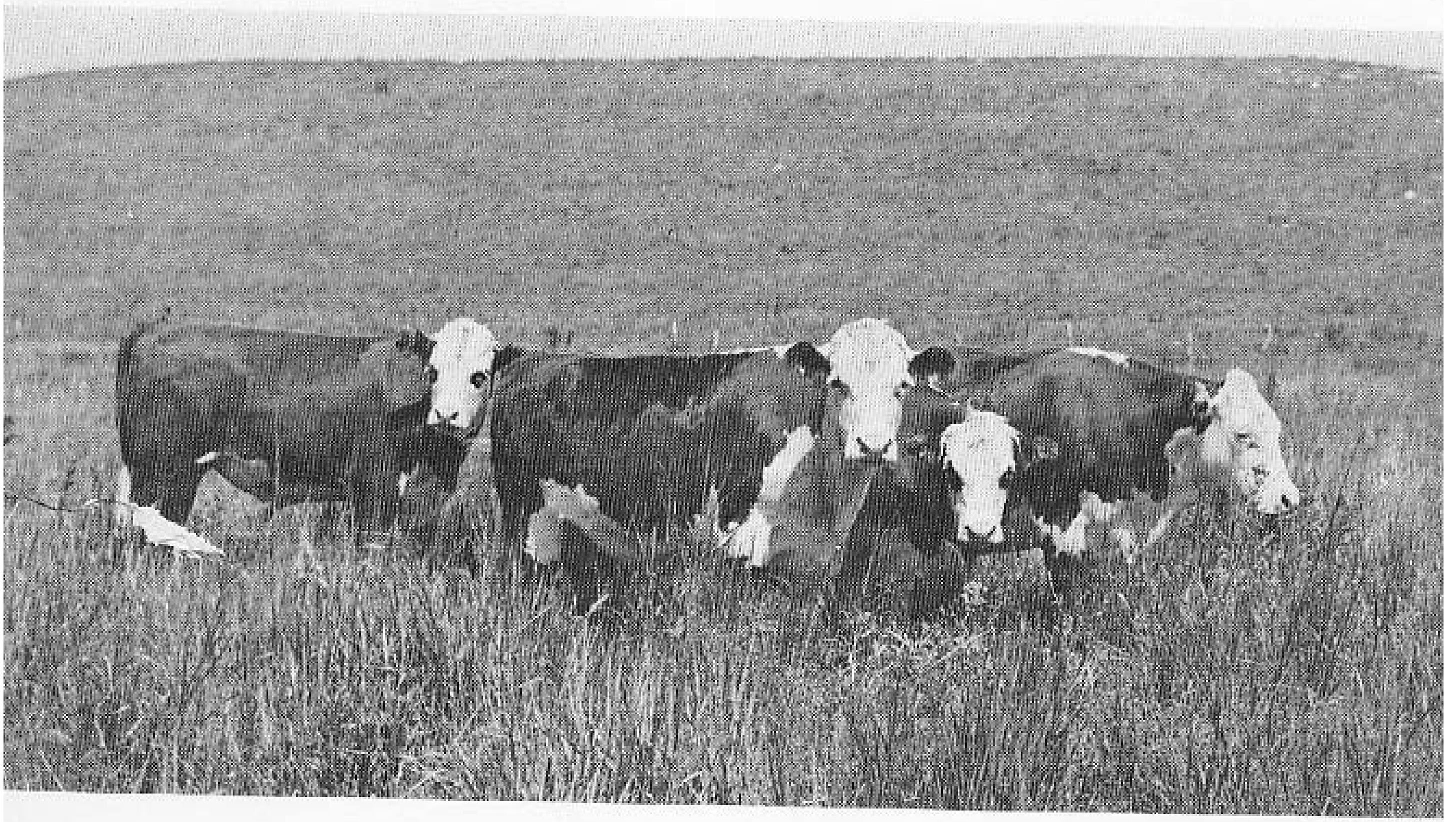
Bulletin 568
February 1973

60th Annual

CATTLEMAN'S DAY



Friday, March 2, 1973

Department of Animal Science and Industry
Agricultural Experiment Station

KANSAS STATE UNIVERSITY
Weber Hall
Manhattan, Kansas

60th Annual

CATTLEMEN'S DAY

Friday, March 2, 1973

FRIDAY, MARCH 2, 1973

8:00 a.m. Weber Hall Arena
Registration—Exhibits
(Coffee and donuts served)

$ Routes to Profit $
- $ Low quality forage
- $ Cattle identification
- $ Pre-weaning performance
- $ Post-weaning performance
- $ Live animal evaluation
- $ Progeny testing
- $ Carcass evaluation

10:00 a.m. Williams Auditorium, Umberger Hall
Dr. Don L. Good, Head, Department of Animal Science and Industry, KSU, presiding

Welcome
James A. McCain, President, Kansas State University

Beef Cow—Calf Management Panel:
Dr. Harold Tuma, Moderator

Low Quality Roughage, Dr. Keith Bolsen

Protein Supplementation, Dr. Keith Zoellner

Fertilization of Native Grasses, Dr. Ed Smith

Energy—Protein Levels in Wintering Rations—Dr. Bob Schalles

Cow Confinement Management, Dr. Miles McKee

Update on Issues of Interest:
Dr. Steve Armbruster, Moderator

Health and Management Tips on Feedlot Arrivals and Force Feeding New Calves —Dr. Homer Caley, Extension Veterinarian

What's Happening in the Kansas Legislature, Kansas Pesticide Use Law as Related to Livestock Producers and Legislative Action on Assessment of Cattle—Virgil Huseman, KLA Cattle Feeders Service

Growth Stimulants for Feedlot Cattle and Concepts in Protein Nutrition—Dr. Jack Riley

Federal Water Pollution Control Act Amendments of 1972 and Occupational Safety and Health Act (OSHA)—Prof. Leo Wendling, Extension Agri. Engineer

12 noon Weber Hall
Lunch: Roast Beef

1:00 p.m. Williams Auditorium, Umberger Hall
Remarks
Mr. William G. Amstein, Jr., President, Kansas Livestock Association, Clifton, Kansas

1:15 p.m. Williams Auditorium, Umberger Hall
Introduction of Guest Speaker
Dr. Don L. Good, Head, Department of Animal Science and Industry

Kansas Agriculture in Transition

Dr. Glenn H. Beck, Vice President for Agriculture, Kansas State University

Dr. Glenn H. Beck became Vice-president for Agriculture at Kansas State University December 1, 1965. He is administratively responsible for the total agricultural teaching, research, extension, and foreign agricultural programs of the University.

Vice-president Beck returned to K-State in 1956 from the University of Maryland to become director of the Kansas Agricultural Experiment Station. In 1960 he was named Dean of Agriculture, a position he held until being promoted to Vice-president.

Dr. Beck was provost for agriculture and veterinary medicine at Ahmadu Bello University in Northern Nigeria for tre Rockefeller Foundation from January, 1969 to February, 19[illegible].

Dr. Beck's research work was primarily in dairy cattle nutrition, artificial breeding, and managed milking.

Administrative assignments have made him a world traveler. Since 1962, he has been abroad frequently for administrative visits with Kansas State's faculties in India and Nigeria, to head a multi-University research Consortium for Nigerian Rural Development, and as a consultant and administrator for the Rockefeller Foundation. He previously had been abroad to judge dairy cattle.

Most Kansas Cattlemen know how effectively Vice-president Beck has supported livestock research, teaching, and extension programs through the legislature, the Board of Regents, and throughout the state.

2:00 p.m. Beef Cattle Research Center
(about 2 miles north, at end of College Avenue)

FOR THE LADIES

Thursday, March 1, 1973

6:30 p.m. Bluemont Room, KSU Union
Kansas Cow Belles Dinner

Reservations by February 28 to:
Mrs. Don L. Good
2027 Sunnymeade Road
Manhattan, Kansas 66502

Friday, March 2, 1973

9:30 a.m. Weber Hall, Staff Memorial Library
Coffee for visiting ladies
Ladies Program to follow the coffee
Ladies will join the men for Roast Beef lunch at Weber Hall.

CONTENTS

Effects of Late Spring Burning and Nitrogen Fertilization on Nutritive Values of Big and Little Bluestem Plants

L. J. Allen, R. R. Schalles, B. E. Brent, J. S. Woolfolk, and E. F. Smith

Effects of late spring burning and nitrogen fertilization on nutritive value of Big Bluestem (Andropogon gerardi) and Little Bluestem (Andropogon scoparis) on native rangeland were determined at monthly intervals during the 1972 growing season. Burning significantly decreased dry matter percentage, crude fiber, cell walls, and lignin. Fertilization did not significantly influence any of those factors except for increasing lignin slightly. Big Bluestem had significantly less crude fiber, cell walls, and lignin than Little Bluestem.

Introduction

Both increasing populations and per capita consumption of beef in the United States and in other countries call for new management practices to increase the carrying capacity of native rangelands.

It has long been recognized that annual late-spring burning of True Prairie rangelands stimulates beef cattle performance. Commercial fertilizers also have been used to increase production of cultivated crops but such use on native prairies has been questionable.

Reported here are how annual late-spring burning and nitrogen fertilization, separately and together, affect nutritive values of Big and Little Bluestem, two primary grass species of the True Prairie.

Experimental Procedure

The study was conducted during the 1972 growing season on native True Prairie rangeland near Manhattan, Kansas. Four pastures varied in size from 44 to 60 acres were involved.

Samples of two species of grass, Big Bluestem and Little Bluestem, were collected on loamy upland range.

One of four treatments was applied to each pasture to evaluate effects of annual late-spring burning and nitrogen fertilization on the nutritive value of bluestem grass.

Burning. Burning was April 28 with a light northern breeze. All organic matter was consumed by the fire.

Nitrogen. Nitrogen in the form of granular urea was aerially applied May 17 at 40 pounds of nitrogen per acre.

Burning and Nitrogen. Burning and nitrogen fertilization were as just indicated.

Control. No burning or fertilization.

The grass samples were clipped at ground level from within 25-foot square exclosures in three randomly located, loamy upland sites in each pasture. The exclosures were constructed with "T" type steel posts and 4 strands of barbed wire.

Three samples were taken from each pasture on the first of each month, June to November.

Preparation for analysis consisted of drying overnight at 90° C in a forced air oven and grinding in a Wiley mill through a one-millimeter screen.

Results

Dry Matter

Burning significantly decreased the dry matter content of the bluestem grass in June, September, and November (Table 1). In July and October there were no significant differences. Although not shown, fertilization and fertilization plus burning had no additional effect on the dry matter content of the grass. No species differences were detected.

Crude Fiber

Table 1 shows the crude fiber content of the bluestem grass. The general trend is for crude fiber to gradually increase as the growing season advances. The August 1 clipping showed a decline in the fiber content of the grass. Increased production of new plant tissue (low in crude fiber) after 2.54 inches of rainfall in July may explain the fiber decline.

Burning significantly lowered the crude fiber content of the grass throughout the study period (Table 1). That likely explains why beef cattle on burned range outperforms cattle on range not burned. Although not shown, fertilization had no effect on crude fiber content of the grass.

Big Bluestem was significantly lower in crude fiber, 32.28%, than Little Bluestem, 33.16%.

Cell Walls

Cell wall percentages followed the same trend as crude fiber (Table 2). Cell walls increase as the season advances. Burning compared to not burning significantly decreased cell wall percentages June through August; no differences were detected in the September or October clippings but the burned pastures had significantly lower cell wall percentages in November than the nonburned pastures did.

As with crude fiber, Big Bluestem had significantly lower percentages of cell walls than Little Bluestem did. Table 2 shows cell wall percentages for each species during the study. Big Bluestem was consistantly lower. Although not shown, fertilization did not influence cell wall percentages.

Protein

Table 3 shows effects of treatment on protein levels of the grass. Burning or fertilization alone did not significantly affect protein levels but burning and fertilization together significantly increased protein content. This difference was only a .57% and of little practical importance.

Table 4 shows the average protein levels at monthly intervals throughout the study. The protein levels dropped from 11.62% in June to 2.89% in November.

Lignin

The average lignin content of the bluestem grass is shown in Table 5. Lignin gradually increases as the growing season advances. Both burning and fertilization significantly influenced lignin content of the grass plant (Table 6).

Table 1. Dry Matter and Crude Fiber Percentages of Big and Little Bluestem grass (Combined dry matter basis), June 1-November 1, 1972.

	Dry Matter, %		Crude Fiber, %		
Month	Not burned	Burned	Average	Not burned	Burned
June	30.44^{e}	24.35	30.48^{b}	$32.62^{c d}$	28.33
July	$31.77^{d e}$	$34.07^{c d}$	32.82^{a}	34.47^{a}	31.16
August	---	---	30.80^{b}	32.22^{d}	29.36
September	40.88^{b}	34.59^{c}	33.98	34.50^{a}	$33.47^{b c}$
October	$43.17^{a b}$	43.89^{a}	33.36	$33.90^{a b}$	$32.83^{c d}$
November	79.59	70.41	34.90	36.52	$33.28^{b c}$

Least Square Means
Values followed by the same superscript do not differ significantly ($P<.05$)

Table 2. Cell wall percentage of Bluestem Grass (dry matter basis), June l-November 1, 1972

	Big and Little Bluestem Combined			From all treatments	
Month	Average	Not burned	Burned	Big Bluestem	Little Bluestem
June	72.54	75.76$^{b c}$	69.31	72.01	73.06
July	75.38^{c}	76.19^{b}	74.57^{c}	74.46^{e}	76.30$^{c d}$
August	76.25$^{b c}$	78.22^{a}	74.28^{c}	75.11$^{d e}$	77.39$^{b c}$
September	77.77^{a}	78.35^{a}	77.20$^{a b}$	76.20$^{c d}$	79.34^{a}
October	76.99$^{a b}$	77.21$^{a b}$	76.77$^{a b}$	75.31$^{d e}$	78.67$^{a b}$
November	79.25	80.71	77.79	79.24^{a}	79.26^{a}

Least Square Means.
Values followed by the same superscript do not differ significantly (P<.05).

Table 3. Protein percentages in Bluestem Grass (dry matter basis) June 1-Nov. 1

	Not fertilized	Fertilized
Not burned	5.41[c b]	5.19[c]
Burned	5.73[a b]	5.98[a]

Least Square Means
Values followed by the same superscript do not differ significantly (P<.05)

Table 4. Averaged Percent Crude Protein, (dry matter basis) June 1-Nov. 1

	Crude Protein, %
June	11.62
July	5.96
August	4.47[a]
September	4.31[a]
October	4.22[a]
November	2.89

Least square means
Values followed by the same superscript do not differ significantly (P<.O5).

Table 5. Percent Lignin in Bluestem Grass by Months June-November, 1972

June	4.66
July	5.88
August	6.61[b]
September	7.32[a]
October	6.92[ab]
November	8.49

Least Square Means
Values followed by same superscripts do not differ significantly ($P<.05$)

Table 6. Lignin Percentages in Bluestem grass, June-November, 1972

	Not fertilized	Fertilized
Not burned	7.13[a]	6.97[ab]
Burned	5.89	6.59[b]

Least Square Means
Values followed by same superscripts do not differ significantly ($P<.05$).

The Effect of Nitrogen Fertilization and Annual Burning of Bluestem Pastures on Cows, Calves, and Vegetation[1]

J. S. Woolfolk, C. E. Owensby, R. R. Schalles, L. H. Harbers, L. J. Allen, and E. F. Smith

Summary

Six native Bluestem pastures and spring-calving cows were used to evaluate effects of burning and fertilizing pastures. Two pastures were controls, two were burned, and two were burned and fertilized with 40 pounds of urea nitrogen an acre applied aerially. Average daily gains of the calves did not differ significantly among pastures. Pounds of beef produced per acre was significantly higher from the burned, fertilized pastures, which supported heavier stocking rates with increased herbage production.

Introduction

The number of cows grazing the native grass in the Bluestem pasture region of eastern Kansas has constantly increased over the years and is expected to continue to increase due to a greater demand for beef. Large feedlots and more efficient corn and sorghum forage production have resulted in young cattle being grown in feedlots, so more grass is available for cows and their calves. A combination of burning and fertilizing pastures to be grazed summer and winter might reduce investment per cow unit by increasing range efficiency, as weed control and fertilizing have increased cropland efficiency.

Experimental Procedure

Seventy-two Polled Hereford cows were divided into six groups and placed in separate Bluestem pastures prior to the 1971-'72 winter. A supplement of sorghum grain, wheat, soybean oil meal, and dehydrated alfalfa pellets was fed daily November 15 to April 15. Calving was from February 21 through April 10.

Four of the pastures were burned April 28; two were not burned. Nitrogen was applied aerially on two of the burned

[1] The following cooperated in making this study possible: Willchemco, Inc., Tulsa, Okla; Erhart Spraying Ser., Inc., Lawrence, Kans; C. K. Processing Co., Manhattan, Kans.

pastures May 17 at 40 lbs. per acre as 45% urea granules. Stocking rates were calculated from previous plot studies on herbage production under similar treatments. Pastures not fertilized were stocked at 8 acres per cow-calf. Fertilized pastures were stocked at 5.5 acres per cow-calf. Cows and calves were gathered the first week of each month, penned overnight without feed or water, and weighed the next morning. Calves were weighed, graded, and weaned October 21.

Results and Discussion

Neither burning nor burning and fertilizing significantly affected average daily gain of calves (Table 1). Pounds of beef produced per acre were significantly increased by burning and fertilizing combined. The increase was primarily from the heavier stodking rates, not individual animal performance.

