

Beef Cattle Research Report – 2003

Department of Animal Sciences
University of Wisconsin-Madison



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Editors



Introduction

The faculty and staff of the Animal Sciences department are pleased to present this edition of the University of Wisconsin Beef Report.

The Animal Science research program is a multi-disciplinary approach that combines the expertise of several departments on campus, county-based extension personnel, and individuals within the industry. Areas of beef research conducted address issues producers are facing now and in the future.

This report was an initial attempt to bring together research and activities related to the beef industry conducted through our department. We attempted to keep things very brief and in the process not all data may be represented. Additionally, several projects are in their infancy and data reported here may change slightly as the data is finalized. We felt it important, however, to give supporters of our department the opportunity to see what the faculty and staff connected to the beef program are currently involved with. We will continue to improve upon this effort and welcome feedback.

We hope you enjoy this overview and the Animal Sciences department looks forward to serving the beef industry in the upcoming year.

Sincerely,

Jeff Lehmkuhler, Ph.D.
Extension Beef Specialist and Assistant Professor

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Embryo Biology

REDUCED DIETARY PROTEIN IMPROVES PREGNANCY RATES FOLLOWING TRANSFER OF IN VITRO PRODUCED BOVINE EMBRYOS

A.E. Fischer-Brown, R.L. Monson, D.L. Northey, J.J. Rutledge, K.A. Albrecht and D.M. Schaefer

Evidence exists that high levels of degradable intake protein may lead to elevated blood urea nitrogen concentrations which in turn may influence uterine pH and decrease embryo survival following transfer. Here we propose that embryos derived from artificial insemination (AI), embryo transfer (ET), and in vitro production (IVP) possess varying levels of sensitivity to changes in uterine environment. Embryos maintained in vivo following AI may adjust to their environment while embryos deposited into recipient uteri on day 7 or 8 of the estrous cycle lack this opportunity of adjustment and may be more immediately susceptible to damage. To test this hypothesis, a 2x3 factorial experiment was performed over a 3-year period with 2 levels of dietary protein and 3 breeding methods. Crossbred heifers and cows were fed either a high protein diet (100% alfalfa) or a diet with reduced protein (40% alfalfa and 60% cup-plant, a non-legume, high fiber feedstuff). The high protein diet was approximately 18% protein while the reduced protein diet was approximately 14% protein upon feedstuff analysis. These diets were fed for a period lasting 2 weeks prior to and 4-6 weeks after transfer or insemination. Thereafter, all recipients were pooled and fed grass and legume species. Animals were bred using the same proven Angus semen with one of three methods: AI, in vivo/ET, or IVP/ET. In vivo produced embryos had been previously frozen with ethylene glycol as cryoprotectant, and were transferred via direct transfer. IVP embryos were transferred fresh. Culture medium for IVP embryos was either modified KSOM or SOF with amino acids; there was no effect of medium on pregnancy rates. All embryos for ET or IVP were quality grade 1. Pregnancy was diagnosed via ultrasonography by at least 28 days of gestation. Pregnancy rates were compared within breeding method using a chi-squared test ($P < 0.05$). No difference was observed between dietary protein levels for AI or in vivo transfers (Table 1). There was no donor effect on pregnancy rates. For recipients receiving IVP embryos, pregnancy rates were higher for animals fed reduced protein diets as compared to high protein diets (47.7% vs. 28.0%, respectively).

Table 1. Pregnancy rates (= 28 days) for cattle receiving a high protein or reduced protein diet and bred by AI, in vivo ET, or IVP ET

	HIGH PROTEIN		REDUCED PROTEIN	
	Total animals	% pregnant (n)	Total animals	% pregnant (n)
AI	23	65.2 ^a (15)	31	67.7 ^a (21)
In vivo	15	46.7 ^a (7)	12	41.7 ^a (5)
IVP	50	28.0 ^a (14)	44	47.7 ^b (21)

^{ab}Values with different superscripts within a row are significantly different (P<.05).

Further data will be collected for the last year of this study, including pregnancy diagnoses later in gestation as well as information about parturition and calving. Blood urea nitrogen (BUN) levels sampled at the time of transfer will also be analyzed for correlation with pregnancy rates. These preliminary data suggest that levels of dietary protein influence pregnancy rates of IVP embryos. Observations from this study also support ongoing efforts to improve the viability of IVP embryos.

