Annual Project Report
Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems

In support of Objective 1

B. Cooperating Agency: Auburn University

Personnel: Lisa Kriese-Anderson

C. Report

1. Outputs (include brief description/summary of what was done to measure outputs)

Sixty-seven yearling heifers were classified as high, medium and low RFI after a 70-d feedlot trial. Heifers had been fed MGA daily to suppress estrous and were fed a feedlot finishing diet. Low and medium RFI heifers ate less (2184 and 2288 lbs) than high RFI heifers (2497 lbs) over the feeding period. However, low RFI heifers were 15% more efficient (DM F:G ratio; 7.1) than medium or high RFI heifers (8.6 and 8.3, respectively). These differences did not translate into any carcass trait differences. Additionally, there were no differences in insulin, IGF-1, NEFA or glucose blood level values among the heifers.

2. Outcomes / Impacts

The low RFI heifers ate $42 less feed in a 70 day trial over heifers classified as high. No other measures of performance or blood metabolites were different in this study. This continues to suggest animals with low RFI values perform similarly at a lower cost.

3. Publications

4. Participants

5. Target Audiences

6. Project Modifications

Next year will test steers that were bred to high and low FE bulls.

ANNUAL PROGRESS REPORT – COOPERATIVE PROJECT W1010
Year Ending 2011
Preliminary Information – *Not for Publication*
IDAHO AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF IDAHO

I. PROJECT TITLE:

Feed Efficiency Research & Outreach for the Beef Industry

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS:

Cassie M. Welch, Marcus McGee, John B. Hall, and Rodney A. Hill, Department of Animal and Veterinary Science, Moscow, ID

III. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR:

Objective 1: To understand biological sources of variation in efficiency of feed utilization as quantified by traits like RFI.

Objective 2: To discover physiological biomarkers and genetic markers for RFI.

Introduction:

In 2004, the Red Angus Association of America (RAAA) was the first breed association to include a measure of efficiency in its international genetic evaluation program, attempting to lower cow maintenance costs through the development of the Maintenance Energy (ME) Expected Progeny Difference (EPD). Maintenance Energy EPD is an estimate of energy requirements needed to maintain / sustain animal BDW and condition but there are no reliable direct measurements for ME available. The science underlying the partitioning of energy for maintenance and production in mature cows in extensive environments is very limited. In addition, biological mechanisms contributing to underlying variation in maintenance and production (and thus, efficiency) are poorly understood. Thus, the present study aimed to understand the relationship between ME and a well-defined and measurable feed efficiency trait, residual feed intake (RFI).

Objectives

Our long-term goals are to successfully implement RFI as a superior measure of feed efficiency in objective beef breeding programs and to understand the underlying mechanisms that drive variation in RFI. .

Objective: *Determine the relationship between ME EPD and RFI EPD in bulls divergent for ME EPD.*

Materials and Methods:

In 2008, crossbred calves (steers, n = 25; heifers, n = 17) were evaluated for FE using Calan gates (American Calan, Northwood, NH) to measure individual feed intake. In 2009, crossbred calves (steers, n = 8; heifers, n = 11) were transported from Wood Cattle Company, Ardmore, SD, to NMCREEC for simultaneous Cohort 2 RFI evaluation with NMCREEC crossbred calves (steers, n = 38; heifers, n = 34), using electronic individual feed intake recording equipment (GrowSafe Systems Ltd., Airdrie, Alberta, Canada).

Feeding and Ultrasound Measurements

All testing procedures were conducted in a similar manner for both cohorts. Prior to post-weaning RFI evaluation, animals were allowed approximately 2 wk to adjust to the diet and feeding system environment. Before the morning feeding, animals were weighed on 2 consecutive days at the beginning (d 0 and 1) and end (d 84 and 85) of trial and every 2 wk during the trial. Throughout the post-weaning trial, animals were individually fed a standard growing ration. Animals were allowed *ad libitum* access to fresh feed and water, in which feed was provided twice daily. Ultrasound measurements for fat thickness (UFT), intramuscular fat (UIMF) and *longissimus dorsi* muscle area (ULMA) were taken on d 84. Hair was removed, and vegetable oil was applied between the 12^{th} and 13^{th} ribs in preparation for ultrasound measurements.

Calculations and Statistical Analysis

Statistical analyses were conducted using the SAS system (Version 9.2, SAS Inst. Inc., Cary, NC). Residual feed intake was computed within each contemporary group of each cohort. After computation of RFI, animals were classified into inefficient (> 0.5 SD above the mean), marginal (± 0.5 SD from the mean), and efficient (< 0.5 SD below the mean) groups. All other statistical analyses, including measures of growth efficiency and performance, were calculated across cohort.

Analysis of Variance (SAS: GLM) was employed to test RFI grouping and sire classification on performance variables, carcass data, and product quality. When a significant effect was noted ($P \leq 0.05$), means were partitioned using the pair-wise comparison options of SAS. Contingency tables and Chi Square tests were used to analyze product quality, determining a difference of association among RFI groups within testing traits.

Breeding Value Prediction (Courtesy of Colorado Experiment Station collaborator Dr D Crews).

Beginning with animals with at least daily DMI, a minimum of a four generation ancestral pedigree (n = 460) and the inverse numerator relationship ($\mathbf{A}^{-1}$) was constructed using the RAAA

pedigree database. Breeding values for DMI, ADG, metabolic weight (MWT), and RFI were predicted using a standard mixed linear animal model that can be represented in matrix notation as $\mathbf{y} = \mathbf{X\beta} + \mathbf{Zu} + \mathbf{e}$, where fixed contemporary group (year of birth × cohort × pen of feeding × sex, n = 13) effects in $\boldsymbol{\beta}$ were related to observations in $\mathbf{y}$ with the known incidence matrix $\mathbf{X}$, random animal genetic effects in $\mathbf{u}$ were related to observations with the known incidence matrix $\mathbf{Z}$, and $\mathbf{e}$ was a vector of random residuals, specific to animals with data. First and second moments for $\mathbf{u}$ and e were assumed to be $E(\mathbf{u}) = E(\mathbf{e}) = 0$ leading to $E(\mathbf{y}) = \mathbf{X\beta}$; $var(\mathbf{u}) = \mathbf{A}^{-1}\lambda$ [$\lambda = (1 - h^2)/h^2$ and h^2 = heritability] and $var(e) = \mathbf{I}\sigma^2_e$ (i.e., an identity matrix of appropriate order dispersed with estimated residual variance). Extension to the multivariate case followed in a straightforward manner as has been outlined elsewhere (e.g., Beef Improvement Federation, 2010). Attempts to use REML with an average information algorithm (ASReml, version 3.0, VSN International, Hemel Hempstead, UK) to estimate animal genetic and residual variances for a full animal model failed to converge, most likely due to low numbers of observations and a non-positive-definite estimate of the genetic covariance matrix. The animal model equation system and inverse relationship matrix was constructed, breeding value solutions for all animals predicted, and the system coefficient matrix directly inverted using tools in the Animal Breeder's Tool Kit (ABTK version 4.0, Colorado State University (CSU) Center for Genetic Evaluation of Livestock (CGEL)).

