



THE MICKEL PROJECT

A Leading Edge Study

Funded by ASI's

Let's Grow



Leading
Edge

Genetic Selection Demonstration Project and Study

(EBVs): Estimated Breeding Values
EBVs are science-based, industry-tested measurements of heritable traits that can be tracked and measured. EBVs are proven to improve on-farm productivity and enhance breeding decisions.

Introduction

The Leading Edge study—sponsored in large part through an ASI Let's Grow grant—grew from an earlier, more informal project that assessed the value of using performance-tested blackface (Suffolk) rams in a Western range flock. Rams selected based on their genetic merit for growth sired crossbred lambs that weighed, on average, 3 pounds more at weaning than typical range rams.

Although a very good start, the Leading Edge team, a collaborative group of sheep producers, wanted to do more. Using a science-based approach, they set out to more thoroughly assess the value of using rams selected based on their Estimated Breeding Values (EBV) in an industry setting. An EBV is an estimate of an animal's genetic worth as a parent based on performance data and pedigree information. The primary aim of the project was to determine if those estimates worked out in practice.

This report summarizes the results of that endeavor.

Goals

There were three primary goals to the project:

1. Utilizing genetic testing technology to identify the sire of each lamb using DNA testing;

How big
of a role
do genetics
play?

2. Accurately and efficiently follow the growth and quality of project lambs from birth through harvest by utilizing electronic identification (EID tags); and,
3. Demonstrate the value of using sires with performance-based EBV in an industry setting.

Ram Selection

The team selected 42 Suffolk ram lambs, sourced from 10 seedstock producers to breed the ewes. The ram battery was composed of three groups of 14 rams—each designated as Growth, Muscle or Industry. The Muscle rams were selected on their Eye Muscle Depth EBV, which averaged 2.4 mm, and ranged from 1.9 to 3.6 mm. The Growth rams were selected on their Post-Weaning Weight EBV, which averaged 19.1 lb. and ranged from 17.6 to 24.5 lb. These EBV were obtained through the genetic evaluation services provided by the National Sheep Improvement Program (NSIP). The Industry rams were purchased from three seedstock producers using visual appraisal and traditional selection criteria.

In way of interpretation, lambs sired by a ram with an Eye Muscle Depth EBV of 2.4 mm would be anticipated to have a 1.2 mm thicker loin eye muscle than average lambs. That advantage is one-half the ram's EBV since its offspring only inherit one-half of its genes. Similarly, lambs sired by a ram with a 19.1

lb. Post-Weaning Weight EBV would be anticipated to weigh about 9.6 lb. more after weaning than average lambs.

A DNA sample was collected on each ram for later use in assigning parentage. Each of the Growth and Muscle rams was weighed, and their condition score and scrotal circumference recorded. Similar data were collected on four of the Industry rams that had been purchased earlier and housed with the Growth and Muscle rams. The remaining Industry rams used were weighed prior to the beginning of breeding. Their condition scores were estimated, on average, at 3.0, but scrotal circumferences were not recorded.

Breeding

The Mickel Brothers Sheep Co., of Spring City, Utah, kindly provided 1,100 Western white-faced ewes for use in the project. The ewes were placed on lush alfalfa aftermath for 10 days prior to introduction of the rams. The entire battery of project rams was turned into the ewes on November 5 and were removed on November 22, 2017. They were replaced by Rambouillet and Columbia cleanup rams. They remained on the alfalfa throughout the breeding season until they were taken to their winter range in Western Utah where they remained on winter desert shrub-type range until the week prior to the commencement of lambing. The ewes were brought back to the Sanpete Valley and shorn during the last week of March 2018.

Lambing and Summer Management

Lambing commenced on April 3 and continued through April 22. During this three-week time frame, 1,491 lambs were born to 879 ewes, equaling 1.69 lambs per ewe.

All the ewes were lambed in a shed lambing facility and remained in lambing pens for 48 to 72 hours before being released into a mixing pen with 20 to 30 ewes with lambs. This facilitated grafting of triplets to ewes with single lambs, as well as assuring the best possible opportunity for ewe/lamb bonding. These groups later transitioned to groups of ewes with approximately 100 lambs and remained in those groups to docking.