Table 1. Effects of burning and fertilization of native bluestem pastures on gains of spring-born nursing calves

	Stocking rate, acres per cow	Calf gain per acre, lbs.	Adjusted Daily gain per calf, lbs.
Control	8.0	59	1.95
Burned April 28, 1972	8.0	60	1.86
Burned plus 40 lb. nitrogen per acre	5.5	87	1.88

Response of Yearling Steers to Burning, Fertilization, and Intensive Early Season Stocking of Bluestem Pasture[1]

J. S. Woolfolk, C. E. Owensby, L. H. Harbers, R. R. Schalles, L. J. Allen, and E. F. Smith

Summary

Four hundred ninety-two acres of native bluestem range were divided into nine pastures for summer grazing by yearling steers. Five pastures were burned April 28; four were not burned. Burned and not burned pastures were treated with 0, 40, or 80 lbs. of nitrogen per acre applied aerially as granular urea. Stocking rates were determined from previous work on herbage production from experimental plots under similar treatments. Both average daily gains and weight gains per acre were greater from each burned treatment than from not burned treatments with similar fertilization and stocking rate. Steers grazing an early-season-stocked pasture intensively for 76 days produced the highest average daily gain of 1.72 lbs. Highest gains per acre (137 lbs.) were on the burned pasture that received 80 lbs. of nitrogen per acre.

Introduction

Previous research has indicated that nitrogen fertilization of range grasses increases herbage yields, possibly improves forage quality, and thus, improves animal performance. Fertilizing bluestem pastures with nitrogen contributes to an unfavorable herbage composition shift towards cool-season species and some weeds. Range-burning studies have shown annual late spring burning (about May 1), coupled with moderate stocking, increases steer gains and improves range condition over unburned range stocked at the same rate. In addition, burning essentially eliminates such less productive, cool season species as Kentucky bluegrass. We studied effects from incorporating burning and fertilizing to see if beef yields would be significantly increased with no detrimental effects to range condition. We also studied effects of early-season intensive stocking on both vegetation and cattle.

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[1]The following cooperated in making this study possible: Willchemco Inc., Tulsa, Okla.; Erhart Spraying Ser., Inc., Lawrence, Kansas; C. K. Processing Co., Manhattan, Kansas; Peddicord Feedlot Inc., Wamego, Kansas.

Experimental Procedure

We used native bluestem pasture at the Kansas State University Range Research Unit near Manhattan: six pastures of 60 acres each and three of 44 acres each. The experimental treatments are described in Table 1. One nonburned, nonfertilized pasture and one burned, nonfertilized pasture were retained from previous studies to observe long time effects of burning, especially on vegetation. Those two pastures have been used 23 years for studies. Burned pastures were burned April 28, 1972. Nitrogen was applied May 17 in the form of urea granules, 45% nitrogen. Urea cost $69/ton plus $1 an acre and 2 cents a pound for aerial application. The pastures were stocked from May 2 to October 3, 1972, except the early-season intensely-stocked pasture was grazed only from May 2 to July 15, 1972. Angus steers used to stock the pastures were purchased in March at 345 pounds each and fed silage, alfalfa, and grain until May 2 when they averaged 402 pounds. The steers were gathered the first of each month, penned overnight without feed or water, and weighed the next morning.

Results

Late spring burning increased daily gain and gain per acre (Table 1). Forty pounds of nitrogen per acre seemed to increase daily gain, but 80 pounds per acre did not, but both rates increased gain per acre. Gain per acre was 43 pounds more from burned pastures with 40 pounds of nitrogen applied, and 81 pounds more with 80 pounds of nitrogen applied than from unfertilized pasture.

Highest daily gain was on the pasture stocked intensely 76 days (May 2 to July 15). More gain was produced by stocking a pasture at twice normal rate early in the growing season than at moderate rate the entire season.

Table 1. Steer gains on bluestem pasture, May 2 to October 3 (155 days) - 1972

	Daily gain per steer, lbs,	Gain per acre,lbs.	Acres per steer
Not burned			
No nitrogen, same treatment 23 years	1.15	53	3.3
No nitrogen	0.84	39	3.3
40# nitrogen per acre	0.99	68	2.2
80# nitrogen per acre	0.77	84	1.4
Burned April 28, 1972			
No nitrogen, same treatment 23 years	1.44	70	3.1
No nitrogen	l.23	56	3.3
40# nitrogen per acre	1.42	99	2.2
80# nitrogen per acre	1.27	137	1.4
Intensely stocked early 76 days, May 2 to July 15	1.72	79	1.7

Predicted Digestible Energy and Protein Intakes of Steers Grazing Bluestem Pastures

L. H. Harbers and M. R. Rao

Summary

Digestible protein and energy intakes by steers grazing native bluestem pastures were estimated using prediction equations established at this station. Digestible energy intakes appear to be satisfactory for yearling steers on burned and unburned pastures. Digestible protein intake is probably greater on burned than on unburned pastures; however, that nutrient becomes limiting during the grazing season.

Introduction

Determining forage consumption by a grazing farm animal has been the major obstacle to using modern nutritional knowledge to improve performance. Because animals graze selectively, hand sampling is not valid, so trial and error methods are the major means of improvement. Over the past two summer grazing seasons, we have combined recently developed experimental techniques to predict intake.

Methods

Samples of forages from esophageally-fistulated animals and regression equations developed by us and others have made it possible to predict organic matter intake and digestibility. Fron digestibility studies using hays cut at differing stages of maturity, we (KAES Bull. 557, 1972, p. 6), have estimated digestible energy and protein available.

Results

The data presented represent control and burned pastures the first grazing season. Temperature and precipitation were near expected values. We present the probable digestible energy and protein intakes, based on a 440 lb. steer gaining 1.1 lb./day. Figure 1 shows that digestible energy intake is greater from the burned pasture than from nonburned control pastures until August; after that there seems to be no difference in energy intake. Energy probably is not limiting for 1.1 lb./day gains with steer grazing systems usually used in the Flint Hills area.

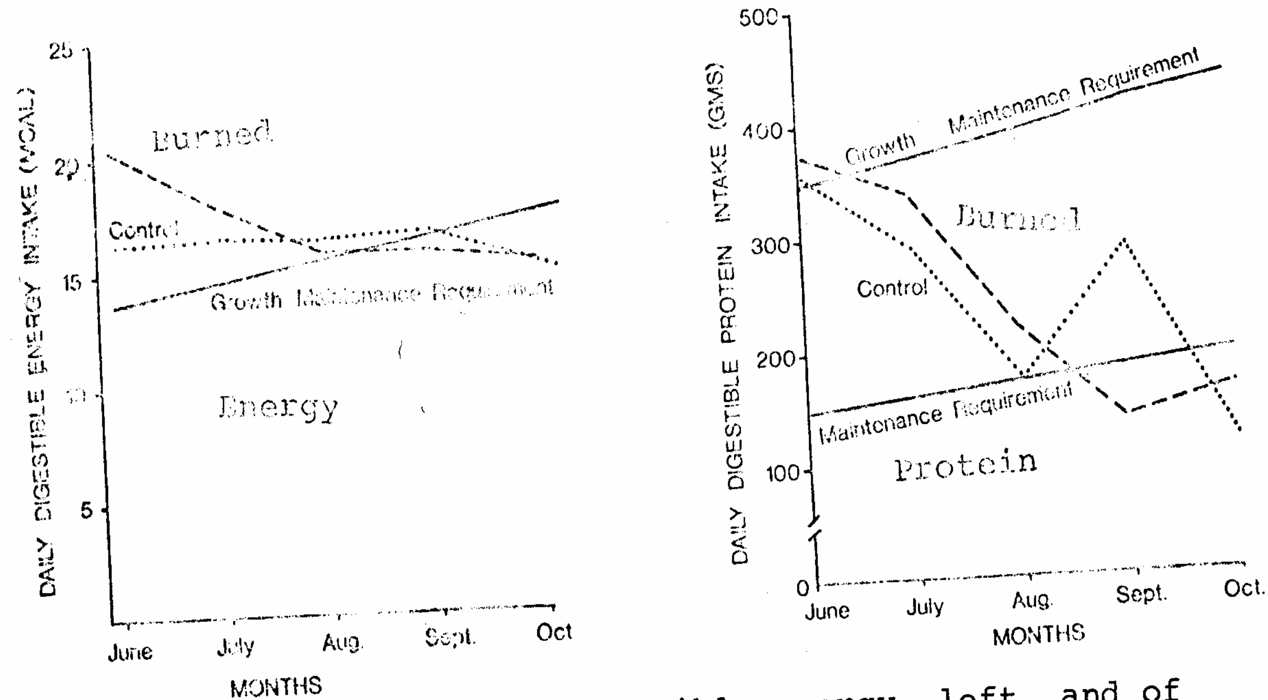

Figure 1 . Amount of digestible energy, left, and of digestible protein, right, required for maintenance plus 1.1 lb. daily gain by a 440-lb. yearling steer and the amounts range forage probably furnishes.

Figure 2 shows the theoretical digestible protein intake by steers. It is consistently higher from burned than from unburned pastures through August. By July, digestible protein intake becomes limiting in both. When protein becomes limiting cannot be determined exactly because of differences in previous pasture management, stocking rate, rainfall, etc.

Calcium and phosphorus intakes may also be important because hays cut at differing stages of maturity indicate balance changes (KAES Bull. 557, 1972, p. 9). Phosphorus balance was negative in animals fed June and September hays while calcium balance was negative when animals were fed September hay. Animals on July hay were in positive balance for both minerals. Salivary contamination prevented us from studying calcium and phosphorus so our implication of imbalances is from indirect evidence only.

Our data suggest that protein is one of the factors limiting steer growth late in the summer grazing period. Feeding protein supplements to steers from August to October usually has been successful but probably not economical (KAES circ. 335, 1956, p. 16; circ. 349, 1957, p. 28).

Protein Blocks for Gestating Beef Cows Wintered on Bluestem Pasture: Soybean Meal and Starea(R) Compared

E. L. Shiawoya, L. H. Harbers, J. D. Evans, and R. M. McKee

Summary

Pregnant Hereford and Angus cows wintered on native bluestem pasture were used to compare soybean-meal and Starea-containing blocks as protein supplements. Cow weight changes were similar with both supplements. Consumption of Starea supplement declined throughout the trial, while soybean meal block consumption remained constant.

Introduction

A previous trial comparing soybean meal, urea, and Starea in concentrate supplements for wintering range cows (KAES Bull. 557, 1972, p. 48) indicated that Starea is similar to soybean meal in maintaining cow weights during gestation and in producing calves with similar weaning weights. Those results are encouraging as urea is usually inferior to natural proteins when fed to adult ruminants consuming poor quality roughages.

Because of the interest in feeding supplements to wintering cattle in blocks rather than in meal mixtures and because the cost of protein supplements has risen so much, we compared soybean meal and Starea blocks* as supplements for gestating cows grazing Flint Hills range.

Methods

Fifty-two pregnant cows (Hereford and Angus) were divided according to weight (1,026 lbs. average) and age (5 years) into two groups of 26 animals each. One group had access to soybean blocks; the other, blocks containing Starea, as main sources of nitrogen. Blocks were kept in open troughs. Compositions of the two blocks are given in table 1. Each 28 days the cows were weighed and rotated between the two pastures to minimize effects of grazing areas on cow weight changes. Salt and minerals were available in other boxes. Hay was fed only when snow cover prevented grazing. Cow weights and block consumptions were collected. Extra blocks were exposed only to the weather to measure that variable. Other data to be collected include calf birth and weaning weights, percentage calf crop, cow breeding dates, and percentage of cows rebred.

(R) - an extruded milo-urea processed material
* - blocks supplied by Dr. Lyle Helmer, Far-Mar-Co, Hutchinson, Kansas.

Results

When the experiment started, no ammonia toxicity was apparent in the Starea-fed group. Those animals were observed for the first hour after exposure to blocks. Of the 26 cows, two ate for only 5 minutes while most spent 25-30 minutes on the blocks before starting to graze. Starea-fed animals were driven 3/4 mile to the supplement. After eating, they stood and panted several seconds, then moved on to graze. The soybean-supplemented group was not observed.

During the first 28 days (Oct. 24-Nov. 21), both groups gained weight (table 2) -- those on soybean meal, an average of 0.39 lb/hd/day (11 lbs/hd/mo); those on Starea, an average of 0.57 lb/hd/day (16 lbs/hd/mo). Block consumption was similar; soybean meal and Starea-fed groups consumed 2.30 and 2.37 lbs/hd/day, respectively. Consumption may be lowered by using harder blocks.

Adverse weather caused both groups to lose weight the second 28 days. Consumption of soybean meal blocks was similar to the first 28 days; Starea block intake dropped to 2.02 lbs/hd/day. The first 56 days (Oct. 24-Dec. 19), cows receiving the soybean meal blocks lost 26 lbs. (-0.46 lb/hd/day); those fed Starea blocks lost 15 lbs. (-0.27 lb/hd/day).

Continued inclement weather the third period caused additional weight losses. Soybean supplemented cows lost 12 lbs. each (-0.50 lb/hd/day); those fed Starea blocks, 34 lbs. (-1.42 lbs/hd/day). Consumption of soybean blocks remained similar to that in other periods while Starea block consumption dropped to 1.36 lbs/hd/day. Hay was supplied most of that time as snow and ice permitted only sporadic grazing.

Weight losses during the 84-day trial were 38 lbs. each by soybean-fed animals and 49 lbs. each for Starea-fed ones. Such losses are expected in the Flint hills area when winter weather is severe. Depressed intake of Starea blocks may result from the consistency of extruded grains when dampened. The material becoming sticky may affect intake. A recently completed trial at the Illinois Station found similar consumption when both supplements were fed in a covered area.

Losses in block weights due to weather exposure (table 3) are not consistent but not excessive. The reason for the smaller loss of the starea block during the third period may be due to the adhesive characteristics of the extruded milo grain.

Table 1. Composition of soybean and Starea blocks fed to wintering cows.

Ingredient	Nitrogen source: Soybean meal	Nitrogen source: Starea
Soybean meal	48%	-----
Milo Starea-70	--------	50%

Urea	5.0%	----
Sorghum grain	17.9%	19.9%
Cane molasses	7.5%	7.5%
Salt	12.5%	12.5%
Dicalcium phosphate	6.0%	7.0%
Trace minerals	1.0%	1.0%
Bentonite	2.0%	2.0%
Vitamin A	37,000 I.U./lb.	37,000 I.U./lb.
Vitamin D	12,000 I.U./lb.	12,000 I.U./lb.

Table 2 . Weight changes and protein block consumption by cows grazing bluestem pasture.

Indicated factor	Nitrogen source: Soybean	Nitrogen source: Starea
No. of cows	26	26
Avg. age (yrs.)	5.07	5.11
Avg. initial wt. (lbs)	1025	1028
Avg. final wt. (lbs)	987	979
Wt. change (lb/hd/period)		
Oct. 24-Nov. 21	+11	+16
Nov. 21-Dec. 19	-37	-31
Dec. 19-Jan. 11	-12	-34
Oct. 24-Jan. 11	-38	-49
Block consumption (lb/hd/day)		
Oct. 24-Nov. 21	2.30	2.37
Nov. 21-Dec. 19	2.27	2.02
Dec. 19-Jan. 11	2.40	1.36

Table 3 . Weight loss of blocks (lbs/mo) exposed to weather.

Period	Soybean	Starea
Oct. 24-Nov. 21	7.50	11.50
Nov. 21-Dec. 19	1.25	1.00
Dec. 19-Jan. 11	8.00	0.50

Winter Nutrition of Spring Calving Cows on Flint Hills Range

D. L. Davis, R. R. Schalles, C. L. Drake, Guy Kiracofe, B. E. Brent, Miles McKee, and Jack Evans

Summary

Energy appears to be the limiting factor in the rations studied. Three lbs. of milo was superior to 1½ lbs. of soybean meal when date of breeding was considered. In the second trial 3 lbs. of alfalfa and 6 lbs. of milo was superior to 3 lbs. of alfalfa hay and 3 lbs. of milo. Delaying feeding grain until after calving did not give satisfactory results. Possibly additional energy was supplemented too late to be effective.

Introduction

One of the greatest costs in a cow-calf operation is winter feed for the cow. It is desirable to feed as little as possible to maintain satisfactory performance. Increased costs of protein supplements make it more important to evaluate various levels of energy and protein supplement. In this 4-year study, we investigated wintering ration components for cows on Flint Hills pasture.

Experimental Procedure

Eight wintering rations, four per two-year trial, were studied from 1968-1971. Spring-calving Polled Hereford cows were allotted randomly by age to one of the four rations in each trial. Cows were randomly assigned to breeding groups approximately May 20 each year and exposed to bulls. Statistical corrections were made for bull exposed to, year, age, and whether or not a cow calved.

The end points considered here are conception percentages and day of the year conception occurred. Day of conception was calculated using a 283-day gestation period and the day a cow calved the following year. Only cows that calved and rebred were included.

Rations studied in 1967-68 and 1968-69 were designed to compare energy and protein levels (Table 1).

Rations in the second trial were based on the results of Trial 1 (Table 2). Ration 7 had a higher energy level than any ration in Trial 1. Ration 5 was the same as Ration 2 in Trial 1 and Ration 6 was an all-concentrate ration including urea, formulated to approximate Ration 5 (Table 3). Ration 8 studied the timing of energy supplementation. Cows on Ration 8 started receiving 6 lbs. of milo in addition to their alfalfa hay within one week after calving.

Results

Nutritional treatments significantly affected day conceived. Rations 2 and 1 were significantly superior to both Rations 3 and 4 and Ration 3 was significantly better than Ration 4. Rations 6 and 7 tended to be superior to Rations 5 and 8 although not significantly so.