Results and Discussion

Relationships among RFI and other Performance Traits

Phenotypic correlations were calculated among measures of growth, efficiency and performance for Cohorts 1 and 2. RFI was positively correlated ($P \leq 0.05$) with DMI and FCR but was not correlated ($P > 0.10$) with ADG. Other research has established that phenotypic correlations between RFI and ADG are zero or close to zero. Data from the current study are consistent with other literature reports in that RFI is independent of ADG in Red Angus sired progeny. In addition, the analysis indicated that there is a moderate, positive correlation ($P \leq 0.05$) between RFI and DMI.

Relationship between Sire ME EPD and Progeny RFI EPD

Partial correlations between sire ME EPD and progeny RFI EPD provide the first indication of possible relationships between these traits, an important objective of the current study. This correlation provides some insight into the suggested relationships between sire ME EPD and 2 other relatively well understood traits, ADG EPD and DMI EPD, which serve here to illustrate the range of relationships between ME EPD and other traits. Average daily gain EPD was positively correlated ($P < 0.0001$) with

sire ME EPD, while MWT EPD was only marginally correlated ($P = 0.07$). No relationship ($P = 0.42$) was detected between sire ME EPD and DMI EPD in this analysis.

RFI was negatively correlated ($P < 0.001$) with sire ME EPD. Our interpretation of this relationship is tentative because of the small numbers of observations available. RFI is a complex trait and clearly, we understand that composition of gain can affect estimation of RFI. There are further complex factors that underpin the biological basis of composition of gain and associated energy demands of different tissues. The energetic cost of deposition of fat is higher per unit than is the cost of deposition of muscle. However, over time, muscle is a much more energy-demanding tissue than fat. Thus, in terms of efficiency, the cost of fat deposition is greater than the cost of muscle deposition, but the cost of maintenance of each depot is the opposite. The relationships between these factors provide a glimpse of the complexities that underlie a comparison between sire ME EPD and RFI EPD. Furthermore, we need to gain a better understanding of the ways that both ME requirement and RFI are affected by variation in the composition of gain.

Conclusion:

In describing the possible relationships between ME EPD and RFI EPD, this relationship still remains unclear. Further interpretation of this relationship is greatly in need of further data and analysis. As the project progress and more progeny are generated, this relationship will become clearer.

Relevant Idaho Publications:

Ahola, J.K., Skow, T.A., Hunt, C.W. and Hill, R.A. (2011). Relationship Between Residual Feed Intake and End Product Palatability in Longissimus Steaks from Steers Sired by Angus Bulls Divergent for Intramuscular Fat Expected Progeny Difference. *Professional Animal Scientist.*27:109-115.

Wulfhorst, J.D., Ahola, J.K., Kane, S.L., Keenan, L.D. and Hill, R.A. (2010). Factors affecting beef cattle producer perspectives on feed efficiency. *Journal of Animal Science*. 88: 3749-3758.

Allen, J.D., Ahola, J.K., Chahine, M., Szasz, J.I., Hunt, C.W., Schneider, C.S., Murdoch, G.K. and Hill, R.A. (2009). Effect of feeding period and ractopamine hydrochloride on feedlot performance, carcass characteristics, and end product quality in market dairy cows. *Journal of Animal Science.* 87: 2400-2408.

Hill, R.A., Kane, S.L., Ahola, J.K., Wulfhorst, J.D., Hough, R.L., Bolze Jr., R.P. and Keenan, L. (2011). Feed Efficiency Research and Outreach for the Beef Industry. National Research Initiative (USDA) Project Director's Meeting, April 18-19, Washington, D.C.

Wulfhorst, J.D., Ahola, J.K., Kane, S.L., Keenan, L.D. and Hill, R.A. (2010). Factors affecting beef cattle producer perspectives on feed efficiency. W1010 Regional Project Meeting, Columbia, Missouri, July 1, 2010.

Hill, R.A**.,** Kane, S.L., Ahola, J.K., Wulfhorst, J.D., Hough, R.L., Bolze Jr., R.P. and Keenan, L. (2010). Feed Efficiency Research and Outreach for the Beef Industry. National Research Initiative (USDA) Project Director's Meeting, July 15-16, Denver, CO.

Soderquist, G.C., Welch, C.M., Murdoch, G.K., Ahola, J.K., Hall, J.B., Schneider, C. and Hill, R.A. (2011). Overview of IL-15/IL-15α Receptor and Their Role in Muscle Growth Related to Residual Feed Intake. Innovation Showcase. University of Idaho, April, 2011. (prize awarded).

Welch, C.M., Murdoch, G.K., Chapalamadugu, K., Thornton, K.J., Ahola, J.K., Hall, J.B. and Hill, R.A. (2011). Gene expression of Red Angus sired steers and heifers evaluated for residual feed intake Journal of Animal Science 89 (E Suppl. 2) .

McGee, M., Welch, C.M., Hall, J.B., Small, W. and Hill, R.A. (2011). Interactions of Residual Feed Intake and other Performance Parameters of Japanese Black (Wagyu) Bulls. Journal of Animal Science 89 (E Suppl. 2).

Thornton, K.J., Davis, L., Welch, C., Doumit, M., Hill, R.A. and Murdoch, G.K. (2010). Muscle Fiber Type is Altered by Selection of Sire for Maintenance Energy Proc., Pacific Northwest Animal Nutrition Conference, October 7-9, 2010, Vancouver, British Colombia

University of Illinois-Dr. Dan Faulkner
Dr. Dan Shike

Annual Project Report
Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Utilizing Heifer RFI to Predict Cow Intake and Efficiency

In support of Objective: Determine if RFI done as heifers is a valuable tool for predicting intake as cows.