Each lamb was tagged with an Electronic Identification (EID) tag with a unique number at birth and prior to being released from the lambing pen. The lamb's date of birth, sex, birth weight, and litter size was also recorded. Additionally, it was noted if it was the ewe's first-time lambing or if she had a black fleece.

Twenty-three lambs died following tagging, and tissue samples were saved so that the sire could be identified to determine individual ram serving capability. Seventy-one lambs could not be grafted and were artificially reared. These lambs were not included in the lamb performance and carcass quality analyses, but they are included in the sire serving capacity portion of the study.

The team worked with Mickel Brothers on April 23, 2018 to collect DNA samples on each lamb, at the time they were being docked and male lambs castrated. These DNA samples were collected using Allflex Tissue Sampling Units.

The industry standard parentage panel was used to identify parentage. This panel consists of 163 genetic markers, and was used to assign lambs to their



Key Terms...

(EBVs): Estimated Breeding Values

EBVs are science-based, industry-tested measurements of heritable traits that can be tracked and measured. EBVs are proven to improve on-farm productivity and enhance breeding decisions.

EBVs available:

Birth Weight (BWT) estimates direct genetic effect on weight at birth. Positive selection on BWT EBVs is anticipated to increase birth weight and have correlated positive effects on early lamb survival especially in twins and triplets. Negative pressure is expected to decrease birth weights and lambing difficulty if oversized lambs are a common problem.

Weaning Weight (WWT) provides an estimate of preweaning growth potential and will receive positive selection pressure in most flocks due to its impact on pounds of lamb weaned per ewe exposed and overall profitability.

Post-Weaning Weight (PWWT) reflects the genetic potential for lambs to grow after weaning based on both pre and post weaning data. Selecting for PWWT will favor individuals with rapid growth to market weight.

Post-Weaning Eye Muscle Depth (PEMD) estimates the genetic potential for muscling. Positive selection pressure will increase carcass cutability and are estimated based on Ultrasound measurements.

Post-Weaning Fat (PFAT) expresses the genetic potential for carcass fatness over the loin at the 12th and 13th ribs. Used in conjunction with PEMD, carcass composition and quality can be improved.

Number of Lambs Born (NLB) expresses the genetic potential for prolificacy and is reported in a percentage (%). If a ram has 26% NLB EBV, he should sire daughters that will have 26% more lambs than the average or if he sires 100 daughters, they will drop 26 more lambs compared to average.

Number of Lambs Weaned (NLW) evaluates combined effects of prolificacy and lamb survival and is also expressed as a percentage. If a ram with NLW EBV of 12% sires 100 daughters, those daughters will wean 12 additional lambs compared to average.

Yield Grade Yield grades are calculated by using the following formula: $YG = 0.4 + (10 \times \text{adj. fat thickness})$

Quality Grade Quality grades indicate the expected eating satisfaction of lamb.

Primal Cut A wholesale cut that has been trimmed to a specific dimensions and fat thickness.

Backfat Thickness Measurement of the amount of the subcutaneous fat on a carcass at the 13th rib.

Loin Eye area Loineye area is measured at the 12th rib by using a plastic grid or by tracing the eye on acetate paper and then using a grid or a compensating polar planimeter to determine the area. In this paper, the loin eye area was measured in square inches

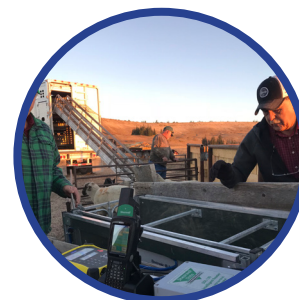
Dressing Percent The percentage of the live animal weight which is the carcass. It is determined by dividing the hot-carcass-weight by the live animal weight then multiplying by 100. Also referred to as yield.

Ovine Cutability Calculation (OCC) The weight of further processed primal weights less the amount of trim and bone.

Ovine Cutability Calculation Yield (OCC Yield) Percentage of OCC against the carcass weight.

Camera VSS 2000 System

- = Camera assigns the USDA quality and yield grade on each carcass
- = Estimates each individual primal weight.
- = Estimates the OCC percentage and OCC weight of each carcass



From Drop to the Feedlot...

