# Comparison of the USSES terminal-sire and Siremax composite breeds with the Suffolk breed as terminal sires in an extensive production system: carcass characteristics

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## INTRODUCTION

Crossbreeding can provide the Western U.S. sheep industry with needed improvements in quality and consistency of lamb carcass traits (Leymaster, 2002; Mousel et al., 2012). The U.S. Sheep Experiment Station (**USSES**) recently compared Suffolk, Texel, and Columbia breeds as terminal sires for improving carcass traits in crossbreed lambs reared in a rangeland system. Suffolk-sired lambs had the greatest hot and chilled carcass weights. Both Suffolk- and Texel-sired lambs had the largest LM area, which indicated greater yielding, more valuable carcasses (Notter et al., 2014). Columbia-sired lambs had the least body wall thickness, an indicator of closely trimmed retail cuts (Mousel et al., 2012). It was readily apparent that no single breed excelled in all carcass traits.

The USSES developed a terminal-sire composite breed (**TSC**) from the Suffolk, Columbia, and Texel breeds to determine if another modern multibreed composite could further enhance lamb survival, growth, efficiency, and carcass traits compared with the Suffolk breed. Likewise, the industry developed the Siremax breed from Suffolk, Columbia, Texel, and Hampshire breeds to excel in structural soundness, longevity, and lean growth. To date, the TSC and Siremax breeds have not been compared with breeds traditionally used as terminal sires in the Western U.S. We hypothesized that when used as terminal sires in a range-ewe production system, the composite breeds would result in crossbreed lambs having in similar consistency and yield of carcass characteristics as crossbreed lambs sired by the Suffolk breed. The objective of this study was to compare the TSC and Siremax composite breeds with the Suffolk breed, when used as terminal sires mated to range-type ewes, on carcass characteristics of lambs. The experiment described herein is 1 yr of a 3-yr study having a broader focus of comparison, which includes survival, growth, efficiency, and retail traits.

## MATERIALS AND METHODS

The USSES Institutional Animal Care and Use Committee (Dubois, ID) reviewed and approved all animal handling, treatment, and management procedures used in this study.

The experimental design, animal management, and sampling protocols for this study were previously described in Leeds et al. (2012) and Notter et al. (2012). Briefly, mature (2- to 7-yr old) USSES Targhee ($n = 80$), Polypay ($n = 80$), and Rambouillet ($n = 80$) ewes were single-sire mated (10 to 15 ewes per sire) to Suffolk ($n = 8$), Siremax ($n = 8$), or TSC ($n = 8$) rams in October, 2016. The goal was to generate at least 12 crossbreed lambs from each ram. Suffolk and Siremax sires were purchased from flocks that partic-

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ipated in the National Sheep Improvement Program. The TSC sires were developed at the USSES. Lambs were born in March and April, 2017, and male lambs were castrated shortly after birth. Ewes and their lambs were managed on sagebrush steppe and sub-alpine range through the spring and summer. Lambs were weaned at 101 to 127 d of age. Lambs were stratified by sex and sire breed and assigned to 1 of 24 pens, with 10 to 12 lambs per pen. Lambs of the same-sex and sire breed were assigned to one of four replicate pens. Individual sires and dam breeds were represented in each pen. Lambs were fed a finishing diet (free choice; 78% concentrate, DM basis) and were monitored and treated for illnesses as previously described in Notter et al. (2012).

Within each pen, lambs were randomly assigned to one of three slaughter groups to achieve a target mean harvest BW of 54.4, 61.2, or 68.0 kg. Lambs were weighed weekly and scheduled for harvest when predicted BW of remaining lambs reached the target BW. At harvest, lambs were weighed and transported by a commercial hauler to Mountain States Rosen abattoir in Greely, CO. A total of 286 lambs (147 ewes and 139 wethers) born in 2017 were evaluated.