B. Cooperating Agency:

American Angus Association

C. Report

1. **Outputs (include brief description/summary of what was done to measure outputs)**
Experimental Animals

One hundred fourteen Angus and Simmental X Angus primiparous cows from the University of Illinois Beef Field Research Laboratory in Urbana, IL were used to determine the effect that utilizing heifer RFI has on predicting cows' intake and efficiency. RFI and RADG were calculated on all animals as heifers.

Management and Diet

Cattle were placed in the barns at the Beef Field Research Laboratory for the 14 d evaluation phases (60 d (lactating) and 240 d (dry) postpartum) where they were fed a common forage based diet. While not on evaluation, cows were placed on pasture and rotated through mixed pastures of endophyte infected tall fescue, red clover, and orchard grass .

Data Collection

During the evaluation periods, measurements were taken to evaluate the performance of the animals. At the beginning of the period, the weigh-suckle-weigh procedure; calves were separated from the cows at 1200 on day 0 without access to feed or water, allowed to nurse at 1900 on day 0 to leave only residual milk in the mammary gland and then put back into pens separate from dams (dams were allowed access to feed and water between nursings), at 700 on day 1 calves were weighed (empty weight), allowed to nurse (pairing was done in a large pen and cross-nursing was prevented), and then reweighed and returned to its dam. The difference between the pre- and post-nursing weight was multiplied by two to provide an estimate of 24 h milk production. This was done for the 60 d postpartum period. The 240 d period was a dry period so no weigh-suckle-weigh was done.

Individual intake was measured during each evaluation period by using the GrowSafe® automated feeding system (Model 4000E, GrowSafe Systems Ltd., 86 Airdrie, Alberta, Canada). Intakes were audited daily by trained personnel (10 d of acceptable data needed for each period). Feed intake data was considered acceptable if at least 85% of feed supplied to the bunk and 90% of corresponding feed assigned to an individual ID was accounted for. Data was also considered acceptable if 95% of the data sent from the weigh panel was received at the computer to all data points sent for a 24 h period. Also, 95% of the data from an individual electronic identification tag needed to be received at the computer to all possible data sent from the electronic identification

panel. A log was kept for repair or replacement of the component parts and data was subsequently discarded that day.

At the conclusion of each evaluation period, weights were taken on two consecutive days, hip height recorded, BCS taken (1-9 scale), and cows were ultrasounded for 12th rib fat thickness. These ultrasound measurements were taken with an Aloka 500SV (Wallingford, CT) B-110 mode instrument equipped with a 3.5-MHz general purpose transducer array. Backfat was taken in transverse orientation between the 12th and 13th ribs approximately 10 cm distal from the midline.

Data was analyzed using the CORR procedure of SAS. Correlations were ran for all measured traits including heifer; RFI, RADG, DMI, PDMI and cow; BW, hip height, BCS, BF, milk production, DMI, and NRC PDMI for the lactating and dry periods alike.

2. **Outcomes / Impacts**

All correlations are listed in Table 1. Heifer RFI and RADG were measured on animals as heifers. As would be expected the mean is 0 on both values with a SEM of 2.04 and 0.37 respectively. Heifer RFI and RADG were negatively correlated at -0.18 (P = 0.06). Heifer RFI was also correlated to cow DMI for both periods (0.20 P = 0.03, 0.29 P < 0.01 respectively). However heifer RADG was not correlated to cow DMI (-0.09 P = 0.32, -0.10 P = 0.29). NRC PDMI was determined, but was not correlated to DMI in the lactating period (0.11 P = 0.25) and the dry period (0.15 P = 0.11). This shows that the NRC is useful for pen feeding but presents challenges when balancing on an individual basis. In regards to all correlations to heifer RFI: cow BW (-0.08 P = 0.42, 0.00 P = 0.99) and hip height (0.02 P = 0.86, -0.09 P = 0.32) which signifies that RFI is phenotypically independent of growth traits. For heifer RADG: cow BW (0.21 P = 0.03, 0.23 P = 0.01)

and hip height (0.25 P = 0.01, 0.31 P < 0.01) which shows that using RADG results in increased cow size.

3. **Publications**
   Abstract #81 – 2011 Midwest Animal Science Meetings

4. **Participants**
   University of Illinois beef staff

5. **Target Audiences –**
   Cow/calf producers

6. **Project Modifications – N.A.**

Combined Years

Item	Heifer RADG	Heifer DMI	Heifer PDMI	Cow BW 1	Cow MW 1	Hip Ht 1	BCS 1	BF 1	Milk Prod.	DMI 1	Cow PDMI 1	Cow RFI 1	NRC PDMI 1	Cow BW 4	Cow MW 4	Hip Ht 4	BCS 4	BF 4	DMI 4	Cow PDMI 4	Cow RFI 4	NRC PDMI 4
Heifer RFI	-.18	.57	-.03	-.08	-.08	.02	-.02	-.03	-.09	-.20	.43	-.06	-.13	.00	.00	-.09	-.09	-.01	.29	.46	-.03	-.02
Heifer RADG		.01	.15	.21	.21	.25	.21	.07	.03	-.09	-.06	-.09	.24	.23	.22	.31	.01	.03	-.10	-.06	-.07	.29
Heifer DMI			.80	-.26	-.26	0.32	-.22	-.37	-.37	.35	.16	-.05	-.08	-.24	-.24	-.09	.03	.18	.06	-.32	-.05	.24
Heifer PDMI				-.26	-.26	.32	-.22	-.42	-.38	.28	-.11	-.02	.00	-.29	-.29	-.05	.10	.23	-.14	-.72	-.04	.30
Cow BW 1					.99	.31	.76	.71	.26	-.02	.44	-.03	.89	.84	.84	.57	.41	.09	.16	.55	.04	.60
Cow MW 1						.31	.76	.71	.26	-.02	.44	-.03	.90	.84	.84	.57	.41	.09	.16	.55	.04	.60
Hip Ht 1							.06	-.07	-.08	.13	.15	-.02	.37	.28	.28	.63	.01	-.02	.11	-.07	.08	.45
BCS 1								.67	.07	-.09	.15	.00	.64	.64	.64	.27	.36	.12	.09	.43	-.03	.49
BF 1									.13	-.22	.14	-.05	.52	.55	.55	.23	.32	.20	.05	.55	-.06	.23
Milk Prod.										.02	.42	-.03	.48	.26	.26	.20	.02	-.19	.28	.35	.27	-.02
DMI 1											.38	.81	.11	.01	.01	-.05	.16	.31	.41	-.10	.38	.20
Cow PDMI 1												-.07	.48	.45	.44	.33	.10	.04	.36	.49	.17	.30
Cow RFI 1													-.02	-.01	-.01	-.14	.15	.26	.34	-.04	.37	.02
NRC PDMI 1														.73	.73	.56	.42	.09	.22	.33	.15	.65
Cow BW 4															.99	.59	.49	.24	.20	.63	.01	.80
Cow MW 4																.59	.50	.24	.20	.63	.00	.80
Hip Ht 4																	.17	.01	.11	.23	.06	.52
BCS 4																		.56	.04	.16	-.06	.55
BF 4																			.07	-.02	.02	.38
DMI 4																				.30	.91	.15
Cow PDMI 4																					-.02	.15
Cow RFI 4																						.01

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Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems

In support of Objective xx:.