Cows on Ration 8 conceived significantly later than cows on Rations 6 and 7. Cows on Ration 5 bred significantly later than those on Ration 7.

Day calved significantly affected day bred. Cows concieved an average of 3 to 5 days later for every 10 days calving was delayed, with the most effect on 2-year-old cows.

Table 1. Breeding Results of Trial One

Items	Ration 1	2	3	4
Soybean meal, lb.	1½	---	1½	---
Milo, lb.	3	3	---	---
Alfalfa hay, lb.	3	3	3	3
No. Cows	33	32	32	31
Conception, %				
2 yr. old	95	99	92	68
3 yr. old	100	96	100	100
4 yr. old	69	63	93	81
Avg. conception date	June 11	June 10	June 20	June 30

Table 2. Breeding Results of Trial Two

Items	Ration 5	6	7	8
Mix[a], lb.	---	5	---	---
Milo, lb.	3	---	6	6 after calving
Alfalfa hay, lb.	3	---	3	3
No. cows	46	48	43	38
Conception, %	92	98	100	88
Avg. conception date	June 17	June 13	June 7	June 22

[a] given in table

Table 3. Ingredients of Mix Fed in Trial Two

Feed	1969 - 70 mix	1970 - 71 mix
Milo	85.5%	70.5%
Wheat	---	15.0
Dehy alfalfa	9.5	---
Alfalfa hay	---	9.5
Urea	1.0	1.0
Limestone	2.0	2.0
Molasses	2.0	2.0

EFFECTS OF VARIOUS UTERINE TREATMENTS ON CALVING-TO-CONCEPTION INTERVAL

Guy Kiracofe, G. R. Brower, and R. R. Schalles

Summary

Cows were given intrauterine infusions of enzymes, antibacterials, bacteria, or a combination of enzymes and antibacterials after calving to study basic changes in the post-partum uterus and effect on rebreeding. The group given nitrofurazone, an antibacterial compound, had the highest conception rate; however, calving-to-conception interval was lengthened. Combining proteolytic enzymes with the nitrofurazone gave an interval to conception similar to that of control cows. Nitrofurazone caused the uterine lining to erode. Combining enzymes with nitrofurazone prevented some of the erosion.

Innoculating the uterus with bacteria (Lactobacillus acidophilus) after calving did not affect the calving-to-conception interval.

Introduction

Failure to produce a calf and long calving intervals are costly in beef production. A cow normally is infertile 50 to 60 days after calving. Any complications that interfere with normal involution of the uterus or return to estrus further delay rebreeding. After calving the uterus must reduce in size, slough necrotic tissue, and regenerate a new lining for that lost. Sloughing necrotic tissue and bacterial content of the uterus after calving may be important in both the uterine involution process and regenerating new tissue to maintain the next pregnancy. We studied effects of an intrauterine infusion of nitrofurazone and/or proteolytic enzymes or Lactobacillus acidophilus on uterine repair and rebreeding.

Methods and Materials

Trial 1. Forty-five cows were alloted to one of four groups at parturition and administered either intrauterine infusions of (1) saline, (2) nitrofurazone, (3) alpha-chymotrypsin and collagenase or (4) alpha-chymotrypsin plus collagenase and nitrofurazone. The saline infused group served as controls. Infusions were given the first, second, and third weeks post-partum in volumes of 100, 50, and 25 ml., respectively. The proteolytic enzymes (Worthington Bio. Chem. Corp.; Freehold, N. J.) were administered in a concentration of mg per ml of sterile saline. Twenty-five ml of 0.2% Furacin solution (Eaton Lab; Norwich, N. Y.) was also diluted to the above volumes. Crystalline proteolytic enzymes were dissolved and combined not more than 24 hours before infusion.

The time of ovulation and diameter of the pregnant and nonpregnant uterine horns were determined at 7-day intervals after calving by rectal palpation. Uterine biopsies were obtained at 14, 21, and 28 days postpartum. Intervals from calving to ovulation, estrus, uterine involution, and conception were determined.

Trial 2. All pregnant cows were corralled once a week; those that had calved the previous week were placed in one of three uterine-treatment groups: (1) untreated controls, (2) Lactobacillus acidophilus in M.R.S. broth or (3) Lactobacillus acidophilus grown in M.R.S. broth and resuspended in 0.1% peptone water. The stock culture of Lactobacillus acidophilus was of bovine uterine origin and was administered at a rate to insure a minimum of 1.5×10^8 bacteria.

Results and Discussion

Trial 1. The uterine treatment had no statistically significant effect on intervals from parturition to either ovulation or estrus or on uterine involution (Table 1). Mean intervals from parurition to ovulation and to estrus were 22.7 and 31.4 days, respectively. Ovulations observed within the first 20 days postpartum were on the side of the previously nongravid horn in 92% of the cases. Although nitrofurazone-treated cows had best conception rates, nitrofurazone significantly lengthened the parturition-to-conception interval over controls, enzyme-treated, and enzyme-plus-nitrofurazone-treated groups.

Palpation data indicated that uterine regression was complete (previously pregnant horn less than 40 mm) by an average of 30 days postpartum; however, the epithelial lining of the uterus was still eroded. Nitrofurazone treatment increased tissue loss and lengthened the time required to obtain a complete uterine lining. Concurrent treatment with enzymes decreased the nitrofurazone-induced erosion.

Infusion of nitrofurazone or proteolytic enzymes or both to clinically normal cows did not shorten the calving-to-conception interval; however, the nitrofurazone-treated group took longer to rebreed. Two theories are proposed for the delayed breeding: (1) nitrofurazone may have caused local inflammation in the uterus which eroded the uterine lining and delayed uterine repair, while enzymes given concurrently had an anti-inflammatory response or (2) nitrofurazone eliminated bacteria that produce beneficial enzymes that aid in uterine cleaning and repair.

Nitrofurazone treatments only interference with conception was delaying rebreeding. Intrauterine treatment with antibacterials seems to delay fertility but then it returns and may be improved.

Trial 2. Conflicting reports on bacterial populations of the uterus, effects of uterine bacteria and of antibacterials on uterine bacteria led to a pilot study to identify bacterial populations of the postpartum uterus. The pilot study revealed that Lactobacillus sp. were prevalent. They are acid producing bacteria reported to be a common constituent of vaginal flora that are a natural defense against infection.

Table 1

Effects of Proteolytic Enzymes and Nitrofurazone on Intervals from Parturition to Ovulation and to Estrus and on Uterine Involution

Treatment groups	No. of cows	First ovulation	First estrus	Uterine involution	Conception	No. cows not rebred
Control	13	18.8 ± 3.3[a]	27.0 ± 3.8	25.8 ± 3.6	53.8 ± 4.3	2
Nitrofurazone	10	25.6 ± 3.1	36.1 ± 4.2	31.5 ± 4.1	72.8 ± 4.7*	0
Chymotrypsin & Collagenase	10	24.5 ± 3.0	31.8 ± 4.0	30.5 ± 3.5	60.1 ± 4.9	2
Nitrofur. + Chy. & Coll.	12	22.0 ± 3.2	30.7 ± 3.6	32.9 ± 4.1	53.2 ± 4.4	1

[a]Values represent days postpartum ± S. E.
*Differ significantly from controls ($P < .05$)

A second study then evaluated effects of intrauterine administration of *Lactobacillus acidophilus* on interval to conception.

The intrauterine innoculation of *Lactobacillus acidophilus* in either 0.1% peptone water or M.R.S. broth did not alter the average parturition-to-conception interval (Table 2). Uteri of treated cows appeared to involute normally and more rapidly than those of untreated cows. Although sloughing of necrotic tissue was not measured histologically, rectal palpation indicated it was more rapid in treated than in untreated uteri.

The treatment regimes in clinically normal cows did not significantly shorten the parturition-to-conception interval; however, the anti-inflammatory properties of the proteolytic enzymes, as well as innoculation with specific types of bacteria, deserves serious consideration in the treatment of cows with clinically abnormal uteri.

Table 2

Effect on Rebreeding after Calving of Uterine Innoculation with *Lactobacillus Acidophilus* (LA)

Treatment	No. of cows	Days from calving to conception ± SE
Control (No treatment)	11	54.7 ± 4.1
LA in peptone water	11	55.8 ± 5.5
LA in MRS broth	10	53.6 ± 2.5

Supplemental Feed for Calves Prior to Weaning

John S. Woolfolk, Ken Conway,
R. R. Schalles, and E. F. Smith

Summary

A mixture of 60% dehydrated alfalfa crumbles and 40% dry rolled sorghum grain was fed ad lib to calves 30 days before weaning. The calves ate an average of 2.6 lbs. per day and gained 0.32 lbs. more per day average during the 30 days than calves receiving no supplemental feed. During the next 30 days all calves received the ration ad lib. Calves continuing on the ration gained 0.48 lbs. more per day average than those that had received no supplement before weaning.

Introduction

Changing diet from milk and grass to other feeds imposes stresses on calves at weaning. Could the stresses be reduced by introducing post-weaning feed to calves before weaning? We attempted to find the answer to that question.

Experimental Procedure

Seventy-two Polled Hereford cows with spring calves were divided into Groups A and B to graze native bluestem range. Thirty days before weaning date, creep feeders were placed in the pastures with Group A. Thirty-two calves had access to the feeders, which contained a ration of 60% crumbled dehydrated alfalfa and 40% dry-rolled sorghum. grain with soybean oil added as needed to reduce dustiness.

After weaning (October 21, 1972) the calves were kept in their respective groups, put into drylots, and both groups were fed the ration free choice thirty (30) days.

Weights were taken at the start of the trial, weaning, and 30 days after weaning.

Results and Discussion

The first 30 days of the trial (just before weaning) Group A ate 2.60 lbs. (average) of the creep ration per head per day. The next 30 days (after weaning) Group A averaged 11.2 lbs. of feed per head per day compared with 10.5 lbs. average for Group B.

Group A averaged 75.0 lbs. average per head (1.25 lbs. ADG) for the 60 days compared with 48.0 lhs. average (0.80 lbs. ADG) for Group B. Gain on pasture before weaning by Group A was 55.31 lbs. per head (1.84 lbs. ADG) compared with 45.6 lbs. per head (1.52 lbs. ADG) for Group 3. The difference in gains was large the 30 days in drylot after weaning. Calves in Group A gained an average of 26.1 lbs per head (0.92 lbs. ADG); those in Group B, an average of 13.2 lbs. per head (0.44 lbs ADG).

Gains in the first 30 days did not differ significantly but gains for Group A were significantly (P .05) higher for both the 30 days in the drylot and the entire 60-day period.

Influence of Fly Control on Incidence of Pinkeye and on Calf Performance

R. R. Schalles, Miles McKee, Jack Evans, D. L. Davis, and C. W. Pitts, Jr.[1]

Summary

Controlling flies significantly decreased incidence of pinkeye in cattle on native Flint Hill range. There was no difference in the average weaning weight of groups sprayed or not sprayed. However individuals severely affected with pinkeye were much lighter than the average.

Introduction

Some type of fly control is usually recommended for cows and calves on summer pasture in Kansas. However the value of fly control is not well established. Nor have the relationships between fly control and incidence of pinkeye or between fly control and calf performance been evaluated. We studied those relationships for this report.

Experimental Procedure

Sixty-two yearling heifers and cows with 32 calves were sprayed with 44% Rabon as needed to control flies (every 7 to 14 days from May 15 to September 20). No fly control was used with another group of 62 yearling heifers and cows with 34 calves.

Cattle were checked several times a week. Individuals with pinkeye were treated with ½ to 1 cc subconjunctival injection of antibiotic-corticosteroid mixture (dosage varied by size of animal).

Calves grazed spring-burned, native Bluestem pasture. All Cattle were weighed each month and the calves were weaned October 21 at an average age of 208 days.

Results

About 10% fewer cows had pinkeye in the fly-control group. Approximately 70% of the calves in each group had pinkeye; however those in the no-fly-control group averaged having pinkeye 2.3 times each, while those in the fly-control group averaged having pinkeye 1.6 times. Calves in the fly-

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[1]Department of Entomology

control group required 1.44 treatments per case of pinkeye compared with 1.74 treatments for those in the no-fly-control group. Sixty-four percent of all pinkeye treatments were on cattle in the no-fly-control group.

Greatest advantage of fly control in reducing pinkeye was early summer. Before July 15, 84% of the pinkeye treatments were on cattle in the no-fly-group. Cases of pinkeye were most numerous the last half of July. After July the incidence of pinkeye decreased and occurred about equally in both groups.

Average weaning weights of calves did not differ between groups, probably because most calves completely recover from pinkeye. However, some are permanently affected with impaired vision. In this study one calf was blind and had a 205-day adjusted weight 120 lbs. less than the average.

Because so many animals required treatment for pinkeye, both groups were handled about the same number of times.

Worming Steers Grazing Summer Bluestem Pasture

E. F. Smith and J. S. Woolfolk

One hundred and sixty-three black steers averaging 402 pounds were grazed from May 2 to October 3, 1972, on native bluestem pasture. They were assembled by a buying firm in Memphis, Tenn., and delivered March, 1972, averaging about 350 pounds. They were fed corn silage, alfalfa hay, and about 5 pounds of grain each daily until started on test May 2. They were alloted to different pastures described in Table 1. Even numbered steers in each pasture (about half) received one bolus of thiabendazole (15 grams) as a worming agent.

The worming agent did not significantly affect gains.

Table 1. Effect of worming on steers grazing summer bluestem pasture May 2 to October 3, 1972, (155 days)

	Total no. of steers[1]	Received thiabendazole Avg. daily gain, lbs.	No thiabendazole Avg. daily gain, lbs.
Nonburned pasture,			
no nitrogen applied	30	0.93	1.00
40# N/Acre	20	1.00	0.99
80# N/Acre	42	0.77	0.75
Burned pasture,			
no nitrogen applied	26	1.30	1.28
40# N/Acre	14	1.45	1.39
80# N/Acre	31	1.27	1.28

[1]Even numbered steers under each treatment received thiabendazole.

Four Forage Sorghum Silage Additives Evaluated

K. K. Bolsen, J. G. Riley and J. D. Hoover

Summary

Two trials were conducted to evaluate four forage sorghum silage additives: ammonium iso-butyrate, aureomycin, sodium hydroxide, and a mixture of acetic and propionic acids. A control silage received no additives.

In an animal performance trial, each of the five silages was fed to 15 heifer calves for 112 days. All heifers were full-fed silage plus 4 lb. of rolled milo and 2 lb. of a soybean meal supplement daily. There were no significant differences in gain or feed consumption. Heifers receiving sodium hydroxide silage required more feed per lb. of gain ($P<.05$) than those receiving ammonium iso-butyrate or organic acid silages. Feed cost per 100 lb. gain was lowest for heifers fed the silage with no additive.

In a digestion trial, each silage was fed to 3 wether lambs in two, 12-day preliminary and 7-day collection periods. Digestion coefficients for dry matter, organic matter, and nitrogen retention were not influenced by silage treatment; however, crude protein digestibilitv was lower ($P<.05$) for lambs fed the sodium hydroxide silage ration than for lambs fed any of the other four silage rations.

Silage analyses showed pH, ash percentage and butyric acid percentage highest in the sodium hydroxide silage.

These results indicate that feeding values of forage sorghum silage were not significantly improved by any of the four additives.

Introduction

Many factors affect the fermentation and quality of corn and forage sorghum, the two principal silage crops in Kansas. Five of the factors are plant maturity and moisture content at harvest, fineness of chop, type of storage structure, and anaerobic conditions. Previous research with silage additives has focused on developing acid conditions in the silage or minimizing production of undesirable fermentation end-products.

The four additives evaluated in these experiments may inhibit mold growth and alter fermentation or change the chemical structure and nutritive value of the silage.

Experimental Procedure

All forage sorghum used was grown in the same location and was the same variety. It was harvested between September 17 and 24, 1971, to minimize plant maturity differences between the silage treatments. Approximately 50 tons of each silage were ensiled in upright, concrete stave silos (10 ft. x 50 ft.) at about 68% moisture (at harvest). The forage chopper had a 2-inch recutter screen.

The silage treatments were:

Silage Treatment	Description
1	Control - no additive
2	Ammonium iso-butyrate (AIB)[1], 10 lb. per ton of wet forage
3	Aureomycin, 1 gram per ton of wet forage (1 gm of aureomycin premixed with 1 lb. of finely ground milo)
4	Sodium hydroxide (NaOH), 28 lb. per ton of wet forage
5	Organic acid mixture[2,3], 30 lb. per ton of wet forage

The additives were added at the silo blower.

Trial 1. Seventy-five Hereford heifers averaging 411 lb. were used in a 112-day growing trial beginning January 19, 1972. Three pens of five heifers each were randomly assigned to each of the five silage treatments. All rations contained a full feed of the appropriate silage, 4 lb. of rolled milo and 2 lb. of supplement (table 1) daily. Grain was added to assure a minimum average daily gain of 1.70 lb. No attempt was made to neutralize the sodium ions in the NaOH silage or to compensate for the additional nitrogen in the AIB silage. The rations were mixed and fed twice daily. Initial and final weights of heifers were taken after 15 hours without feed or water; 28-day, intermediate weights were taken after the a.m. feeding.

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[1] Supplied by W. R. Grace and Co., Washington Research Center, Clarksville, Md.

[2] Organic acid mixture (trade name - ChemStor) contains 60% acetic and 40% propionic acids.

[3] Supplied by Celanese Chemical Co., Corpus Christi, Texas.