Nutrition

EVALUATION OF RAW SOYBEANS VERSUS SOYBEAN MEAL/UREA AS SUPPLEMENTAL CP SOURCE FOR FINISHING YEARLING HOLSTEIN STEERS

D. Schaefer, A. Crooks and J. Lane

Commercial protein supplements for finishing Holstein steers in Wisconsin involve soybean meal (SBM) and urea. These supplements are sold at prices that seem expensive relative to the cost of bulk soybean meal. Wisconsin now has much soybean production. The rationale for this experiment was to consider the utility of soybeans, as a home-raised protein source substituted for commercial protein supplements, in finishing diets. Two DM formulations of a 10% corn silage diet containing 13% CP were prepared as follows:

	SBM/Urea	Raw Beans
Corn silage	10.0	10.0
Dry, whole corn	76.0	69.1
SBM/urea pellet	14.0	-
Soybeans, whole, raw	-	12.9
Balancer pellet	-	8.0
CP, %	13	13
Urea, %	0.6	-
Monensin, g/T DM	26	26
Tylosin, g/T DM	11	11

Ninety-six yearling Holstein steers were blocked by initial weight into four groups and assigned randomly to one of two pens per block. Thus, each dietary treatment was fed to four pens of 12 steers per pen. Average initial weight was 910 lbs and each steer received only one

Synovex-S implant at initiation of the trial. The steers were finished after receiving these diets for 121 days.

	SBM/Urea	Raw Beans	Effect
Initial Wt	911	908	
Final Wt	1312	1297	
DMI	25.2	24.6	P> 0.4
ADG	3.42	3.33	P> 0.4
DMFG	7.37	7.39	P> 0.4

Performance of steers fed the two diets is shown above. There was no treatment effect (P>0.4). In conclusion, it appears that raw soybeans could be substituted for a commercial soybean meal/urea supplement although a balancer supplement would be needed in combination with raw beans in the diet formulation.

COMPARISON OF JERSEY AND HOSLSTEIN STEERS

Jeff Lehmkuhler, Angela Brokman, Steve Arp, and Dan Schaefer

Twelve Jersey and Holstein steers (24 total) were individually penned to evaluate performance and carcass characteristics of the two breeds. The CNCPS computer model (v.5.0) was utilized to formulate two-three step feeding programs with one expected to allow 2.0 lb/d gain and the other 3.0 lb/d during the first two phases with the last phase being a common finishing ration. Diets were balanced to allow a metabolizable energy and metabolizable amino acid allowable gain ratio of near 1. Steers were implanted and reimplanted with an estrogenic implant (Synovex S®). Carcass data were collected following harvest and strip loins from one side were obtained for shear force determination. Samples and data are being analyzed, but raw data as illustrated in the figure reveals Holsteins gaining nearly 1.0 lb/d more during the first two periods in comparison to Jersey steers leading to an approximate 0.6-0.9 lb advantage for Holstein steers for the entire study.

Table 1. Main effects of breed for Jersey and Holstein steers .

	Holstein	Jersey	SEM
Initial wt., lb	481 ^a	256 ^b	3.7
Finished wt., lb	1265 ^a	836 ^b	9.5
Pd 1 ADG, lb	3.04 ^a	2.23 ^b	0.04
DMI, lb/d	15.1 ^a	10.1 ^b	0.11
F/G	0.201 ^b	0.222 ^a	0.001
Pd 2 ADG, lb	3.06 ^a	2.05 ^b	0.06
DMI, lb/d	18.3 ^a	12.3 ^b	0.40
F/G	0.167	0.168	0.001
Pd 3 ADG, lb	3.35 ^a	2.80 ^b	0.09
DMI, lb/d	23.1 ^a	15.9 ^b	0.31
F/G	0.145 ^b	0.179 ^a	0.002

^{ab}Values with different superscripts within a row are significantly different (P<.05).

ALTERING PROTEIN SOURCE TO REDUCE NITROGEN INTAKE IN FINISHING STEERS

Jeff Lehmkuhler, Steve Arp, and Dan Schaefer

This trial investigates utilization of various crude protein sources for finishing steers as a basis for improving nitrogen utilization of finishing steers. Treatments investigated included control (0.5% urea), bloodmeal (2% bloodmeal), urea+bloodmeal, and positive control (1% urea+3% soybean meal). Weaned steer calves (n=70) were assigned to twelve pens. Steers were blocked by source and treatments randomly assigned to pens within block. In Experiment 2, yearling steers (n=68) were blocked by weight and treatments were randomly assigned to pens within block. Steers were implanted with a single estrogenic implant (Synovex S®). Steers were scanned with an ultrasound and marketed at an average backfat thickness near 0.5 inch. Performance and carcass data were collected. Samples and data are currently being analyzed for Experiment 1.