B. Cooperating Agency: University of Illinois: Urbana Champaign

Personnel: K.M. Retallick, D.B. Faulkner

C. Report

1. Outputs (include brief description/summary of what was done to measure outputs)

One hundred and seventy one Angus and Angus x Simmental heifers were utilized to compare RFI between a forage vs grain diet. Diets (Table 1) were formulated for heifers to gain 2.5 to 3 lbs/day. Two treatment phases were utilized: Forage fed phase and Grain fed phase. Forage diet was fed to 58 heifers for the first 70d and then those heifers were switched to grain for the last 70d. Grain diet was fed to 113 heifers for the first 70d and then those heifers were switched to the forage diet for 70 days. There was 14 day adaptation phase between the two 70 d periods. This allowed for the comparison of both forage to grain RFI and grain to forage RFI. Heifers were divided into unequal groups because the heifers which started on grain (n=113) arrived at the beef facility prior to the remaining 58 heifers and had already been receiving grain. Heifers were weighed every 2 weeks and RFI calculated for each 70 d period. All data was analyzed with SAS 9.2 using Proc mixed and Proc Corr procedures.

2. Outcomes / Impacts

Heifers that began the trial on grain and were switched to forage in order to evaluate grain to forage RFI lost weight during the 2nd 70 period so a Grain to Forage RFI was not analyzed in the results. The correlation between Forage and grain RFI was 0.35 ($P<0.01$) indicating repeatability of RFI when switching heifers from forage based diet to a grain diet.

3. Publications: none
4. Participants
5. Target Audiences
6. Project Modifications

Annual Project Report
Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems

In support of Objective xx:.

B. Cooperating Agency: University of Missouri

Personnel: Monty Kerley

C. Report

1. Outputs (include brief description/summary of what was done to measure outputs)

Cows phenotyped for residual feed intake (RFI) were bred to bulls also phenotyped for RFI to measure progeny performance. Calves were weaned and steers placed on feed to measure intake and body weight change over time. Cows were categorized as low (- RFI) and High (+ RFI) RFI and forage intake and calf weaning weight measured. No difference was measured in weaning weight among RFI phenoptyes, however, intake was ~9% lower for low than high cows (Table 1). When progeny were compared between low and high matings RFI of offspring from low parents was lower and intake was reduced without a change in daily gain. Concomitantly feed to gain ratio was improved ~13% by selecting for low RFI parents (Table2). Outcome of this research was that progeny feed efficiency is improved significantly when low RFI parents are used.

Table 1. Forage Intake and Calf Weaning Weight of RFI Phenotyped Cows

RFI Type	Feed Intake	Weaning weight
	Kg/hd/d	lb/hd
Low	18.8	274
High	20.4	287
P value	0.02	0.12

Table 2. Effect of Parent RFI on Progeny Performance

	-/-	+/+
N	16	10
RFI	-0.31	0.75
FCR	5.54	6.59
ADG	1.73	1.71
DMI	8.20	9.46

2. Outcomes / Impacts

A primary question concerning measurement of RFI is what response progeny would elicit when placed on feed. These data show that substantial improvements in feed efficiency can be achieved by first generation progeny. Estimates previously reported for value of progeny based on reduced feed use appear to be correct. In this example, and assuming over 300 kg of gain, -/- progeny would have consumed approximately $100 less fed per head.

3. Publications

4. Participants

5. Target Audiences

6. Project Modifications

Annual Project Report
Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems

In support of Objective 2.2: Increasing the efficiency of agricultural production and marketing systems

B. Cooperating Agency:

Personnel:

C. Report

1. Outputs (include brief description/summary of what was done to measure outputs)

Sixty Angus bulls (age, weight) were placed on a diet of 2.3 Mcal/kg and 14% CP designed to provide 1.5 kg ADG (LE). This is the same diet and growth rate we have reached in previous years of RFI testing. After 42 d bulls were gradually switched over 14 d to a diet of 2.7 Mcal/kg and 15% CP designed to provide 2.5 kg ADG (HE). The diet was fed for 42 days. Bulls were weighed every 14 d during both phases and feed intake recorded. The purpose was to compare the RFI rankings of the bulls on the two different diets.
Correlations, at least $P < 0.05$, r at least 0.5
LE ADG vs. total ADG (0.67)
HE ADG vs. total ADG (0.77)

LE RFI vs. HE RFI (0.56), total RFI (0.82), LE F/G (0.68), total F/G (0.66)

HE RFI vs. total RFI (0.88), HE F/G (0.58), total F/G (0.58)

total RFI vs. total F/G (0.72), HE F/G (0.52). Total RFI also correlated with LE F/G ($P < 0.01$), with r of 0.36.

ANOVA was done with diet as the source of variation. Compared to LE, bulls when fed HE gained faster (4.9 vs. 3.7 kg/d), ate more DM (24.2 vs. 15.3 kg/d), but gained less efficiently (5.0 vs. 4.2). ANOVA repeated with diet as source of variation and initial BW (day 1 or day 56) as a covariate. Adjusted for BW, F/G was lower ($P < 0.03$) for LE (4.37) and HE (4.76, SE = 0.11). Dry matter intake, lb/d, adjusted for initial BW, was greater ($P < 0.01$) for HE (22.2) than LE (17.3, SE = 0.38). Average daily gain, lb/d, adjusted for initial BW, was greater ($P < 0.01$) for HE (4.7) than LE (3.9, SE = 0.12).