Trial 2. Fifteen Ramboullet wether lambs averaging 90 lb. were used in a digestion and nitrogen balance trial. Each of the five silage treatments was fed to three lambs in two, 12-day preliminary and 7-day collection periods. The rations contained 78 percent silage and 22 percent soybean meal based supplement (dry matter basis). During each preliminary period, silage was offered free-choice from day 1 through day 10. Silage voluntary intake was determined for each lamb on days 8, 9, and 10.

Results

Chemical analyses of the silages are shown in table 2. Only slight differences were obtained in proximate and structural components among the five silages. Ash content was highest and neutral detergent fiber content lowest in the NaOH silage. Crude protein analysis indicates that only about 20 percent of the nitrogen in the AIB was recovered in the silage after fermentation and storage. AIB contains 84 percent crude protein equivalent so the calculated crude protein in the AIB-treated silage when ensiled was 6.40 percent. Its crude protein content was 5.40 percent when fed.

Acid percentages in the silages after fermentation varied widely. The control and aureomycin-treated silages had similar amounts of acetate, lactate and butyrate. The AIB-treated silage contained 1.46 percent iso-butyrate. The NaOH-treated silage had the highest pH (6.40), the highest percentage butyrate, and only traces of lactate. It was also a much darker color (dark brown to black) than the other four silages.

Performance of heifers in trial 1 is shown in table 3. None of the differences in daily gain or feed consumption differed significantly. Heifers fed AIB and organic acid silage rations tended to gain faster than heifers fed the other three silage rations. NaOH silage was consumed in the largest amounts; but heifers fed this silage required more feed per lb. of gain ($P<.05$) than those fed AIB or organic acid silages. Also, consumption was more variable between pens of heifers being fed the NaOH silage than those fed the other silages. Heifers fed the control silage ration had the lowest feed costs per 100 lb. of gain. Adding NaOH or the organic acid mixture increased feed costs 18 and 8 percent, respectively.

Results of trial 2 are presented in table 4. Apparent digestion coefficients for dry matter and organic matter were not significantly affected by silage treatment. Crude protein digestibility was significantly lower ($p<.05$) and percentage of nitrogen retained tended to be lower in lambs fed the NaOH silage ration than in those fed any other ration. Lambs fed NaOH silage consumed 14 to 20 percent more silage dry matter during the preliminary periods than any other group.

Table 1. Composition of the Supplement.

Ingredient	% (dry matter basis)
Soybean meal	64.62
Rolled milo	29.42
Limestone	1.75
Salt	2.50
Fat	1.00
Trace Mineral Premix	0.25
Chlortetracycline[a]	0.35
Vitamin A Premix[b]	0.11

[a]Formulated to supply 70 mg. per heifer per day.
[b]Formulated to supply 30,000 IU per heifer per day.

Table 2. Silage Analyses (Dry Matter Basis).

Item	Silage treatment				
	Control	AIB	Aureomycin	NaOH	Organic acid
Dry matter, %	32.6	31.3	31.9	31.9	31.6
Ash, %	7.9	8.0	7.9	10.4	6.1
Crude protein, %	5.2	5.4	5.1	5.2	5.2
Crude fiber, %	27.3	27.5	27.3	27.2	25.0
Neutral detergent fiber, %	63.6	62.7	60.7	58.9	62.1
Acid detergent fiber, %	38.7	34.5	35.9	37.6	32.9
Lignin, %	7.5	5.8	6.0	7.3	6.0
pH	4.19	4.17	4.10	6.40	4.10
Acetate, %	0.81	0.98	0.92	2.12	1.88
Propionate, %	----[a]	----[a]	----[a]	0.44	1.19
Lactate, %	4.00	4.24	3.75	Trace	Trace
Butyrate, %	0.12	----[a]	0.17	4.08	Trace
Iso-butyrate, %	----[a]	1.46	----[a]	----[a]	----[a]

[a]None detected.

Table 3. Heifer Performance (Trial 1).

Item	Silage treatment				
	Control	AIB	Aureomycin	NaOH	Organic acid
No. of heifers	15	14[a]	15	15	15
Initial wt., lb.	408	408	408	423	406
Final wt., lb.	613	622	611	620	627
Avg. total gain, lb.	205	214	203	197	221
Avg. daily gain, lb.	1.83	1.91	1.81	1.76	1.97
Avg. daily feed[b]					
Silage, lb.	9.41	9.03	9.27	10.02	9.06
Milo, lb.	3.40	3.40	3.40	3.40	3.40
Supplement, lb.	1.74	1.74	1.74	1.74	1.74
Total, lb.	14.55	14.17	14.41	15.16	14.20
Feed/lb. gain, lb.	7.9[c,d]	7.43[c]	8.02[c,d]	8.62[d]	7.20[c]
Feed cost/100 lb. gain[e], $	19.34	19.37	19.50	22.95	20.91

[a]One heifer died (accidental cause).
[b]Dry matter basis.
[c,d]Means in the same row with different superscripts differ significantly ($P<.05$).
[e]Feed prices per ton: control silage, $10; AIB silage, $11.50; Aureomycin silage, $10.04; NaOH silage, $12.60; organic acid silage, $14.50; milo, $50; and supplement, $150.

Table 4. Ration Digestibility, Nitrogen Retention, and Voluntary Silage Dry Matter Intake by Lambs (Trial 2)[a]

Item	Silage treatment				
	Control	AIB	Aureomycin	NaOH	Organic acid
Apparent digestion coefficients					
Dry matter, %	64.6	63.3	65.5	67.3	65.0
Organic matter, %	66.4	65.2	67.4	67.8	65.6
Crude protein, %	72.7[b]	71.6[b]	72.9[b]	65.9[c]	70.3[b]
Nitrogen retained, %	41.7	41.2	44.1	39.4	41.5
Voluntary silage dry matter intake[d]	100	105	106	120	100

[a] Each value is the mean of six observations.
[b,c] Means in the same row with different superscripts differ significantly ($p<.05$).
[d] Control silage valued 100; intake of the other silages reported as percentage of the control.

Effects of Organic Acids on the Preservation and Feeding Value of Dry and High-moisture Milo[1]

O. J. Cox, K. K. Bolsen, J. G. Riley and D. B. Sauer

Summary

The four milo treatments studied were: (1) artificially dried, (2) artificially dried + organic acids, (3) high-moisture ensiled and (4) high-moisture + organic acids. The dry milo and high-moisture milo contained 14 and 24 percent moisture, respectively. Milo in treatments 1, 2, and 4 was stored in unlined concrete bins; milo in treatment 3 was ensiled in an air-tight silo.

Each of the four grain treatments was fed to 15 yearling steers (avg. weight - 700 lb.) for 104 days. The final rations contained 82 percent of the appropriate milo, 13 percent silage and 5 percent supplement, Steers receiving high-moisture milo rations gained faster and more efficiently and had higher dressing percentages than steers receiving dry milo rations. Steers fed organic acid-treated milo rations consumed more feed but were less efficient than steers fed untreated milo rations. Carcass quality and yield grades were not affected by grain treatment.

After three months of storage, high-moisture milo treated with organic acids had developed some mold and spoilage adjacent to the bin wall. Moving the grain to a polyethylene-lined bin prevented further deterioration.

Introduction

The effectiveness of an organic acid mixture[3] as a preservative for reconstituted milo was reported in the 1972 Cattleman's Day Bulletin (557). Steers fed reconstituted milo either ensiled in an air-tight silo or treated with organic acids had similar feedlot performance.

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[1]Organic acids and financial support provided by Celanese Chemical Company, Corpus Christi, Texas,

[2]USDA Grain Marketing Research Center and Department of Plant Pathology.

[3]Organic acid mixture (trade name - ChemStor) contains 60% acetic and 40% propionic acids.

The purposes of this study were: (1) to evaluate the organic acid mixture[4] as a preservative for field-harvested, high-moisture milo and (2) to determine the feeding value of the preserved grain for finishing beef cattle.

Experimental Procedures

Sixty yearling steers of Hereford and Angus breeding weighing an average of 700 lb. were randomly allotted by weight to twelve pens of five steers each. Three pens were randomly assigned to each of the following milo treatments: (1) artificially dried, (2) artificially dried + organic acids, (3) high-moisture ensiled and (4) high-moisture + organic acids.

All grain was harvested from one source at approximately 24 percent moisture and divided into four 1,000-bushel lots. Lots 1 and 2 were artificially dried to 14 percent moisture and stored in concrete bins; lot 2 was treated with the organic acid mixture at 1.4 percent by weight before storage. Lot 3 was ensiled in an air-tight silo, and lot 4 was treated and stored similarly to lot 2. All grain was stored whole and rolled before being fed.

The steers received a starting ration containing 50 percent of the appropriate milo, 45 percent forage sorghum silage and 5 percent supplement (table 1). Milo was gradually substituted for silage the first 14 days until the steers were on the final full-feed rations containing 82 percent milo, 13 percent silage and 5 percent supplement on a dry matter basis. All rations were mixed and fed twice daily. Urea supplied 60 percent of the crude protein equivalent in the supplement. Each steer was implanted with 30 mg of stilbesterol two weeks before the 104-day feed period began.

Initial and final weights of the steers were taken full on two consecutive days. Final live weights were adjusted to a 59.95 percent dress and feedlot performance was calculated on that basis.

Results

Feedlot performance is presented in table 2. Steers fed high-moisture milo (rations 3 and 4) gained faster ($P<.10$), consumed less feed ($P<.01$), were more efficient ($P<.01$) and dressed higher ($P<.01$) than steers fed dry milo (rations 1 and 2). Steers fed dry milo or high-moisture milo treated with organic acid (rations 2 and 4) consumed more feed ($P<.01$) and were less efficient ($P<.10$) than steers fed dry milo or high-moisture ensiled milo (rations 1 and 3). Treating milo with organic acid

[4]Organic acid mixture (trade name - ChemStor) contains 60% acetic and 40% propionic acids.

did not affect daily gain of steers receiving either dry or high-moisture rations. Neither dressing percentage, carcass quality nor yield grades were influenced by organic acid treatment.

Some heating and molding occurred in the high-moisture milo treated with organic acid. It was limited to within five or six inches of the concrete wall. Such spoilage was observed in reconstituted milo that was treated and stored in a similar manner (1972 Cattleman's Day - Bulletin 557). In the study reported here, moving the mold-free grain to a polyethylene-lined concrete bin prevented further spoilage. Total storage time for the grain was approximately ten months.

Table 1. Composition of the Supplement.

Ingredient	% (dry matter basis)
Soybean meal	56.75
Urea	15.15
Dicalcium phosphate	3.85
Limestone	14.20
Salt	7.50
Fat	1.00
Trace mineral premix	0.40
Chlortetracycline[a]	0.88
Vitamin A premix[b]	0.28

[a]Formulated to supply 70 mg per steer daily.
[b]Formulated to supply 30,000 IU per steer daily.

Table 2. Steer Performance and Carcass Data (104 days: April 6 to July 19, 1972)

Item	1 Dry milo	2 Dry milo + organic acid	3 24% milo ensiled	4 24% milo + organic acid
No. of steers	15	15	15	15
Initial wt., lb.	704	694	704	698
Final wt., lb.[a]	998	986	1013	1004
Avg. daily gain, lb.	2.82	2.82	3.00	2.95
Avg. daily feed, lb.[b]	21.8	23.0	20.8	21.8
Feed/lb. gain, lb.	7.75	8.16	6.94	7.38
Dressing %	59.1	59.3	60.0	61.0
Quality grade[c]	10.7	10.3	10.8	10.1
Yield grade[d]	2.33	2.34	2.40	2.80

[a] Adjusted to 59.95% dress.
[b] Dry matter basis.
[c] Quality grade assigned, 10 = low choice, 11 = average choice.
[d] 2.50 + (2.5 x adj. fat thickness) + (0.2 x % KK) + (0.0038 x hot carcass wt.) - (0.32 x L.E.A.).

KSU

Steam Flaking Conditions and Gelatinization in Sorghum Grain

G. M. Roth, B. E. Brent and R. R. Schalles

Summary

Gelatinization was measured in flaked sorghum grain that weighed 16.5 to 47 lbs. a bushel. Samples were steamed from 20 to 50 minutes, and varied in moisture content from 16.9 to 20.9% as they entered the chamber. Gelatinization was measured by an enzymatic gas production technique and compared with an extruded sample assumed to be 100% gelatinized. Each 1 lb. a bushel decrease in weight between 16.5 and 38 lbs. increased gelatinization 3.65 percent. Each 10 min. increase in steaming time increased gelatinization only 1.5%. Changes in grain moisture between 16.9 and 20.9% only slightly influenced gelatinization percentage. Between 20 and 28 lbs./bu., each pound decrease in bushel weight decreased the capacity of the 18" x 24" Ross roller mill 9 lbs. per minute.

Introduction

Although steam flaking probably is the most popular method of processing sorghum grain in commercial feedlots, reliable, simple methods to control quality of processed sorghum grain are scarce. Benefits of steam flaking depend on "gelatinization" of the grain starch molecule.

Several methods have been proposed to measure gelatinization. Among them are microscopic observations on loss of starch birefringence (the halo of light around the starch granule), and starch uptake of certain dyes. Such methods presume that if one break occurs in a granule, that granule is "gelatinized." More sensitive methods measure the activity of starch-digesting enzymes on starch granules. The more highly gelatinized the granules, the faster the enzymes act.

While enzymatic tests for gelatinization are precise, feedlots need simple, easily applied methods to use on a day-to-day basis. Thus, the relationship between gelatinization (measured by enzymatic gas production) and weight per bushel was examined. The influence of moisture in the grain entering the steaming chamber, and the time the grain remained in the chamber also were studied. Finally, the relationship between gelatinization percentage and roller mill capacity was examined.

Experimental Procedure

Elevator run, number 2 red milo weighing 57 lbs./bu. was cleaned, accumulated in a 200-ton hoppered bin, and used for all the studies reported here.

Grain was steamed in a Ross 960, 96-cubic-foot stainless steel, steam chamber with a capacity of about 4,300 lbs. Eight steam tubes ran through the chamber at five levels. Steam was supplied by a 40 hp, marine boiler operated at 70 to 90 psi. When released in the steam chamber, it raised the grain temperature to 210 degrees F.

The Ross heavy duty mill with rolls 24" long by 18" diameter, corregated with 24 Stevens cuts per inch was powered with a 40-hp electric motor. An ammeter was available to measure current draw. The mill was mounted directly below the steam chamber. Rate of grain discharge from the chamber into the mill was regulated by a feeder roll and adjustable feed gate.

Starch gelatinization was estimated by digesting the starch to glucose with an enzyme (amyloglucosidase), converting the glucose to carbon dioxide with yeast, and collecting and measuring the carbon dioxide.

Bushel weights were made by moving a long-handled ladle the full length of the rolls at a uniform rate then pouring the flakes into a 1-pint test cup from 3 to 4 inches above. The cup was leveled with a standard strike-off board, and the test weight taken immediately.

Experiment I. Bushel weight of flakes was varied by adjusting the mill feed rate and roll pressure to maintain the mill amperage draw at 75% of full load. The 15%-moisture grain was held in the steam chamber 25 min. Final flake bushel weights varied from 16.5 to 47 lbs.

Experiment II. Retention time in the steam chamber was varied from 20 to 50 min. while flake bushel weight was held constant at 24 lbs.

Experiment III. Water was added to grain in a horizontal mixer to produce grain moistures of 16.9 to 20.9 percent. Flake weight remained constant at 24 lbs.

Results

Experiment I. Gelatinization, as measured by gas production, increased as flake bushel weight decreased (figure 1). Bushel weight must lower some before there is any appreciable gelatinization. However, between bushel weights of 38 and 16.5 lbs., the relationship of bushel weight to gelatinization percentage is linear. Because flake weights outside those limits are unusual, flake weight alone may estimate gelatinization percentages accurately (correlation coefficient, -.996).

The equation for the line in figure is: % gelatinization = 156.1 - (3.65 x bushel weight). Thus, if you produce a 25-lb. flake, gelatinization percentage = 156.1 - (3.65) (25) = 64.8%. Each pound increase in flake weight decreases gelatinization by 3.65%.

Gelatinization percentages measured by enzymatic methods are somewhat higher than when estimated by commonly used microscopic methods. A starch granule ruptured at one site is considered gelatinized by microscopic methods. However, more gelatinization still can take place.

Optimum gelatinization is generally considered 30 to 50% when measured by microscopic methods. The optimum range will be higher when measured by such enzyme methods as gas production.

To estimate gelatinization percentage from flake bushel weight, the grain must be weighed under carefully controlled conditions (as given in Experimental Procedures). Flakes that have passed through air lifts or other conveying equipment will be broken, at least to some extent. That increases their bushel weight, but does not decrease gelatinization percentage.

The relationship between bushel weight and mill capacity is shown in figure 2. Each 1-lb. decrease in bushel weight reduces mill capacity 8.98 lbs. per minute. The equation: lbs. per minute = -143.01 + 8.98 (bushel weight) describes the relationship. Thus, for a bushel weight of 25 lbs., the mill capacity was -143.01 + 8.98 (25) or 81.5 lbs. per minute. The 18" x 24" rolls are smaller than those used in most commercial feedlots. However, good working data can be developed for individual flakers by measuring mill capacity while producing flakes of various bushel weights and plotting the results on a graph.

<u>Experiment II.</u> Between steam-chest retention times of 20 and 50 minutes, each additional 10 minutes in the chamber increased gelatinization 1.5%. Other workers have shown that short steaming times (5 to 10 minutes) produce unacceptable flakes. According to our data, however, little is gained by steaming more than 20 minutes. However, unusual grain conditions might call for longer steaming to soften the grain for adequate flaking.

<u>Experiment III.</u> Increasing the moisture content of grain entering the steam chamber had no consistent influence on gelatinization. Extremely dry grains, however, might give different results.