Table 1. Preliminary data for calf-fed steers in Experiment 1 offered varying sources of dietary crude protein supplementation.

	Control	BM	Urea+BM	Positive Control
Initial Wt., lb	648	643	659	658
Final Wt., lb	1243	1225	1232	1263
ADG, lb/d	3.49	3.42	3.79	3.90
DOF	171.7	172.5	157.0	157.8
HCWT, lb	727	716	717	742
REA, sq. in.	12.7	12.9	12.7	13.2
BFT, in.	0.49	0.44	0.49	0.52
Marbling Score	539	564	537	546

PHOSPHORUS SUPPLEMENTATION OF FINISHING HOLSTEIN STEERS

Angela Brokman, Jeff Lehmkuhler, Dan Undersander, & Dan Schaefer

Previous research with native beef cattle would suggest that the current NRC recommendations for phosphorus requirements of finishing steers is overestimated and that no additional dietary phosphorus is required for corn based finishing rations. This trial was designed to investigate responses for Holstein steers receiving feedlot rations containing no additional or additional dicalcium phosphate. The study involved two groups of steers (n=96 & n=78) in 2002 and 2003. Prior to feedlot entry, steers were rotationally grazed and offered mineral supplements containing no additional or 6% phosphorus allowing for the investigation of responses to previous dietary phosphorus status. Steers were implanted at the initiation of the trial with an estrogenic implant (Synovex S®). Steers were blocked by weight and treatments were randomly assigned to pens. Diets consisted of 85% concentrate and 15% corn silage on a dry matter basis. Carcass trait data were collected following harvest of the steers. Diet samples were collected for determination of dry matter intake and nutrient content. This trial is currently being conducted as the 2003 steers are on test. Performance was similar in 2002 and ADG were 3.3 and 3.2 lb/d for the two treatments, however, feed intake data has not been summarized.

Table 1. 2002 Preliminary carcass data for Hoslteins receiving no supplemental phosphorus (-) or supplemental phosphorus (+) during the previous grazing period and during the finishing period (grazing/finishing).

	-/-	+/-	-/+	+/+
HCWT, lb	800	790	787	782
BFT, in.	.19	.23	.21	.18
REA, in. ²	11.2	11.6	11.3	11.2
YG	2.8	2.7	2.8	2.7
QG	611	597	613	560

Grazing

STEER PERFORMANCE ON KURA CLOVER-GRASS AND RED CLOVER-GRASS MIXED PASTURES

F. Mourino, K. A. Albrecht, D. M Schaefer and P. Berzaghi

Assessment of cattle performance on grazed kura clover has not been reported in the USA. This study was conducted to compare steer performance on kura clover-grass (KC-G) and red clover-grass (RC-G) mixed pastures. This field study was conducted at the Lancaster Agricultural Research Station, which is representative of approximately 14 million acres of the hilly, unglaciated soil in the Upper Mississippi Valley. Pastures were rotationally stocked with Holstein steers using a variable stocking rate. Fifteen or sixteen steers (475 lb initially) were assigned to each of four grazing units (6 acres/unit). Pasture stocking rate was managed so as to provide 1.5 to 2.0 lb forage DM/lb live weight at entry into a new paddock in each treatment. Animal performance and pasture composition were recorded from 1998 to 2000. The red clover was annually renewed in the RC-G pasture by frost seeding. The legume fraction accounted for at least 66% of the herbage mass every year in KC-G pasture while in the RC-G pasture, it ranged from 33% in 1998 to 10% in 2000.

Table 1. Mean neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP), and in vitro true digestibility (IVTD) of kura clover-grass (KC-G) and red clover (RC-G) pastures in 1998, 1999 and 2000.

Year	NDF		ADF		CP		IVTD	
	KC-G	RC-G	KC-G	RC-G	KC-G	RC-G	KC-G	RC-G
	%							
1998	36.6	47.8**	24.4	27.7**	22.6	18.8**	84.4	77.7*
1999	34.5	50.8*	23.8	28.3**	24.3	18.5**	85.1	74.9*
2000	35.6	54.2**	23.9	28.1**	25.2	21.6**	85.3	75.8*
mean	35.6	50.9**	24.0	28.0**	24.0	19.6**	84.9	76.1**

* Treatment means within nutritive parameters differ at the 0.05 probability level.