Table 1. Means, standard deviations, minimum and maximum values

Variable	Mean	SD	Minimum	Maximum
LE, Phase 1				
Initial BW, lb	525	68	405	646

Final BW, lb	681	79	526	828
DMI, lb/d	15.3	2.2	11.1	20.7
ADG, lb/d	3.7	0.57	2.68	4.97
F /G	4.15	0.47	3.34	5.46
RFI	0	1.20	-3.13	3.67
HE, Phase 2				
Initial BW, lb	736	84	564	888
Final BW, lb	943	97	747	1129
DMI, lb/d	24.2	2.5	18.6	31.0
ADG, lb/d	4.92	0.67	3.18	6
F /G	4.98	0.57	3.8	6.4
RFI	0	1.63	-2.37	6.46
Total				
DMI, lb/d	19.7	2.2	16.1	25.1
ADG, lb/d	4.13	0.46	3.16	5
F /G	4.8	0.5	4.1	6.35
RFI	0	1.44	-2.72	5.39

Diets are confounded with time as bulls were older and heavier in phase 2 (HE). Bulls ate more and gained more during Phase 2 than 1, either unadjusted or adjusted for BW; F/G increased in Phase 2, ostensibly due to increase gain as fat vs. lean.

Cow Study
Cows (n = 104) which had been tested for RFI as heifers are being evaluated as part of an ongoing study relating heifer RFI to lactating cow RFI. Cows were placed in a Calan gate facility for 42 days and DMI was determined.
Weigh suckle weigh was used to estimate cow milk production. Cows and calves were separated overnight. After returning calves to cows and allowing them to nurse for 15 minutes, they were again separated for 6 h and then calves were weighed, allowed to nurse for 15 min and re-weighed. Cows and calves were separated again for 6 h and the weigh suckle weigh process was repeated. Milk samples were collected from each cow and are being analyzed for milk composition.
Data are still being collected as calves are not yet weaned. Carcass ultrasound measurements have been obtained on cows and calves every 56 days and at weaning. Cow body condition scores will be obtained at weaning as well. After weaning the calves will be evaluated for RFI in the fall as part of our regular protocol. Cows were fed a supplement containing alkanes for one week during the feeding trial and fecal samples collected to analyze for alkanes as markers for digestibility.

2. Outcomes / Impacts
We will determine the usefulness of alkanes as markers for feed intake in these feeding trial which could reduce the time and expense needed for conducting feed efficiency research.

3. Publications
None

4. Participants
Gary Hansen, Scott Whisnant, Gerald Huntington, Joe Cassady, Matt Poore

5. **Target Audiences**

Beef cattle breeders

6. **Project Modifications**

Added change in diet to gather data in future years on correlation of RFI on same animals fed diets differing in energy level. Began collecting weigh suckle weigh and milk composition data on lactating cows. We will add alkanes as digestibility markers in future studies of postweaning RFI.

ANNUAL PROGRESS REPORT – COOPERATIVE PROJECT W1010
Year Ending 2010
Preliminary Information – Not for Publication
OHIO AGRICULTURAL EXPERIMENT STATION
THE OHIO STATE UNIVERSITY

I. PROJECT TITLE:

Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS:

Department of Animal Sciences and the Ohio Agricultural Research and Development Center:
M. E. Davis

III. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR:

Objective 1: To understand biological sources of variation in efficiency of feed utilization as quantified by traits like RFI

A divergent selection experiment was initiated in 1989 to investigate the influence of changes in serum IGF-I concentration on economically important traits in Angus cattle. The selection experiment included 100 spring-calving (50 high line and 50 low line) cows located at the Eastern Agricultural Research Station, Belle Valley, OH.

Beginning with the 2009 breeding season, the selection criterion in the IGF-I selection lines was changed from serum IGF-I concentration to ME EPD as provided by the Red Angus Association. Females in the high line are mated to one of three high (undesirable) ME EPD bulls and cows and heifers in the low line are mated to one of three low (desirable) ME EPD bulls. The first calves produced in this project at the Ohio station were born in the spring 2010 calving season.

Twenty-six high line and 19 low line calves sired by Red Angus AI bulls were born in the spring 2010 calving season. Birth weight, weaning weight, preweaning relative growth rate, and serum IGF-I concentration at weaning were analyzed using PROC GLM in SAS. The statistical model included the fixed effects of selection line, sex of calf, and age of dam, as well as the random effect of sire nested within line, and a covariate for age of calf at weaning for all dependent variables other than birth weight. Sire nested within line was used as the error term in analysis of variance F tests for selection line.

Subclass numbers, significance levels, and least squares means and standard errors are shown in Table 1. Selection line had a significant effect on birth weight with high line calves averaging 2.5 kg greater birth weights than low line calves. Weaning weights were 9 kg heavier for high line than for low line calves ($P = 0.11$), whereas line did not have a significant effect on relative growth rate from birth to weaning ($P = 0.25$). Low line calves (i.e., those sired by low or desirable ME EPD Red Angus bulls) averaged 341 $\pm$ 20 ng/mL of serum IGF-I at weaning, whereas high line calves (i.e., those sired by high or undesirable ME EPD Red Angus bulls)

averaged 270 $\pm$ 17 ng/mL (P = 0.09). This result was somewhat unexpected as most (but not all) previous studies have shown lower serum IGF-I concentration to be associated with more desirable feed efficiency.

Sex of calf was significant only for birth weight with bull calves averaging 2.1 kg greater birth weights than heifer calves. Means for age of dam and for sire did not differ significantly for any of the dependent variables (P > 0.20). Although sire did not have a significant on IGF-I concentration at weaning (P = 0.25), it is interesting to note that all 3 bulls with low (desirable) ME EPDs sired progeny with greater IGF-I concentrations than the 3 bulls with high (undesirable) ME EPDs.

IV. APPLICATION OF FINDINGS:

Results from the first year of the study suggest that use of low (desirable) ME EPD sires results in progeny with lighter birth weights and weaning weights, but greater serum IGF-I concentrations at weaning. All 3 bulls with low ME EPDs sired calves with greater IGF-I concentrations than the 3 bulls with high ME EPDs. Additional calf crops will be evaluated to determine if these trends hold true in the future.

V. IMPACTS:

Feed constitutes a major input to beef production, and is, in fact, the largest single expense in most commercial beef production enterprises. Efficiency of feed utilization is, therefore, an obvious candidate for improvement in order to reduce cost of beef production. Studies conducted under the umbrella of W1010 will aid in the development of national and international genetic evaluation programs for improved feed efficiency. This, in turn, will allow beef cattle breeders to use high efficiency cattle in their herds to reduce the feed cost of production and improve profitability.