Figure 1. Relationship between bushel weight of flaked sorghum grain and percent gelatinization measured by enzymatic gas production.

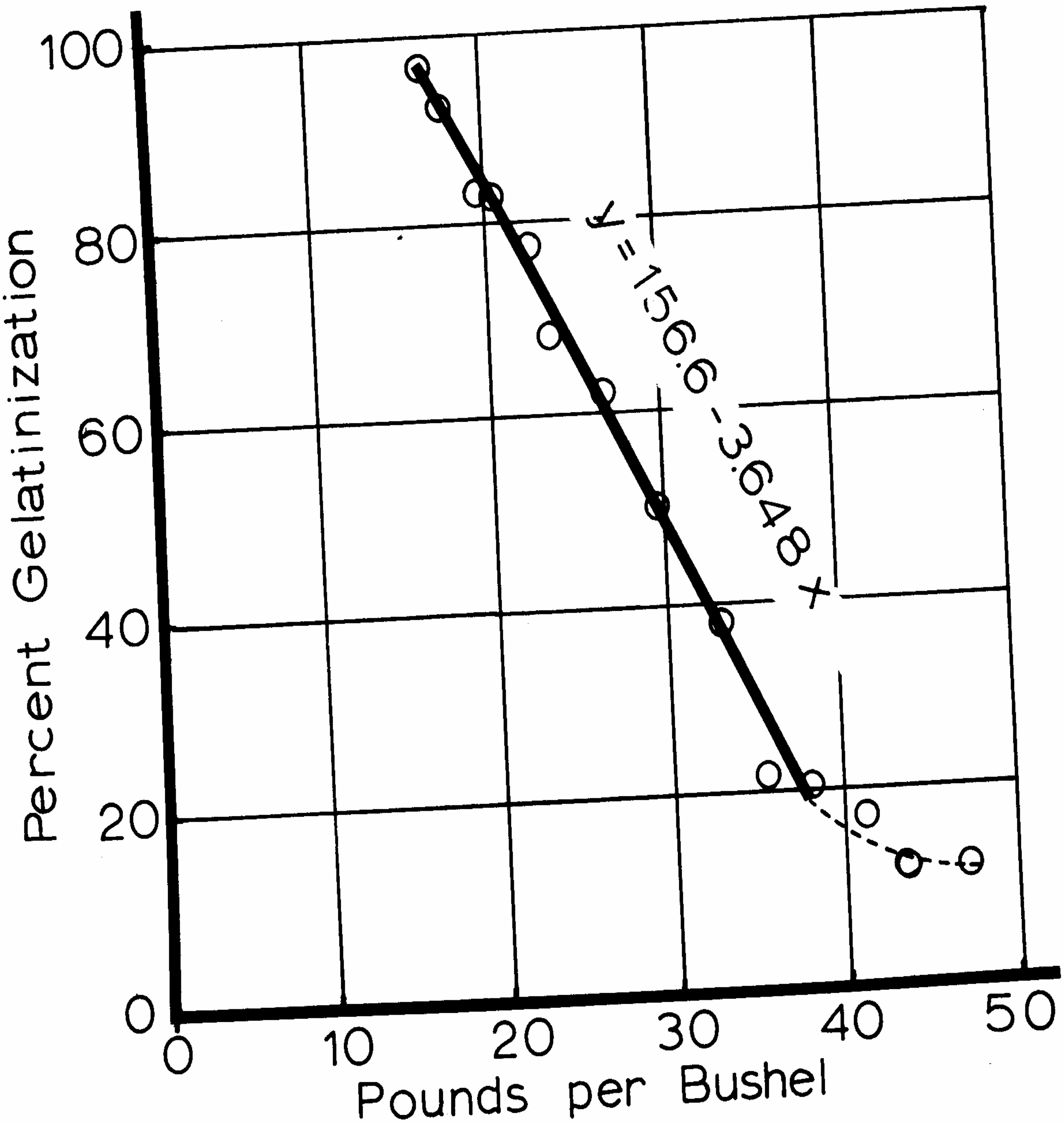
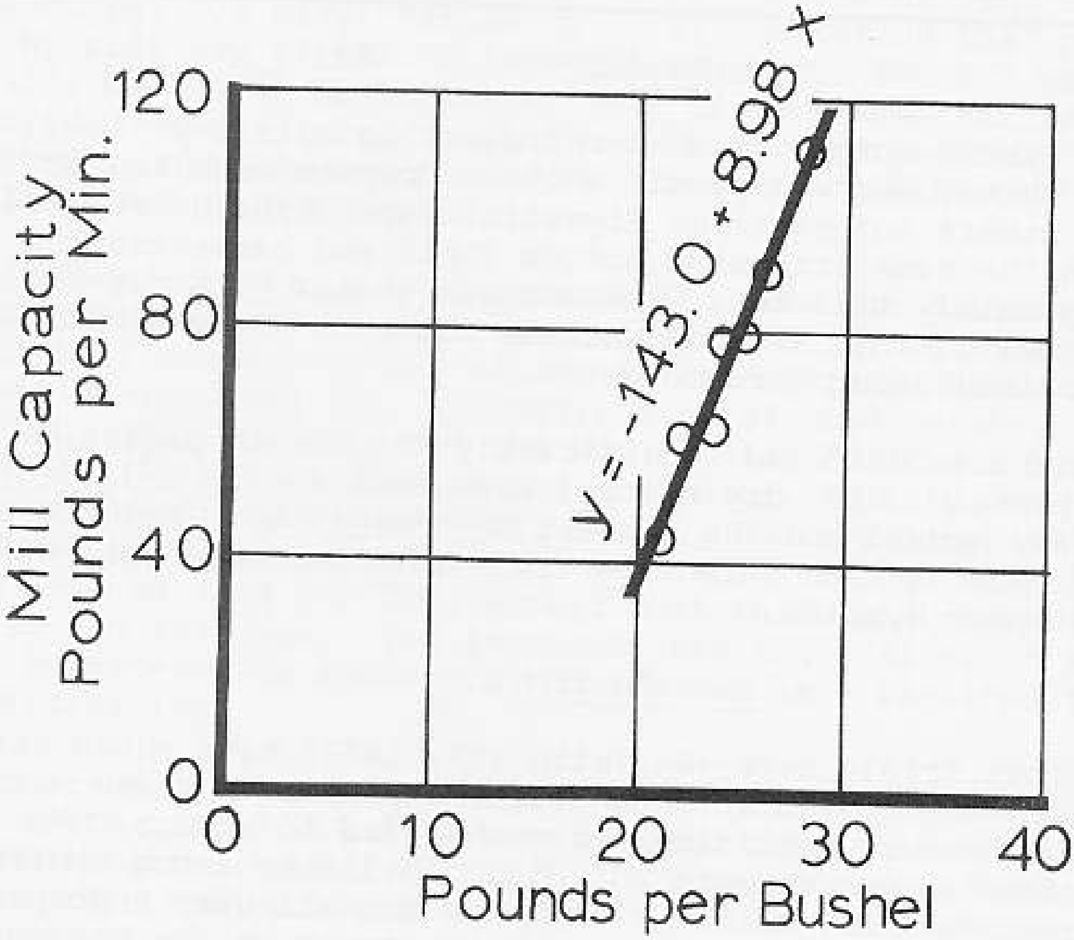


Figure 2. Relationship between bushel weight of flaked sorghum grain and roller mill capacity.



Our results indicate that bushel weight is an excellent quality control for estimating gelatinization percentages of flaked grain. However, bushel weights must be taken carefully. Steaming time (more than 20 minutes) and moisture percentages in the original grain had little effect on gelatinization.

Digestibility of Nine Hybrid Sorghum Grains Fed to Finishing Steers Winter 1971-72[1]

R. L. McCollough and B. E. Brent

Summary

Nine hybrid sorghum grains representing hetero-yellow, all-waxy, white, part-waxy, and white endosperm were fed to finishing steers to determine digestibility. Hybrids were all planted on the same irrigated bottom field and harvested and stored separately till fed. The sorghum grains were dry-rolled and incorporated into 90% concentrate rations. Digestibilities were determined using chromic oxide.

The hybrids differed significantly (P<.05) in digestibilities of crude protein, NFE, dry matter, and gross energy and for TDN. The all-waxy hybrid had the highest digestibility. Hetero-yellow endosperm hybrids were more digestible than white or part-waxy white endosperm hybrids.

Introduction

Previous trials here (Bulletin 557, 1972) have shown hetero-yellow endosperm hybrid sorghum grains superior to those with white endosperms in nutritive value when fed to steers. We compared feedlot performance and digestibilities among hybrids having hetero-yellow, white, part-waxy, and all-waxy endosperm types. Waxy refers to amylopectin-type starch in the endosperm.

Feedlot performance of these hybrids was reported in Bulletin 557, 1972. Digestibility data are now available for the hybrids, and are reported here.

Materials and Methods

Digestibilities of the 9 hybrid sorghum grains fed to steers were determined using chromic oxide. The method has been described previously in Bulletin 557. Description of hybrids is shown in table 1 . Bulletin 557 (1972) gives chemical analysis of complete rations, yields (bu. per acre), and feedlot performance.

All digestibility means were calculated by least squares.

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[1]Mention of companies, names or products does not constitute endorsement over comparable companies, names or products.

Results and Discussion

Table 2 shows the proximate analyses of the nine hybrid sorghum grains. Differences for crude protein or NFE were small. Amylopectin tended to be lower than the normally reported 75%. Amylopectin contents of hybrids NK-275, and NK-280 (genotype, 1/4 waxy) varied by 7.7%, indicating that parentage of hybrids may affect amylopectin content. The 2/3 waxy hybrid (3135) had 80.2% amylopectin, only 5% more than the 1/4 waxy hybrids. The all-waxy hybrid had 96.7% amylopectin. Waxy and part-waxy hybrids tended to yield less than white or hetero-yellow endosperm hybrids.

Digestibilities of 9 hybrids are shown in table 3. Differences among hybrids were significant ($P<.05$) for digestibility of crude protein, nitrogen free extract (NFE), dry matter, gross energy, and TDN. Digestibility of crude protein, NFE, dry matter, gross energy, and TDN was highest for the all-waxy hybrid, CP-622. If TDN is used as index of digestibility, the endosperm types ranked: all-waxy (TDN, 67.6), hetero-yellow (64.83), white (62.4), and part-waxy (59.8). Rankings for feed efficiency are the same as that for TDN, except that white and part-waxy endosperm are reversed. The improved feed conversions of all-waxy and hetero-yellow endosperm hybrids may have resulted from better digestibility.

X-4087 was an experimental white pericarp, hetero-yellow endosperm hybrid with the same genetic characteristics as G-766W. Digestibility (table 3) and feedlot performance (Bulletin 557, 1972) were much poorer than other hybrids. Digestibility data (table 3) of part-waxy hybrids (1/4 to 2/3 waxy genotype) indicate that not only amylopectin content *per se*, but also associated characteristics may influence nutritive value of grains.

Acknowledgments

Appreciation is expressed for sorghum seed furnished by these firms:

Funk Brothers Seed Company, Lubbock, Texas
Anderson, Claton, and Company, Bellomond, Iowa
DeKalb Seed Company, Lubbock, Texas
Nc$^+$ Hybrids, Hastings, Nebraska

Appreciation is also expressed to Frank Rudolph, Manhattan, Kansas for his cooperation in producing the grains.

Table 1. Descriptions of Nine Hybrid Grains Fed, Winter 1971-72

Hybrid	Abbrev. in text	Pericarp color	Endosperm	Endosperm code
Funks G-766W	G-766W	White	Hetero-yellow	Y
ACCO R-109	R-109	Red bronze	Hetero-yellow	Y
Northrup King 275	NK275	Red	White, 1/4 waxy[a]	W, 1/4X[b]
Northrup King 280	NK280	Red	White, 1/4 waxy	W, 1/4X[b]
Nc+ RS-671	RS-671	Red	White	W
Corpustar CP-622	CP-622	White	White, all-waxy	W, AX
Funks G-522	G-522	Red bronze	Hetero-yellow	Y
Northrup King X-4087	X-4087	White	Hetero-yellow	Y
Funks 3135	3135	Red	White, 2/3 waxy	W, 2/3X[b]

[a] Waxy refers to amylopectin starch.
[b] 1/4, 2/3 refers to waxy genotype contributed from parents.

Table 2. Chemical Composition of Nine Hybrid Grains, Dry Matter Basis

Hybrid	Endosperm[a]	%							Gross energy
		Crude protein	Ether extract	Crude fiber	ASH	NFE	Starch	Amylopectin[b]	Kcal/kg
G-766W	Y[b]	10.35	3.31	2.19	1.64	82.51	75.16	68.53	4.459
R-109	Y	10.30	3.04	2.10	1.56	83.00	72.80	68.07	4.513
NK-275	W 1/4X	10.84	3.15	2.12	1.61	82.28	74.63	69.51	4.349
NK-280	W 1/4X	9.91	3.11	1.99	1.63	83.36	68.78	77.17	4.484
RS-671	W	11.24	2.99	1.92	1.63	82.22	72.74	69.31	4.446
CP-622	W, AX	11.19	2.97	1.91	1.62	82.31	73.85	96.66	4.425
G-522	Y	10.67	3.20	1.78	1.59	82.76	73.77	67.09	4.482
X-4087	Y	10.34	3.03	2.23	1.66	82.74	75.79	67.45	4.424
3135	W, 2/3X	10.90	3.17	2.14	1.86	81.93	72.89	80.18	4.508

[a]Y = hetero-yellow, W = white, 1/4X, 2/3X = waxy genotype from parents, AX = all-waxy.
[b]% amylopectin = % amylose - 100.

Table 3. Digestibility of Nine Hybrid Sorghum Grain Rations Fed to Steers, Winter 1971-72 Determined by Chromic Oxide

Hybrid	Endosperm[a]	Feed/day, lbs. (D.M. basis)	% Digestibilities						% TDN
			Crude protein	Crude fiber	Ether extract	NFE	Dry matter	Gross energy	
G-766W	Y	16.62	55.21[1,2]	16.51	35.98	70.67[1,2]	63.90[1-3]	61.25[2,3]	63.05[1-3]
R-109	Y	17.59	57.87[2,3]	21.09	30.20	72.08[1]	65.68[2,3]	63.02[2,3]	64.47[2,3]
NK-275	W, 1/4X	17.20	55.42[2,3]	18.65	40.85	69.04[1,2]	65.16[2,3]	60.06[1-3]	62.05[1-3]
NK-280	W, 1/4X	17.54	47.33[1]	10.23	30.20	65.24[1,2]	58.17[1,2]	55.19[1,2]	57.44[1,2]
RS-671	W	18.60	54.31[1,2]	13.26	52.54	68.62[1,2]	62.96[1-3]	60.75[1-3]	62.43[1-3]
CP-622	W, AX	19.03	62,12[3]	15.32	37.98	75.74[2]	68.34[3]	66.60[3]	67.65[3]
G-522	Y	15.60	56.09[2,3]	22.24	39.40	74.96[2]	67.40[3]	65.47[3]	66.99[3]
X-4087	Y	19.03	50.53[1,2]	18.97	40.02	59.97[1]	55.20[1]	52.10[1]	54.51[1]
3135	W, 2/3X	17.99	56.10[2,3]	7.86	27.05	68.06[1,2]	61.60[1,2]	57.69[1,2]	59.91[1-3]

[a]Y = hetero-yellow, W = white, AX = all-waxy, 1/4X, 2/3X = waxy genotype from parents.

[1,2,3]Means with different superscripts in same columns are significantly ($P<.05$) different.

Summary of Feedlot Performance and Digestibilities of Steers Fed 13 Hybrid Sorghum and 2 Hybrid Corn Grains

R. L. McCollough

Two years and 270 head of steers were used to determine the feeding value of 13 hybrid sorghum grains and 2 hybrid corn grains fed in dry-rolled high-concentrate rations fed to finishing steers. The 15 corn and sorghum hybrids represented 7 endosperm types: hetero-yellow, white, all-waxy (amylopectin-type starch), part-waxy, and bird-resistant endosperm sorghum grains, regular yellow dent corn and high-oil corn. The grains (9 hybrids in each of 2 years and 3 hybrids replicated between years) were produced in the same field, and conditions were similar for each year and each hybrid. Each year, 15 head of steers were fed 126 days on each hybrid. Digestibilities were determined with 5 head of steers fed per hybrid in sheltered concrete lots, using chromic oxide.

Steers fed hetero-yellow endosperm hybrid sorghum gained faster (P<.05) by 6.7% and had a 9.2% better feed conversion (P<.05) than steers fed white endosperm hybrid sorghum grains. Pericarp color did not influence the nutritive value of sorghum grains. Steers fed all-waxy (amylopectin) sorghum grain had the highest average daily gain and the same feed conversion as steers fed regular corn, and 2% better feed conversion than steers fed hetero-yellow endosperm hybrids. Steers fed regular corn gained 2.8% more efficiently than steers fed hetero-yellow hybrids, and 12.3% more efficiently than steers fed white endosperm hybrids. Steers fed bird-resistant sorghum grain had the poorest feed conversion; 30.4% poorer than steers fed yellow corn.

Apparent digestibilities show the differences in feed conversion was primarily due to differences in grain digestibility. Apparent crude protein digestibility was lower (P<.05) for bird-resistant (24.3%) and white endosperm hybrids (49.9%) than hetero-yellow (53.2%), all-waxy (59%), high-oil corn (60.9%) and regular corn (64.7%). Apparent gross energy digestion follows same trend as crude protein.

Details of experiments summarized here can be found in Bulletins 546 (1971) and 557 (1972).