** Treatment means within nutritive parameters differ at the 0.01 probability level.

Kura clover-grass pasture was lower in neutral detergent fiber and acid detergent fiber and higher in crude protein and in vitro true digestibility than the RC-G pasture. Herbage mass and carrying capacity were greater in KC-G than in RC-G pasture each grazing season.

Table 2. Mean carrying capacity (CC), steer average daily gain (ADG), and gain per acre (gain) on kura clover-grass (KC-G) and red clover-grass (RC-G) pastures in 1998, 1999 and 2000.

Year	CC		ADG		GAIN		Grazing
	KC-G	RC-G	KC-G	RC-G	KC-G	RC-G	
	lb LW/acre*d		lb/d		lb/acre		days
1998	1487	1276*	2.66	2.46	1025	849**	184
1999	1402	1197*	2.60	2.02**	786	559**	140
2000	1219	1116	2.73	2.20**	917	730**	183
mean	1369	1196**	2.66	2.18**	909	713**	169

* Treatment means within nutritive parameters differ at the 0.05 probability level.

** Treatment means within nutritive parameters differ at the 0.01 probability level.

Average daily gain was higher every year for KC-G than for RC-G and averaged 2.66 and 2.18 lb/day, respectively. Steer weight gain per acre was greater for KC-G than RC-G and was attributed to the combination of its capacity to produce more forage and its superior nutritive value. Both are consequences of the ability of kura clover to maintain a high proportion of legume in the sward. During this study, three steers died from bloat (3.3% of the herd fed KC-G pasture), one each year on the KC-G pasture. All three steers died in the paddocks with the highest proportion of legume and concurrent to the time of the year when kura clover was more productive than the grasses. The use of poloxalene in the trace mineralized salt after the first observation of bloat prevented additional instances of bloating. Kura clover demonstrated excellent persistence under rotational grazing in mixture with grasses. This study documents unprecedented steer performance on pasture containing a mixture of grass and legume and a new alternative for beef production and soil conservation in the Upper Mississippi Valley.

PHOSPHORUS SUPPLEMENTATION OF GRAZING HOLSTEIN STEERS

Angela Brokman, Jeff Lehmkuhler, Dan Undersander, & Dan Schaefer

This trial was designed to investigate the performance responses for rotationally grazed Holstein steers offered a trace mineralized salt supplement containing no additional phosphorus or 6% phosphorus (2/3 trace mineralized salt and 1/3 dicalcium phosphate). The trial was initiated in 2002 and repeated in 2003. Eighty and seventy-two steers, 2002 and 2003, respectively, were assigned to four grazing groups. Half the animals from each group were assigned to the no phosphorus and the remainder to phosphorus supplementation. Steers were not implanted in 2002 and received a single zeranol implant (Ralgro®) in 2003. Pasture rotations allowed for three or four days grazing in each pasture. Two mineral feeders fit with Calan gates were in each grazing group and animals had keys on a collar around the neck to control access to the correct treatments. Mineral intakes were recorded at each paddock rotation. Pasture samples were taken bi-weekly during the grazing season for estimation of forage availability and nutrient analysis. Estimation of forage intake in 2002 was performed by using fecal bags for total fecal collection for four consecutive 24 h periods. In 2003, fecal grab samples were collected on three consecutive days and composited. Internal forage markers were then utilized to estimate fecal output. Fecal output and forage digestibility were then utilized to estimate forage intake. Steer performance was monitored monthly during the grazing season.

Samples and data are currently being analyzed. Raw performance data for both years would indicate no differences between treatments, however, no conclusion should be drawn at this time.

Table 1. Preliminary performance data for grazing Holstein steers with or without supplemental phosphorus.

