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COW FEED EFFICIENCY UNKNOWNS INCLUDING UTILIZATION OF RANGE FORAGES

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INTRODUCTION

Olsen Ranches is a family-owned diversified operation located in western Nebraska near Harrisburg. The Olsens have a commercial and registered cow herd that markets harvest ready animals as well as replacement females and bulls. Custom services include custom individual feed intake data collection with a GrowSafe system, custom feeding, and custom AI work. The farm enterprise crops include wheat, corn, barley, peas, annual forages, and alfalfa on both dry land and irrigated farm ground. In 2010, Olsens installed a GrowSafe system on the ranch to measure feed intake of steers that are part of the American Hereford Association's National Reference Sire Program as well as bulls and heifers from Olsens' registered program along with custom data collection for other producers seeking intake data on bulls, heifers, or steers.

Olsen Ranches has participated as a test herd for the American Hereford Association's National Reference Sire Program (NRSP) since 1999. This has given Olsens the opportunity to use some of the Hereford breed's elite sires in the herd AI program. In the commercial herd, cows are annually randomly mated to approximately 12 nominated bulls using 65 straws for each bull. Olsens collect birth weight, weaning weight, yearling weight, and all carcass data on harvested progeny. Since 2010, there have been 1683 Hereford sired steers out of the Olsens' commercial cow herd representing 67 sires on whom individual feed intake and gain have been measured. Olsens have also tested 94 Red Angus sired steers out of the commercial cows representing 4 sires tested for Red Angus breeders. Olsens continue to work with the AHA as well as Red Angus breeders to test sires through the commercial cow herd.

WHAT IS EFFICIENCY?

Efficiency is simply a measurement of output divided by input or vice versa. In the feedyard, a pen of cattle is more efficient than another pen if the first pen's feed to gain ratio is less than the second pen. However, when genetic comparisons are added to the analysis, the analysis becomes more complicated. For instance: What was the weight of the cattle? How were the cattle handled before being placed on feed? What other environmental effects such as sickness or in utero effects impacted the cattle's performance?

Cow herd efficiency has many facets. A cow must have the ability to convert the forage resource she is given into a high value calf. There are many qualifications or stipulations that go along with an efficient cow. She must grow enough to get pregnant early for her

first calf, have low rates of dystocia, breed again continually, and require minimal maintenance energy. At the same time, she must produce pounds of a marketable calf that has minimal sickness, is efficient growing, avoids market discounts and/or secures premiums, and produces a quality beef product at harvest. Thus, cow efficiency is a whole life cycle.

On a ranch, there are many controllable aspects that affect the total cow herd's efficiency. Ranch managers try to increase revenue (output) and/or reduce expense (input). These management decisions include balancing multiple resources such as people, livestock, land, and water. The amount of labor a ranch hires has a significant impact. There are many expenses related to each person involved in the ranch such as house, vehicle, tools, and salary. Also, how much total feed and the type of feed whether it is grazing or harvested affects the cow herd's efficiency. Certainly, at some point, more feed fed to the cows does not yield more pounds of quality calves to sell. On the opposite side, the failure to use enough inputs can negatively impact production. Expenses from debt or equipment also have an impact on how efficient the ranch is. Some possibilities for improving ranch efficiency include using more grazing and less fed feed, managing carrying capacity of the ranch, handling cattle well, good management of available grazing resources, and herd genetics. Heterosis deserves consideration by most commercial ranches. Reproduction and longevity traits have a huge impact on cow herd efficiency and yet are hard to select due to low heritability and difficult measurements. Thus, these are areas where heterosis can have a significant impact.

GENETICS OF FEED EFFICIENCY

The genetic component of feed efficiency is a relatively untapped component in the feeding sector and especially in the cow/calf sector. There are several challenges to collecting accurate feed intake data and to applying that information to the selection of animals to propagate. Measuring cow efficiency poses even more unique challenges.

Through Olsens' participation in the NRSP, the ranch's cattle have been involved in several research projects. The Olsen herd was one of the herds involved in the National Cattlemen's Beef Association tenderness study. More recently, the Olsens' cattle have been involved in multiple genomic studies, including the large USDA grant evaluating feed efficiency.

Data is collected on all calves born on the ranch. To date, the Olsens have tested over 200 sires and submitted data through the NRSP to AHA on over 10,400 progeny. All cattle in the herd are handled similarly, and a large effort is made to maintain large contemporary groups to provide clean data for research. Feed intake data and gains are measured on all AI-sired steers while these animals are being fed the finishing concentrate diet. Steers are marketed together as one group to maintain quality carcass data.

Some people have many questions about the validity of feed efficiency research. Growth curve timing, grain versus forage, growth versus maintenance, growth versus milk, and the environmental effects are just some of the areas of discussion. There certainly have been differences between sire groups of steers tested for feed efficiency. In the feedlot setting, the value of the weight gain is the simplest way to exemplify the differences

between sire groups. The data in Table 1 is from steers born in May and June of 2011 and tested in the Olsen GrowSafe facility from June 14, 2012 through August 25, 2012. These 209 steers represent all the Hereford sired steers from an AI mating out of the ranch's 4 year old and older cows. There are 13 sires represented.

Table 1. Value Change of Steers Fed Through the Olsen GrowSafe Facility June 14, 2012 Through August 25, 2012.