Adapted Rumen Microorganisms[1] (ARM) for Feedlot Cattle

J. G. Riley, K. K. Bolsen, and D. L. Good

Summary

Two trials using 200 mixed breed steers were conducted to determine effects of 0, 3, 6, or 12-ounce drenches of Adapted Rumen Microorganisms (ARM) on subsequent feedlot performance. An 85 percent concentrate ration was fed for 90-days before drenching with ARM.

Steers receiving the 12-ounce treatment in trial 1 gained 14.4 pounds more per head during the next 60-day feeding period. The 3 and 6-ounce treatments were less beneficial.

The 12-ounce treatment in trial 2 produced a highly significant ($P < .01$) 15% increase in rate of gain and a 12.5% increase in efficiency compared with the control group.

Introduction

Most veteran cattle feeders have observed that after approximately 90-100 days of full feeding or at 800-900 pounds, Feedlot cattle's rate of gain and efficiency often drop. There are several theories for the "90-day slump" including differences in genetic background, previous treatment, and ration adequacy. Studies at W. R. Grace's Washington Research Center in Clarksville, Md., indicate that the slump may be due, in part at least, to a decreasing ratio of acetate to propionate in the rumen. If so microbial innoculation of rumens of cattle on feed 90 days might stimulate increased gain and efficiency.

Experimental Procedure

Two hundred mixed breed steers were fed a ration composed of 15% sorghum silage and 85% concentrate (rolled milo and supplement) 90 days. In trial 1, 100 steers then were randomly allotted to 20 pens of 5 each and drenched with Adapted Rumen Microorganisms (ARM) (table 1). Fifty of the other 100 steers (trial 2) received a 12-ounce drench of ARM and the other 50 served as controls. Individual weights were taken two consecutive days at both the beginning and the end of each trial and 30 days after drenching. All groups were fed the same ration twice daily. Carcass weight and grade were collected for each steer. None was fed antibiotics or stilbestrol.

[1] Adapted rumen microorganisms, partial financial support, and technical assistance were provided by W. R. Grace and Co., Washington Research Center, Clarksville, Maryland. Represented by O. D. Myrick, Jr. and P. H. Hahn.

Table 1. Experimental Design - Trial 1

No. pens	No. steers	Treatment
8	40	control
4	20	3 ounces ARM
4	20	6 ounces ARM
4	20	12 ounces ARM

Results

Feedlot performance is shown in table 2. Steers drenched with 12 ounces of ARM gained significantly ($P<.01$) more than the undrenched controls. Steers receiving 6-ounce treatment gained 10.1 pounds more each than control steers for the 60-day feeding trial, somewhat less than the 14.4 and 20.0-pound increase of those on the 12-ounce treatment in trials 1 and 2, respectively. Gain and efficiency for the 3-ounce treatment indicated that dosage was not enough to stimulate performance.

The 6-ounce treatment resulted in 4.3% less feed per pound of gain compared with 7.6 and 12.5% for the 12-ounce treatments in trials 1 and 2, respectively. Differences in carcass weights or grades were not significant. Our results agree with those of W. R. Grace and Co.

Table 2. Performance of Steers Drenched with Indicated Quantities of Adapted Rumen Microorganisms (ARM)

Trial	No. Head	Treatment, oz.	Initial wt., lb.	Final wt., *lb.	Total gain, lb.	A.D.G., lb.	Daily D.M. Intake, lb.	Lbs. feed/ lb. gain
1	40	0	905	1038	133	2.22	22.01	9.92
	20	3	902	1028	126	2.10	22.64	10.78
	20	6	903	1046	143	2.39	22.68	9.49
	20	12	903	1050	147	2.46	22.57	9.17
2	50	0	922	1053	131	2.18	22.56	10.35
	49**	12	914	1065	151	2.51	22.75	9.06

* Adjusted to equal dressing percentage

** 1 steer died during trial

Beef Cattle Commercial Feedlot Studies[1,2]

The Livestock and Meat Industry Council initiated a program of purchasing a large group of steers to be used for experimental purposes on topics relevant to the beef cattle feeding industry of Kansas. Objective of the project is to investigate aspects of commercial feedlot operations that are current, or potential, problems: nutrition, health, disease, internal and external parasites, shrinkage, transportation, marketing, management, pollution control, etc. Scientists in various disciplines submit subprojects specifying particular objective(s) and procedure.

The first project used a group purchased in February and sold in June. A second project is in progress.

Results of the first project follow.

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1 Financial support was provided by the Livestock and Meat Industry Council, Inc. (LMIC)

2 General Project co-ordinating committee includes
Dr. Ed Smith, Chairman--Animal Science & Industry
Dr. Jack Riley--Animal Science & Industry
Dr. Don Good--Animal Science & Industry
Dr. Steve Armbruster--Animal Science & Industry
Dr. Ralph Lipper--Agricultural Engineering
Dr. Charles Pitts--Entomology
Dr. John McCoy--Agricultural Economics
Dr. Homer Caley--Veterinary Medicine
Dr. Roy Millerett--Veterinary Medicine
Dr. Keith Huston--Agricultural Experiment Station

Beef Cattle Commercial Feedlot Studies
Trial 1--Effects on Steer Performance of Variable Protein Levels, Implanting, and Worming

J. G. Riley, K. F. Harrison, D. L. Good

Summary

A 112-day trial used 280 mixed-breed yearling steers to study effects of varying protein levels in finishing steers rations. Crude protein content ranged from 15.1 percent for the first 28 days to 8.9 percent crude protein the final 28 days.

Feeding a 15.1% crude protein ration for 28 days and a 13.2% crude protein ration the second 28 days or feeding a 13.2% crude protein ration for the first 56 days did not significantly improve total gain compared with feeding an 11.2% crude protein (control) ration.

Removing supplemental protein from the ration of 140 steers the final 28 days increased rate of gain 6.9% and decreased dry matter required per pound of gain 8.4%.

One hundred twenty steers were implanted with 36 mg. zeranol[1] and 120 with 36 mg. stilbestrol[2] each at the beginning of each trial. Forty controls were not implanted. Implanted steers gained 16.9% more rapidly than control steers with zeranol implanted animals gaining 3.0 pounds each more during the 112 days than those implanted with stilbestrol.

Half the steers, wormed with thiabendazole[3] boluses, gained 5.2 pounds more each during the trial than those not wormed.

Introduction

The tremendous increase in commercial cattle feedlots in Kansas has helped to focus attention on problems for research. Cost of protein supplements is a major concern. An often heard opinion is that cattle need more crude protein

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1 Marketed under tradename RALGRO, an exclusive product of Commercial Solvents Corporation, Terre Haute, Ind. RALGRO provided by Commercial Solvents Corporation.

2 Marketed under tradename STIMPLANTS by Chas. Pfizer and Co., Inc., Terre Haute, Ind. STIMPLANTS provided by Chas. Pfizer and Co., Inc.

3 Marketed under tradename Thibenzole and TBZ by Merck and Co., Inc., Rahway, N. J. TBZ was provided for this trial by Merck and Co., Inc.

(13,14,15%) during early stages of the finishing period. On the other hand, some believe that too much protein is being fed late in the finishing period. Research at other institutions has indicated that zeranol (RALGRO) is as beneficial as stilbestrol, which may be banned.

The effect of internal parasites on animal performance also needs more research effort.

This project was designed to provide data on protein levels, implants, and worming.

Experimental Procedure

Two hundred eighty mixed-breed yearling steers, purchased from a backgrounding lot in southeastern Colorado were used. They averaged 732 pounds at the beginning of the trial. Seventy were allotted at random to each of four groups. Group 1 was fed an 11% crude protein ration for 112 days as the controls. Group 2 was fed an 11% crude protein ration for 84 days, then the protein supplement was removed the last 28 days. Lot 3 was fed a ration containing 13% crude protein for the first 56 days and 11% crude protein the next 56 days. Group 4 received a 15% crude protein ration the first 28 days, 13% crude protein the second 28 days, 11% crude protein the third 28 days, and a basal ration with no protein supplementation the final 28 days. Composition of the supplement is shown in Table 1 and of the complete rations in Table 2.

Removing the protein supplement the final 28 days was done by replacing soybean oilmeal with rolled milo. No adjustment was made for the difference in mineral content between soybean oilmeal and milo. Periodic samples of each ingredient used in the rations were taken and proximate analyses obtained. Average crude protein was calculated as shown in Table 2.

Half the steers in each trial were wormed with thiabendazole boluses; the other half was not. In addition, 30 steers in each pen were implanted with 36 mg. of zeranol, and 30 with 36 mg. of stilbestrol, and 10 in each group were nonimplanted . Individual weights were taken at 28 day intervals and adjustments were made in levels of crude protein being fed. Feeding was twice daily. Hot carcass weight and USDA grade were obtained for each steer at the end of the trial.

Results

Feedlot performance for the 112-day trial are shown in Table 3. Differences in daily gain were not significant. Group 4, started on a 15% crude protein ration, was the fastest gaining and most efficient group. Performances of the other three groups varied little.

Based on a daily dry matter intake of 20 pounds per steer and feed prices January 10, 1973, feed costs were $0.10 more per day per steer with the 13% crude protein ration and $0.18 more per day per steer for the 15% crude protein ration than for the 11% crude protein ration. That assumes that protein was being supplied by soybean oilmeal. The effect on steer performance of discontinuing protein supplements during the final 28 days is shown in Table 4. Protein supplementation seemed not to be required to maintain steer performance the last 4 weeks of the feeding period. Only the supplemental protein was discontinued. Adequate minerals, trace minerals, and vitamins were continued throughout the experiment. The 140 steers with no supplemental protein in their ration gained 6.9% faster and 8.4% more efficiently than the 140 steers fed the more conventional 11.2% crude protein ration the final 28 days. Average weight for the steers at the beginning of the last 28 day period was 963 pounds. Removing the protein portion of the supplement and using January 10, 1973, feed prices reduced the ration cost 8.6%

Performance and carcass grade of steers implanted with zeranol were slightly superior to that of steers implanted with Stilbestrol. Implanted steers gained 16.9% more rapidly (average) than steers not implanted. Our results indicate that zeranol (RALGRO) could be used as an alternative to stilbestrol.

A zeranol advantage is its 65-day waiting period from implantation until slaughter compared with stilbestrol's 120-day waiting period. However zeranol implants now are approximately 3 times more expensive than most stilbestrol implants.

The effects of worming on performance, a small difference in daily gain, is shown in Table 6. Research at other stations has indicated improved efficiency from worming when gains were similar. We did not evaluate efficiency. A worm-egg count before the trial indicated no internal parasite infestation.

Additional trials in progress will further evaluate variable levels of protein in rations for feedlot steers, including no protein supplements near the end of the finishing period.

Table 1. Composition of Protein Supplement

Ingredient	%
Soybean oilmeal*	70.2
Limestone	15.6
Salt	10.0
Urea	2.3
Trace mineral**	1.0
Aureomycin (10 gms/lb.)	0.7
Vitamin A (30,000 I.U./gm)	.2

* Replaced by rolled milo to provide supplement for treatments 2 and 4 last 28 days of trial.

**Calcium Carbonate Co. Z-5

Table 2. Composition of Rations % - Dry Matter Basis

Ingredient	11% C.P. 0-56 Days	11% C.P. 56-112	13% C.P. 0-56 Days	15% C.P. 0-28 Days	Basal 85-112 Days
Sorghum silage	24.0	14.2	22.1	20.1	14.2
Flaked milo	35.1	40.4	33.3	31.6	40.4
Cracked corn	35.1	40.4	33.3	31.6	40.4
Supplement	5.0	5.0	5.0	5.0	5.0
SBOM	0.8	--	6.3	11.7	--
*Calculated crude protein content %	11.1	11.2	13.2	15.1	8.9

* Based on periodic sampling of each ingredient during experimental period.

Table 3. Feedlot Performance of Steers Fed Indicated Levels of Protein

ITEM	Days	% Crude protein (dry matter basis)			
	0-28	11.1	11.1	13.2	15.1
	29-56	11.1	11.1	13.2	13.2
	57-84	11.2	11.1	11.2	11.2
	85-112	11.2	8.9	11.2	8.9
Lot No.		1	2	3	4
Number of steers		70	69[a]	69[b]	70
Initial wt., lb.		728.1	731.3	739.6	727.6
Final wt., lb.		1011.7	1013.7	1025.8	1022.2
A. D. G., lb.		2.53	2.52	2.55	2.63
Daily D. M., lb.		20.18	19.83	20.12	20.07
Feed D.M./lb. gain, lb.		7.97	7.86	7.89	7.63

[a] one steer removed because of abcess
[b] one steer died during trial

Table 4. Effect on Steer Performance of Withdrawing Protein Supplement Final 28 Days

	Lots 1 & 3 11.2% C. P.	Lots 2 & 4 8.9% C. P.
No. steers	139	139
Avg. initial wt., lb.	965.95	961.10
Avg. final wt., lb.	1018.75	1017.95
Total gain. lb.	52.80	56.85
Avg. daily gain, lb.	1.89	2.03
Avg. daily D.M., lb.	19.36	19.05
Feed D.M./gain, lb.	10.24	9.38

Table 5. Influence of Implants on Performance and Carcass Characteristics of Feedlot Steers

Item	Implant		
	0	36 mg. Ralgro	36 mg. stilbestrol
No. steers	39	119	120
Initial wt., lb.	734.7	732.5	729.6
Final wt., lb.	984.7	1026.3	1020.4
Total gain, lb.	250.0	293.8	290.8
A.D.G., lb.	2.23	2.62	2.60
Dressing percentage	63.1	63.6	63.8
USDA Prime	1	13	4
USDA Choice	33	101	107
USDA Good	5	5	9

Table 6. Effect of Worming on Performance of Feedlot Steers

Item	Thibenzole*	No wormer
No. steers	140	138
Initial wt., lb.	733.1	730.2
Final wt., lb.	1022.4	1014.3
Total gain, lb.	289.3	284.1
A.D.G., lb.	2.58	2.54
Dressing percentage	63.5	63.6

*

Performance and Carcass Characteristics of Different Cattles Types--A Preliminary Report

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This report contains results from the U.S. Meat Animal Research Center Cattle Germ Plasm Evaluation Program. Dr. Keith Gregory and Dr. Hudson Glimp, U.S. Meat Animal Research Center, Clay Center, Nebraska, initiated and designed the cattle germ plasm evaluation program. Dr. Dan Laster and Dr. John Crouse are currently working on the project from the Research Center. Kansas State University and the Livestock Division, C&MS, U.S.D.A. are cooperating on the project.

The project was designed to characterize breeds from different cattle types regarding economic traits that relate to reproduction, maternal ability, growth, feed efficiency, and carcass and meat traits. Hereford, Angus, Jersey, South Devon, Limousin, Simmental, and Charolais breeds are represented as different biological types.

This report includes data on calving difficulty and preweaning growth from three calf crops (1970, 1971, and 1972 spring dropped calves). Data on postweaning growth, feed efficiency, and carcass and meat traits are presented for the 1971 calf crop, along with postweaning growth, puberty, and conception data for heifers from the 1971 calf crop. In addition, calving and rebreeding information (Phase II) obtained in 1972 on the two year old heifers born in 1970 are presented.

Postweaning growth, feed efficiency, and carcass and meat data on the 1970 calf crop were presented in the 1972 Cattlemen's Day report.

A complete analysis of the data and interpretation of the results will be made and published after all data from each segment of the study have been obtained.

Appreciation is extended to Miss Jean Riggs and Mr. Coy Allen, Housing and Food Service, Kansas State University, for their excellent cooperation in allowing the use of the Food Service meat cutting facilities for this project.

Experimental Procedure

Phase I

Commercial Hereford and Angus females were bred artificially to seven breeds of sires. The females were purchased as weaning calves in Nebraska and were two, three, four, and five years old at calving in 1970, two, three, four, five, and six years old at calving in 1971, and three, four, five, six, and seven years old in 1972. The calves were born in late March, April and early May, and were creep fed a ration of whole oats beginning in mid-July.

Thirty-four Hereford, 35 Angus, 33 Jersey, 36 South Devon, 30 Limousin, 37 Simmental, and 38 Charolais sires were used in 1969, 1970, and 1971. The Hereford and Angus bulls had been selected on individual performance information as a basis to be accepted for progeny testing by an artificial insemination organization. The Charolais breed included domestic and French bulls. The Simmental bulls were those available commercially, and some that the Canada Department of Agriculture had imported for research. The Limousin bulls were those available commercially. The South Devon bulls were sampled from a commercial importation, and the Jersey bulls were selected at random from two artificial insemination organizations.

Because the number of progeny per sire is relatively low, information on individual sires is not released.

Calving difficulty scores were obtained on 2,595 births in 1970, 1971, and 1972. Scores were assigned to each calf at birth using this scoring system:

Score		
1. No difficulty	-	Calves unassisted
2. Little difficulty	-	Assistance by hand, but no jack or puller used;
3. Moderate difficulty	-	Assistance with jack or calf puller; some difficulty encountered even then.
4. Major difficulty	-	Calf jack used and major difficulty encountered; usually 30 minutes or more required to deliver calf.
5. Caesarean birth		
6. Posterior presentation		

Table 1 shows the calving difficulty summary for cows calving at two years of age, and table 2 , the summary for cows calving at three to seven years of age. In the summaries, scores of 1 and 2 were combined and designated "no difficulty" and scores of 3 and 4 were combined and designated "calf puller." No females were bred in 1971 to calve as two year olds in 1972.