1,491 lambs were born to 879 ewes, equaling 1.69 lambs per ewe.

Each lamb was tagged with an Electronic Identification (EID) tag with a unique number at birth and prior to being released from the lambing pen. The lamb's date of birth, sex, birth weight, and litter size was also recorded. The team worked with Mickel Brothers on April 23, 2018 to collect DNA samples on each lamb, at the time they were being docked and male lambs castrated. These DNA samples were collected using Allflex Tissue Sampling Units.

sires. Assignment was determined by excluding rams that could not be a lamb's sire based on their own and the rams' genetic markers. Of the 1,457 lambs with a DNA sample, 92% could be aligned with a sire. For nearly all those lambs that could not be assigned a sire it was due to a poor sample or the

DNA not passing quality control in the lab.

Although not part of the design of the project, the number of lambs sired by each ram was tracked. There was considerably more variability among the rams in their serving capacity than

anticipated. Twelve rams sired 10 or fewer lambs, with two having no progeny. At the other end of the spectrum, seven rams sired more than 55 lambs each, with two producing more than 100 lambs each. Such variability in ram serving capacity deserves much greater study.



Following docking, the flock was moved onto mid-elevation spring ranges for approximately two months. Due to a variety of factors, chiefly high depredation, extremely dry conditions and very rough terrain, the Mickel Brothers sustained over 20% lamb mortality during this time period. This is another area that could significantly increase profit if these losses could be reduced or eliminated.

On July 1, 2018 the herd was trucked to high-elevation (7,000'-10,400' elevation) summer range on the Manti-LaSal National Forest (USFS) east of Ephraim, Utah. According to the Mickel Brothers, there were minimal lamb losses while the sheep were on the USFS, despite having no measurable precipitation during the entire time they were there.

Weaning

The lambs were weaned on September 22, 2018. The remaining 1,104 lambs weaned (1.26 lambs per ewe)

were weighed individually on a Shearwell EID weigh crate prior to being loaded on trucks bound for the Forrest Arthur Feedlots in Burley, Idaho. Utilizing this technology to weigh and record the individual weights of lambs was accomplished in approximately four hours, which equals about 15 seconds per lamb. This proved to be a very efficient way to collect individual data on the weaned lambs.

Differences among the three sire groups were found at weaning. The lambs from Growth rams weighed the most on average at weaning at 108.6 pounds. The lambs from the Muscle rams weaned the lightest on average at 104.1 pounds. The lambs sired by Industry rams were between the other two groups at 106.0 pounds.

One of the main objectives of the project was to demonstrate the value of using sires with performance-based EBV in an actual industry setting. The Muscle and Growth rams were chosen from flocks



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participating in NSIP. Therefore, their genetic merit for a variety of production traits were available, including weight at weaning (recorded between 45 to 90 days of age) and post-weaning (recorded between 90 to 150 days of age). Based on those EBV, it was predicted that the lambs sired by the Growth rams should weigh 2.6 pounds more at weaning, and 5.0 pounds more at post-weaning, than those sired by the Muscle rams.

The lambs were on average 161 days of age when weaned. Those sired by Growth rams weighed 4.5 pounds more than those sired by Muscle rams. That advantage would be worth \$6.30 per lamb (assuming \$140 cwt.), which is substantial when spread across a lamb crop. Perhaps even more important, despite the differences in ages and the conditions in which these commercial lambs were raised, their performance very closely aligned with what was estimated based on their sire's EBV. The value of using rams evaluated based on performance is crystal clear.

Combining this ram data with the ability to identify low performing ewes provides a significant opportunity to producers by eliminating the bottom 10% of the ewes producing light lambs. The averages alone, however, can disguise this opportunity. With an average weaning weight of over 100 pounds, the heaviest weaned lamb was 160 pounds while the lightest was 54 pounds. Most important to note that over 11% of the lambs weighed less than 80 pounds. If these lambs had been equal to the average it would have added an additional \$5,000 of profits (again assuming \$140 cwt.). Tying these underperforming lambs to specific ewes and potentially underperforming rams can help producers identify the right brood animals to keep and those that should be culled.