After harvest, HCW was recorded for each lamb, and carcasses were stored in a cooler (2–4 °C) for approximately 24 h. After chilling, each carcass was ribbed between the 12th and 13th ribs. Trained personnel subjectively assigned muscling scores, flank streaking, and maturity scores according to USDA (1992) guidelines. Fat depth was measured at the midpoint of the LM and body wall thickness was measured at approximately 12.7 cm from the dorsal midline of both right and left sides. Right and left LM perimeters were traced on acetate paper and later measured with a pork grid to obtain LM area. Measurements for fat depth, body wall thickness, and LM area of the left and right sides were averaged. The calculated percentage of boneless, closely trimmed retail cuts (**calculated %BCTRC**) were calculated as %BCTRC = 49.936 − (.0848 × HCW, pounds) − (4.376 × 12th rib fat, inches) − (3.53 × body wall thickness, inches) + (2.456 ×LM area, square inches) (Boggs, 2006). Estimated weights of boneless, closely trimmed retail cuts (**EstBCTRCwt**) were estimated by multiplying calculated %BCTRC by HCW. USDA yield grades were assigned on unribbed carcasses taken by trained personnel using USDA (1992) guidelines. Following ribbing of the carcasses, a calculated yield grade was also assigned using the formula (12th rib fat (inches) × 10) + 0.4 (USDA, 1992).

HCW, calculated and USDA yield grades, 12th rib back fat, body wall thickness, LM area, calculated %BCTRC, and EstBCTRCwt were analyzed using the Mixed Model Procedure of SAS (v9.4; SAS Inst. Inc., Cary, NC). The model included fixed effects of sex, sire breed, dam breed, slaughter group, and dam breed × slaughter group interaction and a random effect of sire nested within sire breed. Orthogonal linear contrasts were used to compare Suffolk-sired lambs to the average of Siremax- and TSC-sired lambs and to compare lambs sired by the composite breeds. Other two-way interactions among fixed effects and the random effect of pen (nested within sex and sire breed) were tested in preliminary analyses but were not significant for any trait and were removed from the final models. Results were interpreted using an alpha of 0.10.

## RESULTS AND DISCUSSION

The dam breed × slaughter group interaction was significant ($P$ = 0.07 to 0.09) for HCW, 12th rib fat depth, EstBCTRCwt, and calculated yield grade, but was not significant ($P$ > 0.18) for all other measures. The effect of slaughter group was significant ($P$ < 0.0001) for HCW, 12th rib fat depth, body wall thickness, LM area, calculated %BCTRC, EstBCTRCwt, and calculated and USDA yield grades (Table 1). These results were expected, with differences in average lamb age of approximately 1 mo between adjacent slaughter groups. Sire breed effects were significant ($P$ = 0.08) for HCW and EstBCTRCwt, but were not significant ($P$ > 0.13) for 12th rib fat depth, body wall thickness, LM area, calculated %BCTRC, and calculated and USDA yield grades (Table 2). Sex effects were significant ($P$ ≤ 0.10) for HCW, 12th rib fat depth, body wall thickness, LM area, EstBCTRCwt, and calculated and USDA yield grades, while sex had no effect ($P$ = 0.11) on EstBCTRCwt. The effect of dam breed was not significant ($P$ > 0.25) for any measures.

Beneficial effects have resulted from the use of crossbreeding. Specifically, the use of terminal-sire crossbreeding can improve weaning BW, daily gain, and carcass weights of the lambs (Sidwell, 1971; Mousel et al., 2012). For this study year, Suffolk-sired lambs had 0.43 kg (3.01%) heavier EstBCTRCwt ($P$ = 0.02) and 1.06 kg (3.43%) heavier ($P$ = 0.08) HCW compared with TSC- and Siremax-sired lambs (Table 2). These results of greater HCW from Suffolk-sired lambs are consistent with the previous results reported by Kirton et al. (1995) and Leymaster (1981). While HCW and EstBCTRCwt were greater in Suffolk- sired lambs,