	2002		2003	
	No Phos	Phos	No Phos	Phos
Initial weight, lb	553	541	656	651
Final weight, lb	808	785	993	981
ADG, lb/d	1.85	1.77	2.65	2.60

BREEDING AND GENETICS

EVIDENCE FOR QUANTITATIVE TRAIT LOCI AFFECTING TWINNING RATE IN NORTH AMERICAN HOLSTEIN CATTLE

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Twinning in dairy cattle has been associated with many negative health and reproductive events that cause economic loss to the producer. While most of these negative effects hold true in beef cattle as well, with proper management twin birth might be exploited in beef cattle as a means of greatly improving reproductive efficiency. Putative quantitative trait loci (QTL), ie. genes, for twinning and ovulation rate on bovine chromosomes 5, 7, 19, and 23 have been previously identified in other populations. The objective of this study was to detect and possibly confirm the existence and effects of these QTL in the North American Holstein population. Half-sib families of 20 North American Holstein sires with high twinning rate PTA comprised the sample under investigation. Twinning rate PTA values had been estimated from calving data. DNA extracted from semen samples was analyzed using 45 to 61 microsatellite markers across the four chromosomes. Evidence of twinning QTL was found in multiple families on chromosomes 5, 7, and 23 and in one family on chromosome 19. Four of the sires formed one three-generation family: one sire and three half-sib sons with sons of their own. This extended family was analyzed with additional markers confirming a twinning QTL of significant size on chromosome 5. Information generated from this research project will aid efforts to more finely map the location of the gene or genes responsible for the chromosome 5 QTL, ultimately leading to genetic markers that can be used in genetic selection.

GENETIC RESISTANCE TO PARATUBERCULOSIS IN CATTLE

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Paratuberculosis is a slowly developing, often clinically invisible but fatal disease of cattle and other ruminants that is caused by infection with *Mycobacterium paratuberculosis*. US dairy producers suffer immense economic losses annually due to reduced milk production and culling of infected animals, though the disease affects beef producers as well. This troublesome infection continues to spread throughout the dairy industry, currently affecting more than 20% of the national herd. Genetic control strategies offer a way to diminish the costs of paratuberculosis by improving cows' resistance to infection. This project is attempting to identify chromosomal regions associated with susceptibility to paratuberculosis. Approximately 5000 daughters of 12 Holstein sires will be studied. Cooperating herds have been identified on the basis of a survey, and cooperators have provided blood and fecal samples from mature daughters of the chosen sires. Johne's disease status for individuals is determined by presence of antibodies to the causative organism (blood sample) and presence of the mycobacterium itself (fecal sample). The blood sample also serves as the source of DNA from the study. A genome-wide search for genes contributing to susceptibility to Johne's disease is underway. This analysis compares inheritance of alternative genetic marker alleles between infected and uninfected daughters of a given bull. Inheritance by these two groups of different marker alleles from their common sire indicates that the marker in question is near a gene of interest.

Meat Science

DETERMINATION OF THE NUTRIENT CONTENT OF BEEF VALUE CUTS

Sponsor: National Cattlemens' Beef Association

Dennis R. Buege (Principal Investigator)

Objective:

To determine the nutrient content of 6 newly-identified beef value cuts from the beef chuck and round, for use in nutritional labeling programs for these cuts in the retail and food service industries.

Scope of Work:

Six carcasses of prescribed yield and quality grades (reflecting current industry mix) will be identified in each of two geographically-separated plants, representing major U.S. beef processors (12 carcasses in total). Twelve sets of 3 primal cuts (shoulder clod, knuckle and bottom round) will be vacuum packaged and transported to the Meat Science Laboratory at the University of Wisconsin-Madison.

The designated primals will be taken to a cooperating Madison-area purveyor, for removal of the following six beef value cuts:

<u>Trade Name</u>	<u>Muscle</u>	<u>Primal</u>
Top blade steak	Infraspinatus	Shoulder Clod
Shoulder top and center steaks	Triceps brachii	Shoulder Clod
Shoulder tender	Teres major	Shoulder Clod
Tip center	Rectus femoris	Knuckle

Tip side
Bottom round

Vastus lateralis
Biceps femoris

Knuckle
Outside round (flat)

The meat cutting staff of the cooperating purveyor will remove the 6 muscles from the designated primals. Removed beef value muscles will be trimmed free of all external fat and heavy connective tissue, and stored at 35°F prior to steak cutting and cooking.

Beef value muscles will be cut into steaks approximately 1 inch thick. From the various areas of each muscle, steaks will be removed in pairs, with one steak from each pair going for analysis in the raw state, and the other for analysis in the cooked state

Steaks to be submitted for analysis in the cooked form will be prepared on a home-type gas grill. Initial raw weight will be obtained on each batch of steaks, and thermocouples will be inserted into the geometric center of the steaks to monitor internal temperature rise during cooking. A cooked weight will be obtained for determination of cooking loss.