VI. WORK PLANNED FOR NEXT YEAR:

A divergent selection experiment was initiated in 1989 to investigate the influence of changes in serum IGF-I concentration on economically important traits in purebred Angus beef cattle. The selection experiment included 100 spring-calving (50 high line and 50 low line) cows located at the Eastern Agricultural Research Station, Belle Valley, OH.

Beginning with the 2009 breeding season, the selection criterion in the IGF-I selection lines was changed from serum IGF-I concentration to ME EPD as provided by the Red Angus Association. Females in the high line are mated to high (undesirable) ME EPD bulls and cows and heifers in the low line are mated to low (desirable) ME EPD bulls. This is a collaborative project with Rod Hill at the University of Idaho. The same Red Angus bulls are used for breeding at the Ohio and Idaho experiment stations. The first calves produced in this project at the Ohio station were born in the spring 2010 calving season and the second calf crop was born in the spring 2011 calving season.

VII. PUBLICATIONS:

Davis, M. E., and R. C. M. Simmen. 2010. Estimates of inbreeding depression for serum insulin-like growth factor I concentrations, body weights, and body weight gains in Angus beef cattle divergently selected for serum insulin-like growth factor I concentration. J. Anim. Sci. 88:552-561.

Smith, S. N., M. E. Davis, and S. C. Loerch. 2010. Residual feed intake of Angus beef cattle divergently selected for feed conversion ratio. Livest. Sci. 132:41-47.

Qing, Q. 2010. Effect of Divergent Selection for Insulin-Like Growth Factor I (IGF-I) on Mature Weight and Growth Curves in Angus Cattle. M.S. Thesis. The Ohio State University, Columbus.

Bilgin, O. C., N. Esenbuga, and M. E. Davis. 2010. Comparison of models for describing the lactation curve of Awassi, Morkaraman, and Tushin Sheep. Archiv Tierzucht 53:447-456.

Hafla, A. N., P. A. Lancaster, G. E. Carstens, D. W. Forrest, J. T. Fox, T. D. A. Forbes, M. E. Davis, R. D. Randel, and J. W. Holloway. 2011. Relationships between feed efficiency traits, and scrotal circumference and semen-quality traits in yearling bulls. J. Anim. Sci. (in review)

H. Huang, H. C. Hines, K. M. Irvin, K. Lee, and M. E. Davis. 2011. Response to divergent selection for insulin-like growth factor-I concentration and correlated responses in growth traits in Angus cattle. J. Anim. Sci. (in review)

Qin, Q., M. E. Davis, S. J. Moeller, and T. B. Turner. 2011. Comparison of four growth curve models for estimating mature weight and correlations between mature weight and postweaning serum IGF-I concentration in Angus cattle. Animal (in review)

Table 1. Least squares means ± SE for weights, relative growth rate, and IGF-I concentration

Independent Variables	N	Birth wt	Weaning wt	Relative growth rate	IGF-I[a]
Line		P = 0.03	P = 0.11	P = 0.25	P = 0.09
High	26	34.5 ± 0.5	204 ± 5	0.0097 ± 0.00015	270 ± 17
Low	19	32.0 ± 0.6	195 ± 6	0.0098 ± 0.00018	341 ± 20
Sex		P < 0.01	P = 0.74	P = 0.19	P = 0.46
Male	28	34.3 ± 0.5	201 ± 5	0.0096 ± 0.00015	296 ± 16
Female	17	32.2 ± 0.6	198 ± 6	0.0099 ± 0.00018	315 ± 20
Age of dam, yr		P = 0.40	P = 0.30	P = 0.56	P = 0.20
3	8	33.3 ± 0.9	189 ± 9	0.0094 ± 0.00028	248 ± 31
4	8	32.0 ± 0.9	196 ± 9	0.0099 ± 0.00027	323 ± 30
5-9	17	33.8 ± 0.6	209 ± 6	0.0099 ± 0.00019	324 ± 21
10+	12	33.8 ± 0.7	203 ± 7	0.0098 ± 0.00022	327 ± 24
Sire[b]		P = 0.46	P = 0.86	P = 0.92	P = 0.25
108	12	34.0 ± 0.7	203 ± 7	0.0097 ± 0.00023	253 ± 25
174	7	34.4 ± 0.9	206 ± 9	0.0098 ± 0.00028	280 ± 32
322	7	35.0 ± 0.9	203 ± 9	0.0096 ± 0.00028	278 ± 31
129	7	32.8 ± 0.9	193 ± 9	0.0096 ± 0.00028	406 ± 31
218	6	32.6 ± 1.0	203 ± 10	0.0099 ± 0.00031	306 ± 34
230	6	30.5 ± 1.1	189 ± 10	0.0099 ± 0.00033	311 ± 37

[a]Serum IGF-I concentration at weaning.
[b]Sires 108, 174, and 322 were selected based on their high (undesirable ME EPD). Sires 129, 218, and 230 were selected based on their low (desirable ME EPD).

Annual Project Report
Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems

In support of Objective 1. To understand biological sources of variation in efficiency of feed utilization as quantified by traits like RFI.

B. Cooperating Agency:

Oklahoma Agricultural Experiment Station
Personnel: R.P. Wettemann

C. Report

1. Outputs (include brief description/summary of what was done to measure outputs)
Experiments were conducted to identify potential biomarkers for maintenance requirements in beef cows. Maintenance requirements and hormones in plasma were quantified.

2. Outcomes / Impacts
Three experiments with gestating, Angus cows were conducted to determine the effects of maintenance energy requirement (MR) on plasma concentrations of insulin-like growth factor I, thyroxine (T4), and triiodothyronine (T3), walking activity, and ruminal temperature (RuT. Cows were fed a diet to maintain body weight during gestation and had ad libitum prairie grass during lactation. Cows were classified based on MR as low (> 0.5 SD less than mean, LMR), moderate (± 0.5 SD of the mean, MMR) or high (> 0.5 SD greater than mean, HMR). Average MR was 90.3 Kcal/kg$^{0.75}$/day. The differences between the least efficient and most efficient cow was 33%. Plasma concentrations of T3 and T4 were influenced by maintenance requirements. Ruminal temperature during maintenance and during ad libitum roughage was not influenced by MR. When cows had ad libitum roughage during early lactation, HMR had greater plasma concentrations of IGF-I compared with LMR cows. Walking activity was not related to the amount of energy needed to maintain BW. Thyroxine, T3, and IGF-I may have the potential to be biomarkers for MR. Identification of cows with lower MR could improve the profitability of beef production.