Sire	In Weight	In Value @ 1.45/lb	ADG	Out Weight	Out Value @ $1.35/lb	Feed Cost @$283.02 / DM ton	Value Change
A	759	$1100.77	5.43	1148	$1550.16	$295.33	$154
B	718	$1041.31	5.25	1096	$1478.93	$289.23	$148
C	740	$1072.65	5.27	1117	$1507.56	$287.13	$148
D	728	$986.48	5.20	1099	$1483.51	$282.05	$146
E	680	$1023.37	4.81	1025	$1384.13	$263.61	$134
F	733	$1063.21	4.93	1060	$1431.52	$278.31	$130
G	685	$993.03	5.03	1093	$1476.06	$285.70	$127
H	678	$982.56	4.71	1023	$1381.31	$263.73	$125
I	731	$1059.23	5.07	1042	$1406.19	$299.75	$124
J	764	$1108.41	4.88	1079	$1456.23	$273.35	$124
K	727	$1053.88	5.01	1122	$1514.77	$285.30	$121
L	747	$1083.56	4.70	1065	$1437.96	$275.32	$109
M	726	$1053.18	4.80	1094	$1476.36	$287.96	$105

In the genomic research paper published by Saatchi et al.: 2014, the Hereford cattle (847 head in 10 contemporary groups) represented in Table 2 are all from the Olsen herd. The marker-base estimates of heritability certainly show the opportunity for genetic change. The moderate to high heritabilities of RFI using genetic markers or phenotype measurement represent some of the opportunities to improve feed efficiency and the profitability of beef production. The genetic markers that account for significant variation in feed efficiency tend to be population-specific with little overlap between populations.

Table 2 Marker-base estimates of heritability (h^2), additive genetic variance (VA) and residual variance (VE) for ADG, DMI, MMWT and RFI

Breed	DMI(lb)			MMWT ($lb^{.75}$)			ADG (lb/d)			RFI(lb/d)		
	VA	VE	h^2	VA	VE	h^2	VA	VE	h^2	VA	VE	h^2
Hereford	3.2	4.6	.41	79	78	.50	.09	.23	.27	1.60	1.90	.45
USMARC	1.9	3.4	.35	84	97	.47	.07	.16	.30	0.91	0.94	.49
Simmental x Angus	1.4	3.7	.27	28	36	.48	.04	.13	.23	0.96	2.02	.32
Angus	4.1	7.5	.35	125	130	.49	.06	.24	.19	1.30	4.80	.21

ADG: average daily gain, DMI: dry matter intake, MMWT: mid-test metabolic body weight, and RFI: residual feed intake.

Saatchi et al.: QTLs associated with dry matter intake, metabolic mid-test weight, growth and feed efficiency have little overlap across 4 beef cattle studies. BMC Genomics 2014 15:1004

As ranchers select genetics for their cow herd, they should consider their goals and resources to optimize the efficiency on their ranch. A reasonable inquiry is what continued selection for growth, muscle, and milk will do to the cow herd. If an increase in feed intake and milk potential occurs, there could also be an increase in the visceral organ mass relative to body weight. There are differences in how cows partition nutrient intake toward the different biological processes, such as self preservation, body reserve, milk, and reproduction. The goal should be to improve digestion, metabolism, or health of animals to increase efficiency. The goal should not be to develop cows that pass too many nutrients to milk or growth of the calf at the expense of maintenance and reproduction

As cattle producers work together to unlock the potential genetic improvement of the nation's cow herd, we will learn more about the environmental and genetic effects that trigger genes to network or excite other genes. We will learn more about the economic returns of output (growth or calf pounds and quality) versus the inputs (rangeland, forage, or grain). This will enable geneticists to formulate indexes to allow producers to have selection pressure on the ultimate goal and not one trait.

Some of the biggest opportunities for genomic research are in the area of health as health relates to efficiency. Increasing weaning rate in the cow herd (without large inputs) would have a large impact on the profitability of all ranches. Research on some least efficient animals has shown that their immune system has been excited. Even though research tried to sample healthy inefficient animals similar in body weight to the most efficient animals, the sampled animals were actually probably subclinically sick, suggesting that animal health actually has a significant impact on feed efficiency. Also, there is certainly a significant opportunity to select genetics that have less embryonic death related to genetic abnormalities. Broken genes that are inherited from the sire and dam result in spontaneous abortions or genetic abnormalities. As scientists sequence more animals, they will find more broken genes or variants that cause embryonic death.

CONCLUSION

The area of production efficiency, and specifically feed efficiency, has plenty of room for improvement in the nation's cow herd. Producers must carefully evaluate the effects of the level of growth, muscle, and milk in their cow herd. These traits can certainly affect the maintenance cost of the herd. Selection for feed efficiency does not appear to have negative effects on cow fertility and weaning rates. More research will evaluate the correlations of all traits to feed intake, growth, and carcass quality. Indexes formulated from actual data and genomics will allow producers to make genetic progress with feed efficiency. At this point, there are still a lot of questions. The genetic component of cow efficiency is not something that that can be determined with a simple visual appraisal. The more data we can capture about traits that affect weaning rate and cow efficiency and the more feed intake data that is collected, the greater the opportunity to increase the production efficiency of our nation's cow herd.