Of course the same analysis applies for the high performing brood stock. Lambs weighing over 120 pounds represented 20% of the lambs produced and would have generated an additional \$9,500

of potential revenue. Tying these lambs back to both specific ewes and rams can provide extremely valuable information to identify the right lambs to keep as replacements.

Perhaps even more economically significant for the commercial producer are the differences observed between the lambs as a result of whether they were a twin raised as a twin, a twin raised as a single, or a single raised as a single, and how that impacted the pounds of marketable lamb weaned per ewe. As seen in Table 1, even though the average weight of a twin lamb raised as a twin is significantly lighter than either the single lamb or the twin raised as a single, the total pounds of marketable lamb is nearly doubled. This means that there is an economic advantage to selecting ewes that consistently raise and wean twins versus ewes that only wean a single lamb. It is also important to note that despite the material difference in weight between twins and singles at weaning, that difference was much less at harvest (on average, 3.4 and 6.8 pound for twin born lambs reared as singles or twins, respectively).



Assuming the carrying cost of a ewe per year is \$140.00 and the value of the weaned lambs was \$140.00 cwt. the total potential profit of the entire lamb production was approximately \$39,500, averaging \$45.00 per ewe. Despite a higher than normal death loss, all the ewes birthing singles lost -\$5,097 or -\$17.00 per ewe while the ewes birthing twins produced a profit of \$44,619 or \$77.00 per ewe. Perhaps as important, the top 28% of the twinning ewes generated all of the \$39,500 potential profit. The other 72% of the ewes either lost money or covered only their fixed and variable carrying costs.

Feeding and Finishing

The lambs were fed out at Forrest Arthur Feedlots in Burley, Idaho, from late-September through April 2019. They were fed a stretch ration designed for moderate gains over that period. The lambs were fed to a finished weight between 140 and 150 pounds. The feedlot was asked to sort the heavier, YG 2 appearing lambs each time the lambs were shipped. Finished lambs were shipped in six drafts to the Superior Farms harvest facility in Dixon, California.

Lambs sired by Growth rams finished earlier than the other two ram groups (Table 2), with about 61% being harvest in the first three drafts compared to about 47% and 52% for the Muscle and Industry ram groups, respectively. Although lambs sired by the Growth rams gained more weight, and grew more quickly, than lambs sired by either the Muscle or Industry groups, the differences were not substantial enough to be considered significant statistically.

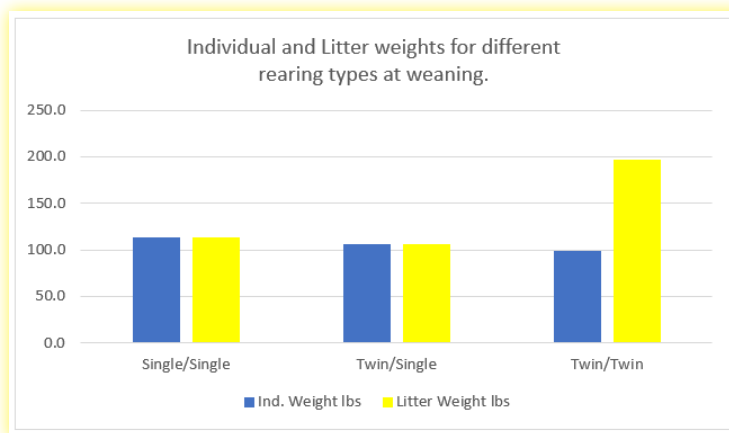
Harvest

At finished condition, the lambs were shipped to Superior Farms in Dixon, CA, for slaughter. With Superior Farm's support, individual live weights were taken and a comprehensive evaluation of the carcass was carried out. Hot carcass weights were recorded, with dressing percentages then calculated. Ovine Cutability Calculation (OCC) in pounds and yield, individual primal weights, Quality Grade, and Yield Grade were predicted using Superior Farms electronic grading system (VSS2000 system camera; Table 3). The OCC is a measure of saleable meat.

Of the 1,056 carcasses evaluated, all but one was graded Choice; the one exception was graded Good.

Table 1. Individual and Litter weights at weaning for different rearing types.