3. Publications:
Pye, T.A., B.H. Boehmer, and R.P. Wettemamnn. 2011. Maintenance energy requirements of gestating beef cows and plasma concentrations of thyroxine and triiodothyronine. J. Anim. Sci. (E-Suppl. 1)89:(in **press).**

4. Participants: R.P. Wettemann, T.A. Pye

5. Target Audiences: researchers and producers

6. Project Modifications: none

ANNUAL PROGRESS REPORT – COOPERATIVE PROJECT W1010

Year Ending 2011

Preliminary Information – Not for Publication

Texas AgriLife Research
Texas A&M University

I. PROJECT TITLE:

Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production

II. COOPERATING AGENCIES AND PRINCIPAL LEADERS:

Department of Animal Science and Texas AgriLife Research
Gordon Carstens

III. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR:

Objective 1: Understand biological sources of variation in efficiency of feed utilization as quantified by traits like RFI
Objective 2: Discover physiological biomarkers and genetic markers for RFI
Objective 4: Examine the effects of selection for RFI on other economically relevant traits

To determine if RFI measured in growing heifers was associated with subsequent efficiency of forage utilization during the 2nd trimester of gestation, RFI was measured in Bonsmara heifers for 2 years (N = 57/yr). Heifers with the lowest (n = 12/yr) and highest (n = 12/yr) RFI retained for breeding. As heifers, those with low RFI consumed 20% less DMI (7.28 vs 9.07 ± 0.23 kg/d), but had similar BW and ADG compared to high-RFI heifers. First and 2nd parity females from trials 1 and 2 were subsequently fed a hay diet (ME = 2.11 Mcal/kg), and DMI, feeding behavior and heart rate (**HR**) measured. Pregnant females with low RFI as heifers continued to consume less ($P < 0.01$) DMI (9.00 vs 11.62 ± 0.55 kg/d) then high-RFI females even though BW, ADG and BCS were similar. Low-RFI females had lesser ($P < 0.05$) bunk visit durations (149 vs 198 ± 13 min/d) and HR (65.8 vs 71.1 ± 1.7 beats/min) during mid-gestation then high-RFI females. Females with low RFI as heifers consumed 23% less forage during mid-gestation than high-RFI females, demonstrating that RFI of growing heifers was favorably associated with subsequent cow efficiency. Results suggest that between-animal variation in RFI was related to differences in HR and feeding behavior patterns.

To evaluate the effects of residual feed intake (**RFI**) classification on performance, feed efficiency and behavior traits in feedlot steers. Individual DMI, ultrasound carcass and feed behavior traits were measured in Angus-based composite steers (N = 508) from the Rex Ranch (NE) during 3 trials. Steers were fed a high-grain diet (ME = 3.08 Mcal/kg DM), and DMI and bunk visit (**BV**) frequency and duration data collected for 70 d using a GrowSafe system. RFI was computed as the residual between actual and expected DMI derived from regression of DMI on ADG and mid-test BW$^{0.75}$, and steers classified into low (n = 148), medium (n = 206), and high (n = 154) RFI groups (± 0.5 SD from trial mean RFI). Meals are clusters of BV events separated by short intervals that are differentiated from the next meal by a non-feeding interval that is long compared to the intervals within a meal. The longest non-feeding interval considered to be part of a meal is defined as meal

criterion (**MC**). A 2-pool Gaussian distribution model was fit to log-transformed interval lengths between BV events for each animal using R mixdist package (2.9-2), and the intersection of the distributions computed as the MC. Individual MC was used to derive meal frequency and duration data. Initial BW (310 ± 4.6 kg) and ADG (1.68 ± 0.02 kg/d) were similar, but DMI (9.62 vs 11.39 ± 0.09 kg/d) and F:G (5.95 vs 6.95 ± 0.11 kg/d) were lower ($P < 0.0001$) for low- compared to high-RFI steers. Steers with low RFI had lesser ($P < 0.001$) backfat depth (0.66 vs 0.77 ± 0.02 cm) and lower ($P < 0.05$) intramuscular fat percentage (3.06 vs 3.27 ± 0.06%) than steers with high RFI. Final REA area was not affected by RFI classification. Steers with low RFI spent less time ($P < 0.01$) at the feed bunk (51.4 vs 64.6 ± 1.2 min/d) and had fewer ($P < 0.01$) BV events (53.1 vs 62.3 ± 1.4 events/d) than high-RFI steers. Meal criterion (29.0 vs 24.9 ± 0.03 min) was longer ($P < 0.05$) for steers with low- compared to high-RFI steers. Steers with low RFI had similar frequency of meals, but shorter ($P < 0.0001$) daily meal durations (116 vs 136 ± 4 min/d), and fewer ($P < 0.01$) BV events per meal (10.8 vs 12.4 ± 0.3) than high-RFI steers. Steers with low RFI consumed 15% less feed and were leaner, but had similar performance and REA compared to high-RFI steers. Steers with divergent RFI had distinctive feeding behavior patterns, and results suggest that feeding behavior traits may be an effective indicator trait for RFI in growing beef cattle.

IV. APPLICATION OF FINDINGS: Results from this project indicate that RFI of developing heifers is favorably associated with cow efficiency during mid-gestation. Also, feeding behavior traits are moderately correlated with feed intake and RFI. Future research will be directed to determine if inclusion of feeding behavior traits as indicator traits for RFI will enhance accuracy of predicting genetic merit for feed efficiency in beef cattle.

V. **IMPACTS:** Considerable genetic variation exists in beef cattle for feed intake that is unaccounted for by individual animal variance in weight and growth rate, which can be quantified as residual feed intake (RFI). Evidence exist that selection for RFI will improve genetic merit for feed efficiency through reductions in feed inputs, with minimal influences on growth or mature size. The expense of measuring feed intake has limited implementation of selection programs that target this trait, thus genomic markers and phenotypic indicator traits that are predictive of RFI will help to facilitate identification of animals with favorable genetic merit for feed efficiency in a cost-effective manner. Results from this project suggest that feeding behavior traits may be useful as indicator traits for selection of beef cattle for improved RFI. Ultimately development of these technologies will result in reduced production costs, mitigation of environmental effects of beef production systems and improve the competitive position of beef producers.