Prepared vacuum packaged, frozen samples of raw and cooked value cuts will be delivered to a selected analytical laboratory. Samples will be analyzed for the following nutrients:

- Proximates (moisture, protein, fat, ash)
- Cholesterol
- Fatty acids (including total trans fatty acid, but excluding CLA)
- Minerals
- Primary meat vitamins (B-vitamins)
- Secondary meat vitamins (vitamin E, retinol)
- Amino acids
- Choline, Folate, vitamin K

Laboratory results will be analyzed and summarized by the principal investigator, in cooperation with the USDA Nutrient Data Laboratory and NCBA.

All processing operations required to prepare the muscle samples for submission to the analytical laboratory will take place between August 1 and September 15, 2003. Additional time will be required to complete nutrient content determination by the laboratory, and for summarizing of the results.

Management

RADIO FREQUENCY ANIMAL IDENTIFICATION TECHNOLOGY

Jeff Lehmkuhler and Steve Gilsdorf

Among the top of the list for livestock management issues is animal identification and tracking. A national animal identification program is anticipated to be implemented in the United States in the near future and expected to be based upon radio frequency technology. This is based upon the reported need of a 48-hour traceback system in the event of a foreign animal disease discovery. This research involves utilizing available steers to test prototype walk-thru radio frequency antennas, structures, and readers. Additional on-farm work is looking at retention rates of ear tags in the cow-calf herd. This research is in cooperation with Digital Angel/DeStrom Fearing. Results of this work are expected to help advance animal identification systems.

FENCELINE WEANING DEMONSTRATION

Jeff Lehmkuhler and Arin Crooks

Fenceline weaning has been promoted as a low stress weaning management strategy. Some research trials have indicated improved performance and behavior responses with fenceline weaning while others have not observed such performance responses. In 2002, all the calves at the Lancaster station were fenceline weaned. Due to the satisfactory responses observed, in 2003 a demonstration project was initiated. Half the calf crop was fenceline weaned while the other half was weaned on pasture away from the cows. Calves were weighed at weaning, 9-d postweaning and 22-d postweaning. After nine days, all calves were commingled and placed into a mound pen and offered a common haylage based diet. Weaning weights for steers and heifers in the fenceline and pasture weaned systems averaged 451, 414, 460, and 406 lb, respectively. A slight advantage was observed for the pasture weaned calves in comparison to the fenceline weaned calves for the first 9-d postweaning, but this response was diminished by 22-d. Differences in performance during the first 9-d post-weaning may be related to increased intakes of pasture-weaned calves versus fence-lined weaned calves. Performances were similar for the two management systems and calves gained very well with 22-d ADG of 3.2, 3.1, 2.9, and 2.6 lb/d for fenceline steers, pasture steers, fenceline heifers, and pasture heifers respectively.

Outreach Programs

WORLD BEEF EXPO FED STEER FUTURITY

Jeff Lehmkuhler, Dan Schaefer, and Steve Arp

This is an outreach program that allows producers to obtain performance and carcass data for a group of five steers. Animals arrive to the Arlington Beef Nutrition unit the first week of November. Steers are processed and worked up to a high concentrate ration. Ultrasound technology is utilized in order to assist in determining market readiness and avoid large discounts. Reports are sent to producers summarizing results. The program is terminated by the middle of June. This program is supported by Fort Dodge Animal Health, Merial Inc., Elanco Animal Health, Digital Angel, World Beef Expo and Wisconsin Cattlemen's Association.

Common Abbreviations

ADG	Average Daily Gain
G/F	Unit of gain per unit of feed = Inverse of F/G
F/G	Unit of feed per unit of gain = Inverse of G/F
DMI	Dry Matter Intake
DM	Dry Matter
BW	Body Weight
CP	Crude Protein
TDN	Total Digestible Nutrients
IVDMD	In Vitro Dry Matter Digestibility
NDF	Neutral Detergent Fiber
ADF	Acid Detergent Fiber
IVP	In Vitro Produced
AI	Artificial Insemination
ET	Embryo Transfer
SEM	Standard Error of the Mean
kg	kilogram(s)
lb	pound(s)
d	day
wt	weight
wk	week
DOF	Days On Feed
REA	Rib-eye Area
BFT	Back fat thickness
YG	Yield Grade
QG	Quality Grade
HCWT	Hot Carcass Weight