Birth/Rearing type	Single/Single	Twin/Single	Twin/Twin
Ind. Weight lbs	113.9	106.0	98.7
Litter Weight lbs	113.9	106.0	197.4



Perhaps even more economically significant for the commercial producer are the differences observed between the lambs as a result of whether they were a twin raised as a twin, a twin raised as a single, or a single raised as a single, and how that impacts the pounds of marketable lamb weaned per ewe. As seen in Table 1, even though the average weight of a twin lamb raised as a twin is significantly lighter than either the single lamb or the twin raised as a single, the total pounds of marketable lamb is nearly doubled. This means that there is an economic advantage to selecting ewes that raise and wean twins versus ewes that only wean a single lamb.

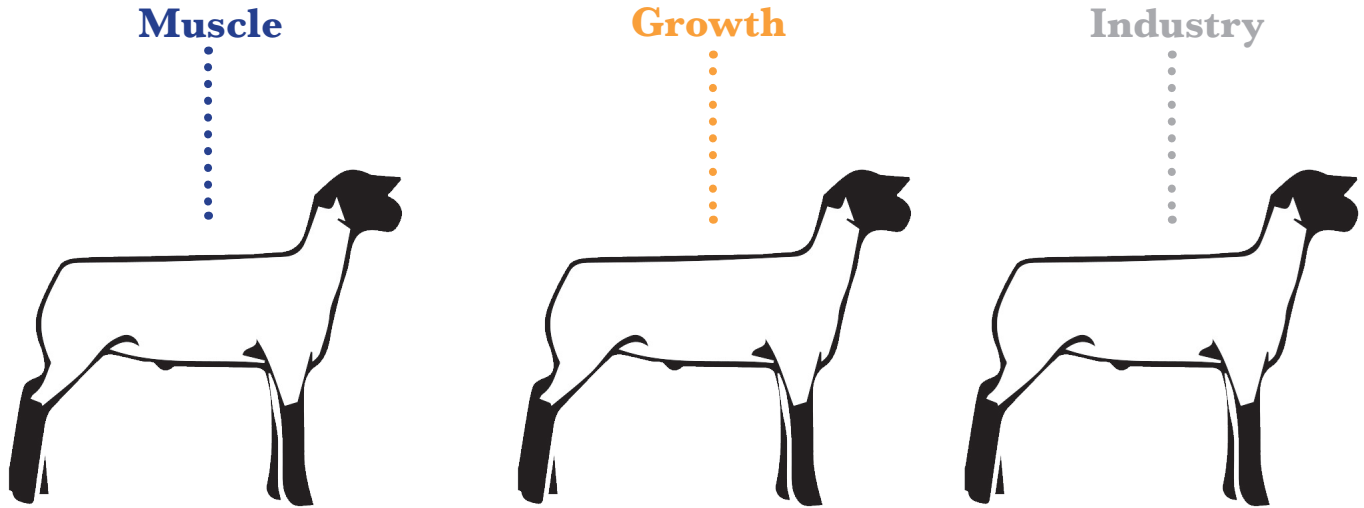


"The value of using rams evaluated based on performance is crystal clear."

As anticipated, the Muscle-sired lambs had higher dressing percentages than either the Growth- or Industry-sired lambs. Perhaps more important, they also produced lambs with heavier carcasses (on average 1.5 to 2.3 pounds) and more saleable meat (on average 1.1 to 1.6 pounds).

There were differences in carcass merit, however, depending on the ram group. As anticipated, the Muscle-sired lambs had higher dressing percentages than either the Growth- or Industry-sired lambs (Table 3). Perhaps more important, they also produced lambs with heavier carcasses (on average 1.5 to 2.3 pounds) and more saleable meat (on average 1.1 to 1.6 pounds). Those differences were significant both statistically and biologically, and particularly when multiplied across the entirety of the lamb crop. Carcasses from the Muscle group had slightly, but not statistically significant, more fat cover.

The Rams...and their lambs...



The Muscle rams were selected on their Eye Muscle Depth EBV, which averaged 2.4 mm, and ranged from 1.9 to 3.6 mm. The

Growth rams were selected on their Post-Weaning Weight EBV, which averaged 19.1 lb. and ranged from 17.6 to 24.5 lb.