Preweaning growth information on 2,264 calves for the 1970, 1971, and 1972 calf crops were combined (table 3). Weaning weights were adjusted to a steer basis and to a five, six, and seven-year-old basis. The adjustment factors, developed from the combined calf crops, were as follows:

	Birth wt., lb.	Preweaning A.D.G., lb.	200-day wt., lb.
Heifer calf adjustment	+5.4	+0.103	+26
Steer calf adjustment	0	0	0
2-year old dam	+8.0	+0.396	+87
3-year old dam	+6.3	+0.191	+44
4-year old dam	+2.5	+0.066	+16
5-6-7-year old dam	0	0	0

Steer calves with adjusted weaning weights more than three standard deviations below the mean were removed from the study. The remaining steers were placed in the feedlot by breed of sire group (replicated with two lots per sire breed) to obtain data on growth rate and feed efficiency. Feedlot rations are presented in table 4 for the 1971 calf crop. Postweaning average daily gains (table 5) are based on actual weaning weights and final weights at slaughter. Final weights at slaughter were the average of two weights (on feed and water) taken on different days to reduce errors from differences in fill. Adjusted final weight was obtained by adding postweaning average daily gain x days on feed to weaning weight adjusted to 200 days of age, and to a four, five, or six-year-old dam basis. Average daily gains and adjusted final weights (400 days, 442 days, 484 days of age) for each of the three slaughter groups are for steers slaughtered in that group only. Feed efficiency for each breeding group was obtained by dividing the cumulative average daily TDN consumption per steer by the average daily gain of the steers.

Approximately one-third of the steers in each breed of sire by breed of dam group was slaughtered at each of three slaughter dates (200, 242 and 284 days on feed after weaning). Steers to be slaughtered from each breeding group at each of the three times were identified at random across all birth dates. The steers averaged 42 days between slaughter groups 1 and 2 and between slaughter groups 2 and 3. However, differences in conception date and gestation length kept birth dates from averaging the same for all breeding groups.

Steers were transported to a commercial slaughter plant approximately 12 hours before slaughter, and their carcasses were allowed to chill 24 hours after slaughter before carcass data were obtained. Carcasses were evaluated for conformation, maturity, marbling, color, texture, and firmness. U.S.D.A. Quality Grade was determined by representatives of the Livestock Division, C&MS, U.S.D.A., and Kansas State University (table 6). Loin eye area and external fat thickness were measured and U.S.D.A. Yield Grade determined (table 7). Additional selected linear carcass measurements and other data were obtained but not included in this report.

The right side of each carcass was transported to Kansas State University approximately 56 hours after slaughter to obtain detailed cut-out and meat quality data. Each side was separated into wholesale cuts, which were then processed into closely trimmed, boneless cuts with no more than 0.30 in. of fat on any surface. Amounts of retail product, fat trim, and bone were determined for each wholesale cut (table 8).

One steak was removed from each carcass at the 11th rib for Warner-Bratzler shear determination. The steaks were cooked at 350°F to an internal temperature of 150°F. After cooling for approximately 30 minutes at room temperature, one-half inch cores were removed for shear determination. Steaks were removed at the 10th rib from four representative carcasses per breed group per slaughter date (168 carcasses), cooked at 350°F to an internal temperature of 150°F, and subjected to taste panel evaluation for tenderness, flavor, juicinesss, and overall acceptability by experienced taste panelists (table 9).

Additional carcass information obtained on the 1971 calf crop included chemical analyses (water, protein, and fat) of the 9-10-11 rib section from the left side of the carcass. Total chemical composition was also determined on the left side of the carcass from three representative steers of the Hereford X Angus, Simmental x Angus, and Limousin x Angus breeding groups per slaughter group (total of 27 carcass sides, nine per breeding group). Those data are not reported here.

Data for carcass and meat traits were analyzed by least squares procedures for unequal subclass numbers using a model that included effects of age of dam (two, three, four, five, and six-year-olds); breed of sire (straightbred Hereford and Angus, Hereford-Angus reciprocal crosses Jersey, South Devon, Limousin, Simmental, and Charolais; breed of dam (Hereford, Angus); time of slaughter, and breed of sire-breed of dam-time of slaughter; and birth date was included as a covariate to adjust for differences in age of calf within slaughter groups. Thus, the least-squares means for the carcass and meat traits are adjusted for age of dam and to 400, 422, and 484 days of age for the three slaughter groups.

Postweaning average daily gain and adjusted final weight for both steers and heifers were analyzed by least squares procedures using the same model except the birth date was not included as a covariate.

Postweaning growth, puberty, and pregnancy data on the heifers in the 1971 calf crop are presented in table 10. The heifers were kept in drylot from weaning through the artificial insemination breeding period (early July). Their postweaning ration was 50% corn silage and 50% grass silage fed ad libitum or a grass silage and grain mixture to provide an equivalent energy intake. The adjusted 400-day weight is based on a full weight; the adjusted 550-day weight is based on a shrunk weight.

Date of puberty, defined as date of first observed standing estrus, was determined by checking animals for estrus twice daily. Body weights were taken every 28 days from weaning to the breeding period and again when the breeding period terminated. Heifers were inseminated only after standing for vasectomized bulls or other heifers. Following the 45-day artificial insemination breeding season, heifers were placed on pasture for a 24-day natural service breeding period. The percentage of heifers reaching puberty by 15 months and the average age of those that reached puberty are for heifers observed in estrus up to the end of the artificial insemination breeding season only; the percentage pregnant includes heifers that may have reach puberty and bred during the 24-day natural service breeding period.

Phase II

Data on calving and rebreeding as two year olds for heifers born in 1970 are presented in tables 11 and 12. They were bred in 1971 by artificial insemination to Hereford, Angus, Brahman, Devon and Holstein bulls and to Hereford and Angus bulls during the cleanup period.

Because numbers of calves by each sire breed group were disproportionate among the cow breeding groups and because calves in some of the sire breed-dam breed subgroups were so few, weaning weights of the calves are not given and data in tables 11 and 12 were not statistically analyzed. That will be done with results published after data from three calf crops are available. Data presented here should be considered preliminary.

Females in phase II will be bred as two year olds (to Hereford, Angus, Gelbvieh, Maine Anjou and Chianina bulls) to calve as three year olds. Then these cows will be bred naturally to Brown Swiss bulls for their third and fourth calves.

Results and Discussion

Calving difficulty and preweaning growth information presented here include data from three calf crops. Although mean differences have not been statistically interpreted, certain differences are great enough for valid conclusions. Postweaning growth, feed efficiency, and carcass and meat data presented here are for the 1971 calf crop only. Future data will be needed for final conclusions.

Calving difficulty scores on two-year-old females indicate calving difficulty in all crossbred combinations. However, more difficulty occurred with Limousin, Simmental, and Charolais sired calves. The latter two breeds sired more calves that had to be delivered by caesarean that any other breeds. So those three breeds should not be bred to heifers. Jersey calves caused the least difficulty in calving, as expected. More difficulty was encountered with Hereford than with Angus two-year-old females.

Many fewer calving problems occurred in the three, four, five, six, and seven-year-old females than in two-year old females. There were slightly fewer problems with Angus than with Hereford cows. However, South Devon, Limousin, Simmental, and Charolais calves still caused some problems in calving.

Simmental and Charolais calves were somewhat heavier at birth than calves from other breeds. South Devon and Limousin calves were intermediate in birth weights, and Jersey calves were lightest. Calves out of Angus dams were slightly lighter at birth than those out of Hereford dams.

Adjusted weaning weights were higher for Simmental and Charolais calves than for any other calves. Limousin and South Devon calves were heavier than Angus, Hereford, or Jersey calves. Jersey calves were the lightest. There was an approximate 15 lb. weaning weight advantage in the Angus-Hereford reciprocal crosses over the straightbred Angus or Hereford calves. Calves out of Angus females weighed somewhat heavier at weaning than those out of Hereford females.

All steers averaged 2.73 lb. gain per day during the feedlot period, about 0.30 lb. per day more than the steers from the 1970 calf crop, undoubtedly due to a harsher 1971-72 winter. Simmental and Charolais steers averaged about 0.20 lb. gain per day more than any other breed. South Devon and Limousin steers were about average in daily gain while Jersey steers were somewhat lower than other breeds. There appeared to be a slight advantage in daily gain of Angus-Hereford reciprocal crosses over straight bred Angus or Herefords.

Charolais and Limousin calves used feed somewhat more efficiently than any other breed. Charolais and Angus-Hereford reciprocally crossed steers were about average in feed efficiency; Jersey steers appeared to be less efficient than the other breeds.

Simmental and Charolais steers were heavier than other breeds at slaughter because of their heavier weaning weights and higher average daily gains. South Devon, Limousin, and Angus-Hereford reciprocally crossed steers were all three similar in slaughter weights.

Dressing percentage differences were not large, but Limousins dressed somehwat higher than other breeds and Jerseys dressed somewhat lower.

All steers averaged between high Good and low Choice on the rail. On a scoring system of 9 for high Good, 10 for low Choice, all steers averaged 9.5. The average grade and the percentage of all steers grading low Choice or better were lower for the 1971 calf crop than for the 1970 calf crop. The 1971 steers averaged slightly younger than the 1970 steers, which could partially explain why the grades were lower. Also, some grading personnel changed between the two years, which may partially explain lower grades for the 1971 steers. Steers out of Angus cows graded somewhat higher than steers out of Hereford cows. The average quality grade increased from the first to the last slaughter group, as expected.

Limousin and Charolais steers had lower Yield Grade scores than other breeds with Simmental steers running close third. Larger rib eye areas and less external fat covering gave those three breeds the more desirable Yield Grade scores. Angus and Hereford straightbreds, Jersey crosses, and South Devon crosses were similar in Yield Grades while Angus-Hereford reciprocally crossed steers tended to have the least desirable Yield Grades. Jersey steers had higher percentages of kidney and pelvic fat than other breeds did.

Actual cutability and retail product percentages were definitely higher for Charolais steers followed closely by Limousins and then by Simmentals. South Devon Crosses and straightbred Angus and Herefords had cutability percentages about 3% below those of the first three breeds. Jersey and Angus-Hereford reciprocal crosses were similar in cut-out percentages. Steers out of Hereford dams had slightly higher cutability percentages than those out of Angus dams.

Bone percentage differences were small between breeds. Charolais and Simmental steers had slightly higher bone percentages than other breeds, and steers out of Hereford cows tended to have higher bone percentages than steers out of Angus cows.

Warner-Bratzler shear data suggest little variation among breeds and that all breeds had steaks with desirable tenderness. Simmental and Limousin crosses, however, had slightly higher shear values (slightly less tender). Taste panel data show steaks from all breeds "moderately" desirable in all palatability traits with very small differences among breeds.

Preliminary data for growth of heifers indicate that there was no difference between heifers out of Angus cows and those out of Hereford cows in weight at 550 days. Heifers by Charolais and Simmental bulls were heavier than heifers from other sire breeds. Heifers out of Angus cows reached puberty younger and a higher percentage was pregnant at the end of the breeding season than heifers out of Hereford cows.

Reproduction of F_1 Females

Of the two-year-old females born in 1970 and calving in 1972, all breed crosses had some difficulty in calving but Jersey crossbred heifers had the fewest problems. Birth weights of calves dropped from the various breeds of heifers differed little.

A larger percentage of females out of Angus dams exposed to breeding in 1971 calved in 1972 than females out of Hereford dams. The percentage of females from Angus dams detected in estrus after calving was similar to the percentage from Hereford dams. However, a greater percentage of females out of Hereford dams conceived postpartum.

More data are needed before conculsions can be made on calving and rebreeding of F_1 two-year-old heifers.

Table 1. Calving difficulty summary, 1970-71 calf crops, 2-year old females.

Breed of sire	Breed of dam	No. calves	Type of parturition, %: No calving difficulty[a]	Calf-puller	Caesarean	Posterior presentation	Dead at or shortly after birth
Hereford	Hereford	81	46.9	45.7	4.9	2.5	7.4
Angus	Angus	83	62.7	36.1	1.2	0.0	8.4
	Average[b]	164	54.8	40.9	3.1	1.3	7.9
Angus	Hereford	77	54.5	41.6	1.3	2.6	7.8
Hereford	Angus	86	61.6	37.2	1.2	0.0	3.5
	Average[b]	163	58.1	39.4	1.3	1.3	5.7
Jersey	Hereford	61	80.3	19.7	0.0	0.0	1.6
	Angus	76	85.5	13.2	1.3	0.0	5.3
	Average[b]	137	82.9	16.5	0.7	0.0	3.5
South Devon	Hereford	28	53.6	42.9	3.6	0.0	7.1
	Angus	45	35.6	62.2	2.2	0.0	13.3
	Average[b]	73	44.6	52.6	2.9	0.0	10.2
Limousin	Hereford	63	17.5	74.6	6.3	1.6	11.1
	Angus	58	32.8	65.5	1.7	0.0	6.9
	Average[b]	121	25.2	70.1	4.0	0.8	9.0
Simmental	Hereford	27	11.1	63.0	25.9	0.0	14.8
	Angus	37	40.5	51.4	5.4	2.7	10.8
	Average[b]	64	25.8	57.2	15.7	1.4	12.8
Charolais	Hereford	37	21.6	54.1	21.6	2.7	16.2
	Angus	34	23.5	67.6	8.8	0.0	11.8
	Average[b]	71	22.6	60.9	15.2	1.4	14.0
Average of all sire breeds	Hereford	374	44.4	47.3	6.7	1.6	8.6
	Angus	419	54.4	43.0	2.4	0.2	7.6
	Average[b]	793	49.4	45.2	4.6	0.9	8.1

[a] No assistance or minor hand assistance.

[b] Unweighted means.

Table 2. Calving difficulty summary, 1970-71-72 calf crops, 3-, 4-, 5-, 6-, 7-year-old females.

Breed of sire	Breed of dam	No. calves	Type of parturition, %: No calving difficulty[a]	Calf-puller	Caesarean	Posterior presentation	Deat at or shortly after birth
Hereford Angus	Hereford	118	92.4	3.4	0.0	4.2	2.5
	Angus	94	94.7	4.3	1.1	0.0	2.1
	Average[b]	212	93.6	3.9	0.6	2.1	2.3
Angus Hereford	Hereford	112	91.1	1.8	0.0	7.1	0.9
	Angus	150	95.3	2.7	0.0	2.0	0.0
	Average[b]	262	93.2	2.3	0.0	4.6	0.5
Jersey	Hereford	67	98.5	1.5	0.0	0.0	3.0
	Angus	108	99.1	0.0	0.0	0.9	1.9
	Average[b]	175	98.8	0.8	0.0	0.5	2.5
South Devon	Hereford	92	77.2	16.3	1.1	5.4	4.3
	Angus	76	88.2	7.9	0.0	3.9	3.9
	Average[b]	168	82.7	12.1	0.6	4.7	4.1
Limousin	Hereford	140	85.0	11.4	0.0	3.6	5.7
	Angus	127	89.8	6.3	0.0	3.9	2.4
	Average[b]	267	87.4	8.9	0.0	3.8	4.1
Simmental	Hereford	178	80.9	15.2	0.6	3.4	7.9
	Angus	186	84.4	12.4	0.0	3.2	3.8
	Average[b]	364	82.7	13.8	0.3	3.3	5.9
Charolais	Hereford	164	70.7	24.4	0.0	4.9	11.0
	Angus	190	81.1	13.7	0.0	5.3	6.3
	Average[b]	354	75.9	19.1	0.0	5.1	8.7
Average of all sire breeds	Hereford	871	83.5	12.1	0.2	4.2	5.7
	Angus	931	89.3	7.6	0.1	3.0	3.1
	Average[b]	1802	86.4	9.9	0.2	3.6	4.4

[a] No assistance or minor hand assistance.

[b] Unweighted means.

Table 3. Preweaning summary, 1970-71-72 calf-crops.

Breed of sire	Breed of dam	No. calves[a]	birth date	Birth wt., lb.[b]	Preweaning A.D.G., lb.[b]	Adjusted 200-day wt., lb.[b]	200-day wt. ratio
Hereford	Hereford	132	Apr. 1	83.5	1.83	450	95.7 c
Angus	Angus	203	Mar. 27	76.0	1.96	469	95.9 d
	Average	335	Mar. 29	79.8	1.90	459	95.8 e
Angus	Hereford	179	Mar. 31	82.0	1.91	464	98.7 c
Hereford	Angus	157	Mar. 28	81.1	2.03	487	99.6 d
	Average	336	Mar. 30	81.6	1.97	475	99.2 e
Jersey	Hereford	116	Mar. 31	74.8	1.87	449	95.5 c
	Angus	167	Mar. 24	71.1	1.92	455	93.0 d
	Average	283	Mar. 28	73.0	1.90	452	94.4 e
South Devon	Hereford	107	Apr. 2	88.1	1.89	467	99.4 c
	Angus	108	Mar. 31	83.3	2.03	490	100.2 d
	Average	215	Apr. 1	85.7	1.96	478	99.8 e
Limousin	Hereford	179	Apr. 11	88.4	1.93	473	100.6 c
	Angus	174	Apr. 7	84.7	2.06	498	101.8 d
	Average	353	Apr. 9	86.5	1.99	485	101.3 e
Simmental	Hereford	182	Apr. 6	93.5	1.99	492	104.7 c
	Angus	202	Apr. 1	88.6	2.10	510	104.3 d
	Average	384	Apr. 3	91.1	2.05	501	104.6 e
Charolais	Hereford	163	Apr. 4	93.9	2.00	493	104.9 c
	Angus	195	Mar. 31	90.0	2.13	516	105.5 d
	Average	358	Apr. 2	91.9	2.06	505	105.4 e
Average of all sire breeds	Hereford	1058	Apr. 3	86.3	1.92	470	100.0
	Angus	1206	Mar. 31	82.1	2.03	489	100.0
	Average	2264	Apr. 1	84.2	1.98	479	100.0

[a] Includes all steer and heifer calves weaned.
[b] Adjusted to a steer and a 5-, 6, and 7,-year-old cow bases.
[c] Ratio computed relative to average for Hereford cows adjusted to a steer calf and a 5-. 6-, and 7-year-old cow bases.
[d] Ratio computed relative to average for Angus cows, adjusted to a steer calf and a 5-, 6-, and 7-year-old cow bases.
[e] Ratio computed relative to overall average adjusted to a steer calf and a 5-. 6-, and 7-year-old cow bases.

