rapidly after weaning compared to Composite-sire lambs. Suffolk-sired lambs were thus 3 to 5 lb heavier at weaning and 10 to 18 lb heavier at 90 days after weaning than lambs sired by rams of the other breeds.

Body and carcass composition

Both ewe and wether lambs were scanned using ultrasound every 2 weeks during the postweaning period to estimate loin muscle area and backfat thickness. Wether lambs were also harvested in three groups when mean weights of all wethers in the project reached 120, 135, or 150 lb, and loin muscle area, backfat thickness, and body wall thickness were measured on the carcasses. Predicted breed differences in loin muscle area at various harvest endpoints are shown for ultrasound and direct carcass measurements in Figures 4 and 5, respectively, and were generally consistent for the two types of measurements. At 90 days after weaning, Suffolk-sired lambs were much heavier (Figure 3) and, as expected, had larger loin muscle areas compared to other sire breeds. By contrast, Texel-sired

lambs were superior in loin muscle area at comparable harvest body weights to lambs sired by the other breeds, but were also substantially fatter than Suffolk- and Columbia-sired lambs, and somewhat fatter than Composite-sired lambs, at these weights (Figures 6 and 7). At comparable harvest weights, Columbia-sired lambs had smaller loin muscle areas than lambs sired by the other breeds.

Repeated scans on the same lambs allowed us to predict breed differences in loin muscle area at comparable levels of ultrasound backfat thickness (Figure 4). At 0.25 inches of ultrasonic backfat thickness, Suffolk- and Columbia-sire lambs were heavier than lambs of the other breeds (125 and 123 lb, respectively). Texel-sired lambs weighed the least (112 lb) and Composite-sired lambs were intermediate (119 lb). At these weights, Suffolk-sired lambs had larger loin muscle areas than lambs sired by the other breeds. Columbia-sired lambs, despite their relatively heavy weights, still had the smallest loin muscle areas.

Differences among sire breeds in ultrasonic backfat thickness are shown in Figure 6. Values in the figure are averages for ewe and wether lambs. At comparable body weights, Texel-sired lambs had the most backfat, Suffolk- and Columbia-sired lambs were leanest, and Composite-sired lambs were intermediate. When harvested at 110 lb, estimates of untrasonic backfat indicated that lambs sired by all breeds would have been predominantly in Yield Grade (YG) 2, although nearly 50% of Texel-sired lambs would have fallen into YG 3. At 132 lb, Suffolk- and Columbia-sired lambs were mainly in YG 3, whereas Composite and, especially, Texel sires had substantial numbers of progeny in YG 4. By contrast, after 90 days on test (corresponding to body weights shown in Figure 3), Texel-sired lambs weighed least but were fattest; Suffolk-sired lambs were heaviest and relatively fat; Columbia-sired lambs were relatively heavy but remained lean; and Composite-sired lambs were intermediate in both body weight and backfat thickness. These differences were generally consistent with recognized differences among these sire breeds in adult body size and associated maturing patterns.

Direct measurements of backfat and body wall thickness in wether lambs harvested at mean weights of 120, 135, or 150 lb were used to derive sire-breed means for these variables at an average of 82 days on test or an average chilled carcass weight of 65 lb (corresponding to an average live weight at harvest of approximately 135 lb) (Figure 7). Breed rankings for observed carcass fatness were similar to those observed for ultrasound backfat, but the magnitude of the differences among sire breeds in measured carcass backfat thickness was considerably less than those observed for ultrasonic measures of backfat thickness. Based on observed carcass backfat, lambs produced by all sire breeds were solidly in YG 2 at mean chilled carcass weights of approximately 65 lb, whereas measures of ultrasonic backfat thickness would have predicted substantial numbers of lambs in YG 3 at this weight. Interestingly,

measures of sire breed differences in carcass body wall were more consistent with those for ultrasound backfat. For example, relative to Suffolk-sired lambs, Texel-sired lambs were predicted to have 33% greater ultrasound backfat thickness at 132 lb (Figure 6) and 20% greater carcass body wall thickness at a chilled carcass weight of 65 lb but only 10% greater carcass backfat thickness at a chilled carcass weight of 65 lb.

Differences in the magnitude of sire-breed effects on backfat thickness have implications for assigning value to carcasses of lambs sired by the various sire breeds. Lamb YG is based exclusively on predicted carcass backfat thickness, although graders have the option to "adjust" the backfat to reflect differences in fatness observed at other sites on the carcass. Differences in ultrasound backfat thickness in Figure 6 indicate clear differences among sire breeds in YG and, therefore, carcass value and are, to some extent, supported by observed differences in body wall thickness in Figure 7. However, differences in carcass backfat thickness in Figure 7 would not result in meaningful differences among sire breeds in YG.

When carcasses were fabricated into closely trimmed high-value cuts from the rack, loin, and leg, the ultrasound backfat measurement was superior to the actual carcass backfat thickness as a predictor of yield of high-value trimmed cuts, and carcass body wall was a superior predictor compared to either measurement of backfat thickness. This result is consistent with results from other countries where the "GR" fat measurement, which is analogous to our body wall measurement, is preferred for prediction of lean meat yield from the carcass. The observed increase in carcass backfat across harvest groups was less than that predicted by ultrasound and less than that observed in body wall thickness, leading us to question whether carcass backfat thickness alone was an adequate predictor of lean meat yield and carcass value in these lambs.