The Industry rams were purchased from three seedstock producers using visual appraisal and traditional selection criteria.

Table 2.
Averages For
Feedlot
Measures
For Each
Ram Group's
Lambs

Ram group	Finish weight (lb.)	Total gain (lb.)	Average daily gain (lb./day)	Days on feed
Muscle	143.9	37.93	0.30	134.5
Growth	144.7	38.89	0.30	118.4
Industry	142	36.97	0.29	125.3
<i>Standard error¹</i>	<i>1.4</i>	<i>1.28</i>	<i>0.01</i>	<i>3.6</i>

¹ The standard error assesses the quality of data, accounting for how much information is available and its variability. Among the three ram groups, the value of this statistic was similar for a given measure; for conciseness, only the maximum value is presented. Generally, if the difference between a pair of averages is more than twice the standard error, that difference is considered large enough to be statistically significant. Applying that rule, lambs sired by the Growth group required, on average, significantly fewer days to reach harvest than those sired by the Muscle group. There were no clear differences, however, in finish weight, total gain or average daily gain among the lambs sired by the three ram groups.

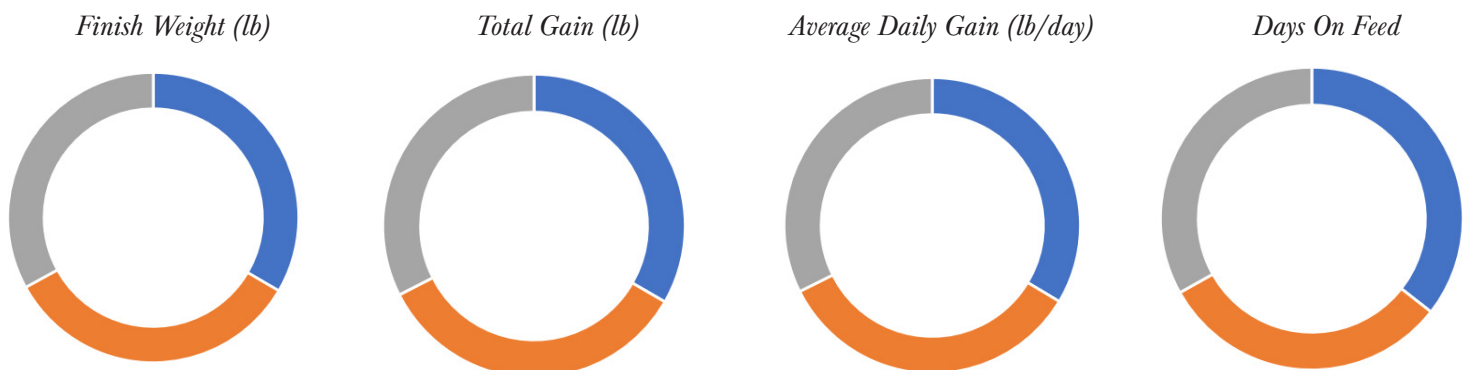


Table 3. Averages For Carcass Measures For Each Ram Group's Lambs

Ram group	Hot carcass weight (lb.)	Dressing percentage (%)	Ovine Cutability Calculation (lb.) ¹	Fat thickness (in.) ¹
Muscle	74.6	51.8	50	0.232
Growth	73.1	50.5	48.9	0.222
Industry	72.3	50.9	48.4	0.221
<i>Standard error</i> ²	<i>0.8</i>	<i>0.2</i>	<i>0.5</i>	<i>0.005</i>

¹ Based on electronic grading (VSS2000 system camera).

² A description of the standard error is provided as a footnote to Table 2. Lambs sired by the Muscle group had, on average, significantly higher hot carcass weights, dressing percent, saleable meat (ovine cutability calculation), and loin eye area than either the Growth or Industry sired lambs. There were no clear differences, however, in fat thickness among the lambs sired by the three ram groups.

Genetic selection for an indicator of carcass value—loin eye muscle depth EBV—resulted in more product to market at harvest.