VI. WORK PLANNED FOR NEXT YEAR: Studies will be conducted to evaluate phenotypic and genetic associations between feeding behavior traits and feed intake and RFI in cattle fed high-grain diets to further determine the utility of feeding behavior traits genetic evaluation of feed efficiency in beef cattle.

VII. PUBLICATIONS:

Referred Journal Articles:

1. Hafla, A.N., P.A. Lancaster, G.E. Carstens, D.W. Forrest, J.T. Fox, T.D.A. Forbes, M.E. Davis, R.D. Randel and J.W. Holloway 2011. Relationships between feed efficiency, scrotal circumference and semen-quality traits in yearling bulls. J. Anim. Sci. *(Accepted).*
2. Mendes, E.D.M, G.E. Carstens, L.O. Tedeschi, Pinchak, W.E. and T.H. Friend. 2011. Technical note: Validation of a system for monitoring feeding behavior in beef cattle. J. Anim. Sci. doi:10.2527/jas.2010-3489.

Non-Referred Articles:

1. Johnson, K.A., H. Neibergs, J.J. Michal, G.E. Carstens, M. Settles, A. Hafla, T.D.A. Forbes, J.W. Holloway and A. Brosh. 2010. Differential expression of mitochondrial genes in liver from beef calves with divergent phenotypes for feed efficiency. In: G. Matteo Crovetto (Ed.), Energy and Protein Metabolism and Nutrition. EAAP Pub. 127:75-76.
2. Crews, D.H., Jr., C.T. Pendley, G.E. Carstens, and E.D.M. Mendes. 2010. Genetic evaluation of feed intake and utilization traits in beef bulls. Proc. 9th World Congress on Genetics Applied to Livestock Production, Leipzig, Germany. CD-ROM #0667.
3. Tedeschi, L.O., D.G. Fox, G.E. Carstens and C.L. Ferrell. 2010. The partial efficiency of use of metabolisable energy for growth in ruminants. Energy and Protein Metabolism and Nutrition. EAAP Pub. 127:519-529.

Research Abstracts:

1. Bailey, J.C., G.E. Carstens, J.T. Walter, A.N. Hafla, E.D. Mendes, L.O. Tedeschi and R.K. Miller. 2011. Effects of residual feed intake classification and breed type on feed efficiency and feeding behavior traits in heifers fed a high-grain diet. J. Anim. Sci. 89(E-Suppl. 1):366.
2. Bailey, J.C., L.O. Tedeschi, E.D. Mendes and G.E. Carstens. 2011. Evaluation of bimodal distributions to determine meal criterion in heifers fed a high-grain diet. J. Anim. Sci. 89(E-Suppl. 1):761.
3. Bailey, J.C., G.E. Carstens, J.W. Behrens, R.K. Miller, J.T. Walter, A.N. Hafla, L.O. Tedeschi and D.S. Hale. 2011. Temperament classification affects feed efficiency, feeding behavior and carcass value traits in heifers fed a high-grain diet. Proc. Plains Nutrition Council (Abstr.).
4. Hafla, A.N., G.E. Carstens, T.D.A. Forbes, J.C. Bailey and E.A. Dany. 2011.Heart rate and physical activity in growing Bonsmara heifers with divergent residual feed intake fed in confinement or on pasture. J. Anim. Sci. (In press).
5. Hafla, A.N., G. E. Carstens, T. D. A. Forbes, J, C. Bailey, J. T. Walter, J.W. Holloway and J. G. Moreno. 2011. Relationship between postweaning RFI in heifers and intake and productivity of mid-gestation beef females. J. Anim. Sci. 89(ESuppl. 1):416.
6. Walter, J.T., J.C. Bailey, G.E. Carstens, A.N. Hafla, E.D. Mendes and L.O. Tedeschi. 2011. Residual feed intake classification affects on feed efficiency and

feeding behavior traits and net revenue in Angus-based composite steers. Proc. Plains Nutrition Council (Abstr.).

Annual Project Report
Cooperative Regional Research Project W-1010
Year Ending December 31, 2010
Preliminary Information -- *Not for Publication*

A. Project Title: Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems

In support of Objective xx:.

B. Cooperating Agency:

Personnel: Kristi Cammack, Scott Lake, Steve Paisley

C. Report

1. Outputs (include brief description/summary of what was done to measure outputs)

1) Fall-born bull test completed (July – October 1) using the GrowSafe system.
2) Wyoming Hereford Association bull test completed (Nov. 15 – Feb. 15) using the GrowSafe system. On-line bull sale format was used to sell bulls based on RFI information.
3) Commercial black cows were bred by A.I. to Hereford bulls selected for either high or low RFI and have acceptable traits to produce females for the existing herd. The overall goal is to produce moderate framed black baldy cows that can thrive in the High Plains region. Simmental x Angus and Angus bulls will be used as clean-up. One goal of this project is to test all potential herd sires, and utilize bulls that are divergent for RFI (high RFI and low RFI). Progeny from those sires will be similarly measured for RFI to estimate heritability.

Herd management for this project includes:

a) Evaluating and documenting sire EPD values for backfat (BF), ribeye area (REA, in^2), and percent intramuscular fat (%IMF), an indication of marbling. Sire selection and heifer retention decisions will be made so that both high RFI and low RFI groups are not biased in relation to carcass traits.
b) All heifers will be ultrasounded at approximately 12 months of age, documenting liveweight, BF, REA and %IMF values.

2. Outcomes / Impacts

1) Individual sire data reported back to all producers, along with RFI rankings.
2) Bull test information presented at three field days, reaching 200+ producers.
3) Published Hereford bull test information in Hereford America reaching all registered members.

3. Publications

1) Published two articles for the Wyoming Roundup.
2) Published on article for the University of Wyoming's Reflections publication.
3) Published two articles for Hereford America.
4) One featured article in the Wyoming Business Council quarterly publication.
5) One radio interview with Northern Ag Network.
6) One radio interview with KNEB in Nebraska.

4. Participants

1) Drs. Steve Paisley, Scott Lake, and Kristi Cammack
2) Bull test producers
3) Wyoming Business Council
4) Hereford Association

5. Target Audiences

1) Area beef producers
2) Hereford Association

6. Project Modifications

1) Expand bull tests.
2) Evaluate UW heifers for RFI in coming year.