**Table 1.** Least-squares means and SE by slaughter group for carcass characteristics

| | Slaughter group | | | | |
|---|---|---|---|---|---|
| Trait[a] | 1 | 2 | 3 | SE | *P* value |
| HCW, kg | 25.63 | 29.98 | 34.76 | 0.36 | <0.0001 |
| 12th rib fat, mm | 4.20 | 5.92 | 6.92 | 0.26 | <0.0001 |
| Body wall thickness, mm | 18.34 | 27.99 | 30.68 | 0.48 | <0.0001 |
| LM area, $cm^2$ | 14.67 | 17.57 | 19.03 | 0.22 | <0.0001 |
| Calculated %BCTRC | 47.46 | 46.04 | 45.25 | 0.15 | <0.0001 |
| EstBCTRCwt | 12.14 | 13.76 | 15.68 | 0.15 | <0.0001 |
| Calculated Yield Grade | 2.05 | 2.73 | 3.12 | 0.10 | <0.0001 |
| USDA Yield Grade | 1.87 | 3.19 | 2.64 | 0.05 | <0.0001 |

[a]Measures of LM area, 12th rib fat, and body wall thickness were taken between the 12th and 13th ribs of both sides of the carcass and averaged for analysis.

**Table 2.** Least-squares means and SE for carcass characteristics

| Sire breed | | | | | | Contrasts (*P* value) | |
|---|---|---|---|---|---|---|---|
| Trait[a] | Suffolk | Siremax[b] | TSC[c] | SE | *P* value | Suffolk vs. composites | TSC vs. Siremax |
| HCW, kg | 30.83 | 29.77 | 29.77 | 0.36 | 0.08 | 0.03 | 0.99 |
| 12th Rib fat, mm | 5.84 | 5.61 | 5.58 | 0.31 | 0.81 | 0.52 | 0.96 |
| Body wall thickness, mm | 25.75 | 25.82 | 25.43 | 0.57 | 0.87 | 0.87 | 0.63 |
| LM area, $cm^2$ | 17.17 | 17.28 | 16.83 | 0.22 | 0.31 | 0.68 | 0.15 |
| Calculated % BCTRC | 46.13 | 46.34 | 46.28 | 0.18 | 0.68 | 0.41 | 0.79 |
| EstBCTRCwt | 14.15 | 13.72 | 13.72 | 0.15 | 0.08 | 0.02 | 0.99 |
| Calculated yield grade | 2.70 | 2.61 | 2.59 | 0.12 | 0.81 | 0.52 | 0.96 |
| USDA yield grade | 2.50 | 2.61 | 2.59 | 0.05 | 0.31 | 0.13 | 0.74 |

[a]Measures of LM area, 12th rib fat, and body wall thickness were taken between the 12th and 13th ribs of both sides and averaged for analysis.
[b]Siremax was derived from crosses among the Suffolk, Columbia, Texel, and Hampshire breeds.
[c]The USSES TSC was developed at the USDA, ARS, USSES, Dubois, ID, by crossing the Suffolk, Columbia, and Texel breeds.

the TSC-sired lambs produced similar ($P$ = 0.99) results to Siremax-sired lambs for all other carcass characteristics measured (Table 2). Based on this single year of data, we reject our initial hypothesis, as the TSC- and Siremax-sired lambs did not match the performance of Suffolk-sired lambs.

## IMPLICATIONS

Based on this study year, these data indicate that the development of the TSC and Siremax breeds should continue with increased focus placed on traits associated with carcass weight. Apart from measurable carcass characteristics, other economically relevant whole-production cycle measures such as weight of lamb weaned per ewe exposed, which greatly impact the overall profitability of any sheep enterprise, are currently being analyzed. These data in conjunction with forthcoming preweaning and postweaning production data will clarify the overall utility of the TSC and Siremax breeds as terminal-sire breeds for extensive, range sheep productions systems in the Western U.S.

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