The purchase value was based on a combination of carcass weight and dressing percentage, often referred to in the industry as double the dress. Since a carcass with a higher dressing percentage yields more per pounds, it is worth more. Based on such calculations, a producer would be paid for on average an additional 5.4 pounds for the Muscle-sired lambs, 1.6 pounds for the Growth-sired lambs, and 2.7 pounds for the Industry-sired lambs. Assuming a live price for the lambs of \$1.40/pound, this equates to a difference of \$5.32 per lamb between the Muscle-sired and Growth-sired groups; the difference between the Muscle- and Industry-sired groups would be \$3.75 per lamb.

It is critical to understand that this economic analysis is based on the average feeding and market conditions at the time within the industry and should not be assumed across different markets or at different years. Furthermore, these are industry prices and not specific to the actual prices paid for these project lambs.

Carcass measures: a deeper look

Taking a deeper look at the carcass traits of the lambs illustrates the value of the Muscle-group rams (Table 4). The details of carcass data are relatively new to the industry. These measures were, again, collected using the Camera Grading equipment (VSS2000 system camera) at Superior Farms. This tool will allow producers to see the quality of the carcasses and the amount of saleable meat within those carcasses.

The Ovine Cutability Calculation (OCC) is based on further processed cuts and takes into consideration how much trim and bone are lost when taking those cuts into a retail package. Although OCC in pounds (Table 3), and in the loins and legs (Table 4), was higher in the lambs sired by Muscle rams, when taking into account the starting weight, the OCC% was similar and not considered significantly different among the ram groups.

¹ Based on electronic grading (VSS2000 system camera).

Individual Carcass Data



Harvest Date	2019/02/14
Species	Lamb ABF
Program	ABF
Lot No	401
HotWeight	72.9
Yield Grade	2.160000
Quality Grade	Choice

Occ	48.80
Occ_Yield_0	67.57
Breast	9.7
Rack	8.5
Shoulder	17.7
Legs	24.0
Loins	8.8
Neck	1.8
Trotters	3.1

**This is an example of the carcass pictures taken and data that is calculated by the camera grading system Superior has in the Dixon plant.

Table 4. Averages For Additional Carcass Measures For Each Ram Group's Lambs

Trait ¹	Muscle	Growth	Industry	Standard error ²
Yield grade	2.721	2.62	2.603	0.047
Ovine cutability calculation yield (%)	67.58	67.44	67.59	0.11
Rack (lb.)	8.629	8.422	8.331	0.118
Shoulder Square Cut (lb.)	18.33	18.09	17.93	0.18

²A description of the standard error is provided as a footnote to Table 2. Lambs sired by the Muscle group had, on average, significantly heavier loins and, although to a slightly less extent, legs, than Growth or Industry sired lambs. There were no clear differences, however, in yield grade, saleable meat yield (ovine cutability calculation yield), or in the weights of other primal cuts.

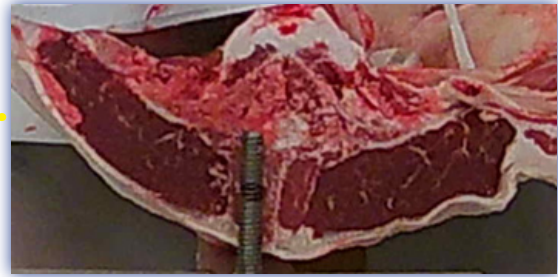


The smallest measuring loin eye by size was from a 50.2 pounds hot carcass weight. The lamb had been on feed for 208 days, measuring a loin eye of 1.45 square inches.

On the opposite side of the spectrum, the largest measuring loin eye was from a 89 pound hot carcass weight. The lamb had been on feed for 178 days and the loin eye measured 4.10 square inches

While these pictures were the extremes, this is an example of the inconsistency that the industry is faced with.

The overall average loin eye was 2.5 square inches, and this picture is just one of the examples that measured at the average size.



Financials of Feeding Lambs

The Muscle and Growth lambs had the higher gains in the feedlot, which also meant that the cost associated with feeding them to those weights also cost more. It was therefore necessary to calculate the additional costs against the price paid for the lambs to see if the income back to the producer was beneficial (Table 5).