Following fabrication, and after adjustment of weights of resulting wholesale and trimmed retail cuts to a standard chilled carcass weight of 65 lb, differences among sire breeds in the distribution of wholesale and trimmed retail cuts in the carcass were extremely small. Before trimming, Composite-sired lambs had a higher proportion of their carcass weight in high-value cuts, and, particularly, in the loin and rack compared to Suffolk-sired lambs. This result suggests that recent selection for frame size in the Suffolk may have had a small negative effect on yield of these high-value cuts. However, this breed difference disappeared after trimming of the high-value cuts.

Feed Efficiency

Efficiency of feed conversion was assessed as the ratio of pounds of gain achieved relative to Mcal (calories x 1,000) of metabolizable energy consumed (Figure 8). Results are expressed as a

percentage of the overall mean, and higher values indicate more efficient growth. Suffolk-sired lambs grew most efficiently to all harvest endpoints. This result largely reflected their more rapid postweaning gain and greater leanness. Differences in efficiency of feed conversion among remaining sire breeds were small at 90 days on test. However, Columbia- and Texel-sired lambs tended to be less efficient than Composite-sired lambs at both 132 lb and 0.25 inches of ultrasonic backfat. This result can be explained by the slower growth and greater fatness of Texel-sired lambs. However, Columbia-sired lambs were also relatively inefficient despite their large adult body size, relatively rapid gains, and tendency to stay lean.

Conclusions

Suffolk rams were clearly superior to rams of other breeds as sires of crossbred market lambs in this extensive rangeland production system. As expected, Suffolk-sired lambs grew more rapidly before and after weaning, were leanest at most anticipated harvest endpoints, and were superior in efficiency of feed conversion. Suffolk-sired lambs were equal or superior to lambs sired by other breeds in loin muscle area when harvested at a constant ultrasonic backfat thickness. Suffolk sires were likewise equal or superior to rams of other breeds in ewe fertility and prolificacy, lamb survival, and ewe productivity.

Composite-sired lambs were equal or superior to the remaining breeds for most measured traits, but were generally inferior to Suffolk-sired lambs. The USMARC Composite was created in the 1970's by crossing Columbia, Suffolk, and Hampshire breeds, remains representative of this older-style terminal sire type, and was not competitive with current Suffolk sires in growth rate or carcass leanness. Composite sires have been recommended for use in relatively stressful production conditions such as pasture lambing, summer mating, lambing of yearling ewes, and use of prolific ewes, but were not superior to Suffolk sires in lamb survival or ewe productivity under our conditions.

Texel-sired lambs grew more slowly and were fatter at most harvest endpoints compared to lambs sired by the other breeds. However, Texel-sired lambs were superior to other breeds in loin muscle area at comparable harvest weights, produced acceptable carcasses when harvested at 110 lb, and generally had favorable residual feed intake values. These results suggest opportunity to develop new composite lines that can combine favorable effects of the Suffolk and Texel breeds and to develop selection strategies that can simultaneous improve growth rates, muscling, leanness, and feed efficiency.

The Columbia breed has been used as both a maternal type, by virtue of its relatively good adaptation to rangeland environments and high-quality wool, and as a terminal sire, reflecting more recent increases in adult body weight and frame size. Our results suggest that more intense selection

for growth rates, loin muscle size, and perhaps efficiency of feed conversion are required in order for the Columbia to compete directly with the Suffolk as a terminal sire. Columbia breeders thus need to consider the relative merits of the breed's existing dual-purpose role in extensive rangeland sheep production compared to opportunities to develop more specialized maternal or terminal-sire lines.

References

Kirschten, D. P., D. R. Notter, T. D. Leeds, M. R. Mousel, J. B. Taylor, and G. S. Lewis. 2011. Correlations between measures of feed efficiency and feedlot return for F_1 lambs. Proc. Western Section, Amer. Soc. Anim. Sci. 62:86-88.

Kirschten, D. P., D. R. Notter, T. D. Leeds, M. R. Mousel, J. B. Taylor, and G. S. Lewis. 2013. Evaluation of Columbia, USMARC-Composite, Suffolk, and Texel rams as terminal sires in an extensive rangeland production system: V. Postweaning growth, feed intake, and feed efficiency. J. Anim. Sci. 91:2021-2033.

Leeds, T. D., D. R. Notter, K. A. Leymaster, M. R. Mousel, and G. S. Lewis. 2012. Evaluation of Columbia, USMARC-Composite, Suffolk, and Texel rams as terminal sires in an extensive rangeland production system: I. Ewe productivity and crossbred lamb survival and preweaning growth. J. Anim. Sci. 90:2931-2940.

Mousel, M. R., D. R. Notter, T. D. Leeds, H. N. Zerby, S. J. Moeller, and G. S. Lewis. 2012. Evaluation of Columbia, USMARC-Composite, Suffolk, and Texel rams as terminal sires in an extensive rangeland production system: III. Prefabrication carcass traits and organ weights. J. Anim. Sci. 90:2953-2962.

Mousel, M. R., D. R. Notter, T. D. Leeds, H. N. Zerby, S. J. Moeller, and G. S. Lewis. 2013. Evaluation of Columbia, USMARC-Composite, Suffolk, and Texel rams as terminal sires in an extensive rangeland production system: IV. Post-fabrications carcass component weights. J. Anim. Sci. 91:2012-2020.

Notter, D. R., M. R. Mousel, T. D. Leeds, J. B. Taylor, D. P. Kirschten, and G. S. Lewis. 2012. Evaluation of Columbia, USMARC-Composite, Suffolk, and Texel rams as terminal sires in an extensive rangeland production system: II. Postweaning growth and ultrasonic measures of composition. J. Anim. Sci. 90:2941-2952.