The Growth lambs had the highest cost associated with their time in the feedlot, with the Muscle lambs the most profitable lambs sold by the producer. Once accounting for feed costs, the least profitable lambs were those sired by the Industry rams.

It is common practice to charge each custom-fed lot of lambs at a cost-per-pound-of-gain basis. Unfortunately, this means that the highest and fastest gaining lambs to reach targeted harvest weight tend to subsidize lambs that are slower-gaining and thus are fed for much longer periods in order to reach equivalent weight. This is representative of the Growth and Muscle lambs, respectively.

Financials of Feeding Lambs

Profitable

Of the 1,056 carcasses evaluated, all but grade Choice or higher—the one exception was graded Good.

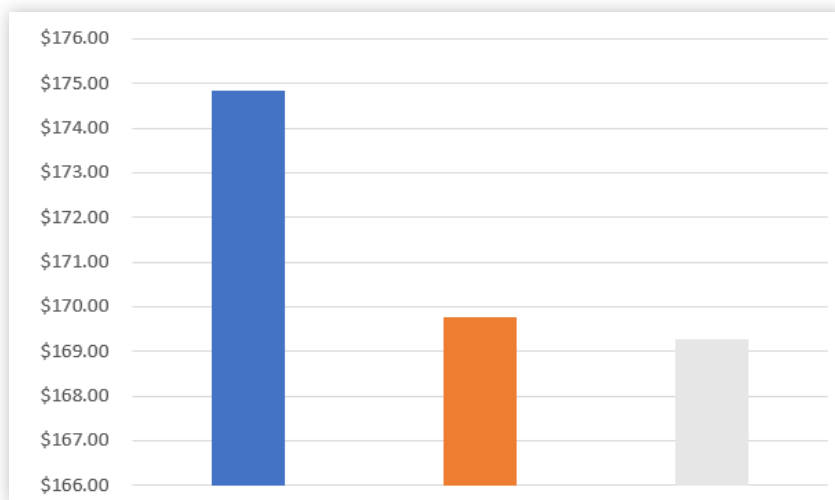
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Table 5. Financials of Feeding Lambs

Description	Muscle	Weight	Industry
Feedlot Cost (based on gain)	\$34.14	\$35.00	\$33.27
If sold as fats on a double the dress basis (lb.)	\$149.26	\$146.26	\$144.68
Extra pounds that were paid based on yield calculation (lb.)	5.36	1.56	2.68
Additional \$ for higher yield (based on \$1.40 fat lamb)	\$7.50	\$2.18	\$3.75
Income per lamb - based on double the dress and \$1.40 mkt price	\$208.96	\$204.76	\$202.55
Income per lamb - minus the feeding costs	\$174.83	\$169.76	\$169.28



*Income
Per Lamb
(minus the
feeding
costs)*

Summing Up

The aim of the Leading Edge project was to demonstrate the potential value of genetic selection, and the use of EBV, to the U.S. sheep industry. The results were conclusive. Depending on the goal of an individual producer's breeding program—lamb marketed at weaning or following finishing at harvest—reliable genetic tools are available to assist them in achieving greater gains and profitability.

The Sheep Industry's Roadmap highlighted the goal of Productivity Improvement. Quantitative genetics provides a vital tool for achieving permanent, cumulative and, most often, highly cost effective improvements in productivity. However, realizing that opportunity necessitates "widespread producer use of quantitative genetic selection," as is stated in the Roadmap. Promoting such uptake was an overall aim of the Leading Edge project. We hope through this truly team-based effort, we have been successful in achieving that ambition.

Meet the Team...



Lesla Eidman, Director of Producer Resources and Sustainability; Superior Farms



C. Kim Chapman, Small Ruminant Specialist; Utah State University Extension



Bill Shultz; Bunker Hill Farms, Ohio



Dr. Ron Lewis, Professor, Department of Animal Science, University of Nebraska-Lincoln



Tom Boyer, Leading Edge Project Coordinator



Alan Culham, ASI Let's Grow Program



Russell Burgett Program Director, National Sheep Improvement Program



Matt Mickel, Mickel Brothers Sheep Company, Utah



Forrest Arthur, Arthur Feedlots



And of course...all the sheep who make these studies so interesting.

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