Table 4. Postweaning steer feedlot rations, 1971 calf crop.

Ingredient	Oct. 25-Nov. 22	Nov. 23-Dec. 21	Dec. 22-Feb. 15	Feb. 16-Slaughter
	%	%	%	%
Corn silage	85.0	75.0	60.0	60.0
Concentrate[a]	7.5	18.5	32.0	33.0
Supplement, 38% crude protein[b]	7.5	6.5	8.0	7.0
Ration analyses, 90% dry matter basis[c]				
Crude protein, %	13.4	12.6	13.1	12.6
Digestible protein, %	9.8	9.1	9.5	9.1
Total digestible nutrients, %	64.9	68.2	70.0	71.0

[a] Concentrate portion included varying amounts of ground shelled corn, ground sorghum grain, and ground wheat.

[b] Composition of supplement: 1600 lb. soybean meal; 150 lb. salt; 60 lb. dicalcium phosphate; 172 lb. ground limestone; 14.0 lb. Vitamine A premix (2;000,000 I.U. Vitamin A/lb.); 1.4 lb. Aureomycin (50 grams/lb.); 2 lb. trace mineral premix; 60 lb. ammonium chloride from April 12 to slaughter.

[c] Dry matter and crude protein based on proximate analyses.

Table 5. Least squares means for postweaning average daily gains, adjusted final weights and TDN efficiencies, 1971 calf crop.

Breed of sire	Breed of dam	No. steers[a] 200	242	284	Total	Postweaning average daily gain[b] 200	242	284	Avg.	Adjusted final weight[c] 200	242	284	Avg.	TDN efficiency[d] 200	242	284	Avg.
Hereford	Hereford	9	9	9	27	2.87	2.54	2.40	2.60	1075	1069	1093	1079				
Angus	Angus	8	9	9	26	2.77	2.74	2.33	2.61	1060	1172	1080	1104	5.56	6.09	7.00	6.22
	Average	17	18	18	53	2.82	2.64	2.37	2.61	1068	1121	1087	1092				
Angus	Hereford	12	13	12	37	2.91	2.71	2.65	2.76	1095	1130	1195	1140				
Hereford	Angus	10	10	11	31	2.89	2.58	2.51	2.66	1110	1123	1183	1139	5.59	6.10	6.51	6.07
	Average	22	23	23	68	2.90	2.65	2.58	2.71	1103	1127	1189	1140				
Jersey	Hereford	8	7	8	23	2.82	2.51	2.43	2.59	1043	1059	1104	1069				
	Angus	7	7	8	22	2.63	2.48	2.25	2.45	1038	1073	1062	1058	5.70	6.29	6.73	6.24
	Average	15	14	16	45	2.73	2.50	2.34	2.52	1041	1066	1083	1063				
South Devon	Hereford	5	7	5	18	2.87	2.79	2.52	2.73	1046	1158	1129	1111				
	Angus	6	5	6	17	2.96	2.72	2.50	2.73	1104	1143	1158	1135	5.92	6.31	6.89	6.37
	Average	11	12	12	35	2.92	2.76	2.51	2.73	1075	1151	1144	1123				
Limousin	Hereford	5	5	5	15	2.64	2.79	2.63	2.69	1074	1164	1137	1125				
	Angus	7	6	6	19	2.75	2.69	2.51	2.65	1099	1142	1170	1137	5.17	5.62	6.20	5.66
	Average	12	11	11	34	2.70	2.74	2.57	2.67	1087	1153	1154	1131				
Simmental	Hereford	9	9	8	26	3.32	3.12	2.93	3.12	1217	1254	1278	1250				
	Angus	9	9	9	27	2.89	2.86	2.71	2.82	1137	1222	1246	1202	5.57	6.04	6.67	6.09
	Average	18	18	17	53	3.11	2.99	2.82	2.97	1177	1238	1262	1226				
Charolais	Hereford	9	9	9	27	3.24	2.98	2.83	3.02	1167	1207	1250	1208				
	Angus	5	7	7	19	3.01	2.86	2.67	2.85	1176	1179	1229	1195	5.21	5.68	6.12	5.67
	Average	14	16	16	46	3.13	2.92	2.75	2.93	1172	1193	1240	1202				
Average of all sire breeds	Hereford	57	59	57	173	2.95	2.78	2.63	2.79	1102	1149	1169	1140				
	Angus	52	53	56	161	2.84	2.70	2.50	2.68	1103	1151	1161	1138	5.53	6.02	6.59	6.05
	Average	109	112	113	334	2.90	2.74	2.56	2.73	1103	1150	1165	1139				

[a] Number of steers slaughtered after 200, 242 and 284 days on feed.
[b] Average daily gain = (final weight - actual weaning weight) ÷ days on feed.
[c] Adjusted final weight = adjusted 200-day weight + (postweaning average daily gain x days on feed postweaning).
[d] TDN efficiency = lb. TDN consumed per lb. gain; 90% dry matter basis for feed consumed.

Table 6. Least squares means for adjusted hot carcass weight, dressing percent, U.S.D.A. quality grade and marbling score[a], 1971 calf crop.

Breed of sire	Breed of dam	Adjusted hot carcass weight, lb. 200	242	284	Avg.	Dressing % 200	242	284	Avg.	U.S.D.A. Quality Grade[b] 200	242	284	Avg.	Marbling score[c] 200	242	284	Avg.
Hereford Angus	Hereford	595	642	678	638	60.3	62.1	62.1	61.5	9.0	8.4	10.0	9.1	9.9	8.8	12.3	10.3
	Angus	600	710	676	662	61.1	62.8	62.5	62.1	10.2	10.5	11.5	10.7	12.2	14.1	17.4	14.6
	Average	598	676	677	650	60.7	62.5	62.3	61.8	9.6	9.5	10.8	9.9	11.1	11.5	14.9	12.5
Angus Hereford	Hereford	608	674	740	674	60.4	62.0	62.3	61.6	9.7	9.6	10.8	10.0	11.2	11.1	15.4	12.6
	Angus	627	675	744	682	61.4	62.1	62.9	62.1	9.9	10.0	10.3	10.1	12.0	12.1	14.0	12.7
	Average	618	675	742	678	60.9	62.1	62.6	61.9	9.8	9.8	10.6	10.1	11.6	11.6	14.7	12.6
Jersey	Hereford	565	612	680	619	59.2	59.9	61.6	60.2	8.6	9.5	10.2	9.4	9.8	13.9	16.0	13.2
	Angus	581	625	639	615	60.3	59.8	60.7	60.3	9.5	10.0	10.4	10.0	12.6	14.6	17.4	14.9
	Average	573	619	660	617	59.8	59.9	61.2	60.2	9.1	9.8	10.3	9.7	11.2	14.3	16.7	14.1
South Devon	Hereford	568	692	703	654	59.7	62.3	62.6	61.5	8.7	9.8	9.3	9.3	9.3	11.9	12.1	11.1
	Angus	613	693	723	676	60.9	63.2	62.7	62.3	9.5	10.6	10.7	10.3	10.6	12.9	15.0	12.8
	Average	591	693	713	665	60.3	62.8	62.7	61.9	9.1	10.2	10.0	9.8	10.0	12.4	13.6	12.0
Limousin	Hereford	628	698	687	671	63.1	62.5	60.9	62.2	8.6	8.8	9.0	8.8	8.7	9.5	9.6	9.3
	Angus	638	693	748	693	62.8	63.0	64.1	63.3	8.1	9.2	9.5	8.9	8.3	11.0	12.0	10.4
	Average	632	696	718	682	63.0	62.8	62.5	62.8	8.4	9.0	9.3	8.9	8.5	10.3	10.8	9.9
Simmental	Hereford	666	736	772	725	60.0	61.4	60.7	60.7	9.1	9.0	9.1	9.1	9.7	9.7	11.4	10.3
	Angus	643	731	774	716	61.3	62.2	62.4	61.9	9.1	9.2	9.7	9.3	10.1	10.3	13.0	11.1
	Average	654	734	773	720	60.6	61.8	61.6	61.3	9.1	9.1	9.4	9.2	9.9	10.0	12.2	10.7
Charolais	Hereford	649	711	760	707	61.2	61.4	61.3	61.3	7.8	8.6	10.2	8.9	7.8	9.1	12.9	9.9
	Angus	678	693	767	713	62.2	61.5	62.7	62.1	9.5	9.3	10.0	9.6	10.2	10.0	11.7	10.6
	Average	664	702	764	710	61.7	61.5	62.0	61.7	8.7	9.0	10.1	9.3	9.0	9.6	12.3	10.3
Average of all sire breeds	Hereford	611	681	717	670	60.6	61.7	61.6	61.3	8.8	9.1	9.8	9.2	9.5	10.6	12.8	11.0
	Angus	626	689	724	680	61.4	62.0	62.6	62.0	9.4	9.8	10.3	9.8	10.8	12.2	14.4	12.4
	Average	619	685	721	675	61.0	61.9	62.1	61.7	9.1	9.5	10.1	9.5	10.2	11.4	13.6	11.7

[a] Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, adjusted for age of dam.

[b] U.S.D.A. Quality Grade: 9=high good;(10=low) choice; 11=average choice; 12=high choice; etc.

[c] Marbling Score: 9=slight+; 10=small-; ..... 27=abundant+.

Table 7. Least squares means for yield grade, rib eye area, fat thickness and percentages of kidney, pelvic, and heart fat[a], 1971 calf crop.

Breed of sire	Breed of dam	U.S.D.A. Yield Grade				Ribeyearea, sq. in.				Fat thickness, in.				Estimated kidney, pelvic and heart fat, %			
		200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	3.0	3.1	3.4	3.2	11.0	11.9	11.7	11.5	.45	.66	.63	.58	2.7	2.2	2.4	2.4
Angus	Angus	3.6	4.0	3.8	3.8	10.9	12.0	11.6	11.5	.71	.91	.83	.82	3.1	3.8	2.8	3.2
	Average	3.3	3.6	3.6	3.5	11.0	12.0	11.6	11.5	.58	.79	.73	.70	2.9	3.0	2.6	2.8
Angus	Hereford	3.5	3.8	4.0	3.8	10.9	11.5	12.1	11.5	.66	.72	.87	.75	2.8	3.3	2.6	2.9
Hereford	Angus	3.3	3.7	4.1	3.7	11.7	11.8	12.7	12.1	.67	.77	.90	.78	2.6	2.7	3.0	2.8
	Average	3.4	3.8	4.1	3.8	11.3	11.7	12.4	11.8	.67	.75	.89	.77	2.7	3.0	2.8	2.8
Jersey	Hereford	3.0	3.4	3.7	3.4	11.4	11.1	11.6	11.4	.35	.40	.58	.44	5.2	5.0	4.3	4.8
	Angus	3.3	3.6	3.6	3.5	11.5	11.1	11.6	11.4	.53	.54	.60	.56	5.0	4.9	4.9	4.9
	Average	3.2	3.5	3.7	3.5	11.5	11.1	11.6	11.4	.44	.47	.59	.50	5.1	5.0	4.6	4.9
South Devon	Hereford	3.0	3.7	3.7	3.5	11.1	12.1	11.5	11.6	.41	.66	.53	.53	4.2	3.8	3.4	3.8
	Angus	2.7	3.9	3.5	3.4	11.8	11.7	12.5	12.0	.40	.70	.68	.59	3.1	4.5	3.7	3.8
	Average	2.9	3.8	3.6	3.4	11.5	11.9	12.0	11.8	.41	.68	.61	.57	3.7	4.2	3.6	3.8
Limousin	Hereford	2.0	2.5	2.6	2.4	13.3	13.6	13.2	13.4	.38	.48	.47	.44	2.7	3.2	3.0	3.0
	Angus	2.4	2.8	3.1	2.8	13.1	13.0	13.8	13.3	.43	.60	.62	.55	3.6	3.4	4.0	3.7
	Average	2.2	2.7	2.9	2.6	13.2	13.3	13.5	13.3	.41	.54	.55	.50	3.2	3.3	3.5	3.3
Simmental	Hereford	2.5	2.6	2.7	2.6	12.6	13.0	13.2	12.9	.41	.39	.38	.39	2.9	3.0	2.7	2.9
	Angus	2.9	2.9	3.5	3.1	12.2	13.1	12.6	12.6	.47	.54	.64	.55	3.7	3.5	3.3	3.5
	Average	2.7	2.8	3.1	2.9	12.4	13.1	12.9	12.8	.44	.47	.51	.47	3.3	3.3	3.0	3.2
Charolais	Hereford	1.9	2.3	2.6	2.3	13.2	13.4	13.8	13.5	.28	.39	.50	.39	2.6	2.3	2.6	2.5
	Angus	2.7	2.5	3.2	2.8	13.0	13.4	13.4	13.3	.45	.47	.73	.55	3.5	3.4	3.1	3.3
	Average	2.3	2.4	2.9	2.5	13.1	13.4	13.6	13.4	.37	.43	.62	.47	3.1	2.9	2.9	3.0
Average of	Hereford	2.7	3.1	3.2	3.0	11.9	12.4	12.4	12.2	.42	.53	.57	.50	3.3	3.3	3.0	3.2
all sire	Angus	3.0	3.3	3.5	3.3	12.0	12.3	12.5	12.3	.52	.65	.71	.63	3.5	3.7	3.5	3.6
breeds	Average	2.8	3.2	3.4	3.1	12.0	12.3	12.5	12.3	.47	.59	.64	.57	3.4	3.5	3.3	3.4

[a] Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, and adjusted for age of dam.

Table 8.[a]
Least squares means for actual percentages of cutability, retail product, fat trim and bone, 1971 calf crop.

Breed of sire	Breed of dam	Cutability, %[b] 200	242	284	Avg.	Retail product, %[c] 200	242	284	Avg.	Fat trim, % 200	242	284	Avg.	Bone, % 200	242	284	Avg.
Hereford	Hereford	54.3	54.3	54.1	54.2	67.2	66.8	66.1	66.7	20.0	21.4	22.4	21.3	12.8	11.8	11.5	12.0
Angus	Angus	53.5	50.2	52.2	52.0	66.9	63.1	64.5	64.8	21.4	26.4	24.9	24.2	11.7	10.4	10.6	10.9
	Average	53.9	52.3	52.3	53.1	67.1	65.0	65.3	65.8	20.7	23.9	23.7	22.8	12.3	11.1	11.1	11.5
Angus	Hereford	51.9	51.5	51.8	51.7	64.7	64.2	63.7	64.2	23.1	24.7	25.1	24.3	12.1	11.0	11.2	11.4
Hereford	Angus	53.2	51.8	51.2	52.1	65.9	64.3	63.0	64.4	22.2	24.7	26.4	24.4	11.9	10.9	10.6	11.1
	Average	52.6	51.7	51.5	51.9	65.3	64.3	63.4	64.3	22.7	24.7	25.8	24.4	12.0	11.0	10.9	11.3
Jersey	Hereford	52.6	51.7	52.2	52.2	66.0	64.4	64.1	64.8	21.5	23.1	24.4	23.0	12.6	12.4	11.6	12.2
	Angus	51.6	51.2	52.4	51.7	64.1	64.5	65.1	64.6	23.9	23.8	23.6	23.8	11.9	11.7	11.3	11.6
	Average	52.1	51.5	52.3	52.0	65.1	64.5	64.6	64.7	22.7	23.5	24.0	23.4	12.3	12.1	11.5	12.0
South Devon	Hereford	54.0	51.9	53.1	53.0	67.3	65.1	64.8	65.7	19.6	23.1	23.9	22.2	13.0	11.7	11.3	12.0
	Angus	54.2	49.7	53.5	52.5	68.1	62.2	65.9	65.4	19.9	27.1	22.9	23.3	12.0	10.8	11.2	11.3
	Average	54.1	50.8	53.3	52.7	67.7	63.7	65.4	65.6	19.8	25.1	23.4	22.8	12.5	11.3	11.3	11.7
Limousin	Hereford	55.7	54.0	56.0	55.2	68.4	67.3	68.8	68.2	20.0	21.0	19.2	20.1	11.6	11.6	12.0	11.7
	Angus	56.0	55.7	55.4	55.7	69.3	68.4	67.4	68.4	18.8	20.5	21.7	20.3	11.9	11.1	10.9	11.3
	Average	55.9	54.9	55.7	55.5	68.9	67.9	68.1	68.3	19.4	20.8	20.5	20.2	11.8	11.4	11.5	11.5
Simmental	Hereford	55.4	56.2	56.3	56.0	67.9	69.2	68.6	68.6	18.4	18.3	18.6	18.4	13.8	12.5	12.8	13.0
	Angus	54.2	54.5	54.4	54.4	67.0	67.3	66.6	67.0	20.2	20.6	21.4	20.7	12.8	12.1	12.0	12.3
	Average	54.8	55.4	55.4	55.2	67.5	68.3	67.6	67.8	19.3	19.5	20.0	19.6	13.3	12.3	12.4	12.7
Charolais	Hereford	58.3	56.7	56.8	57.3	71.1	69.9	68.8	69.9	15.9	17.3	18.9	17.4	13.0	12.8	12.2	12.7
	Angus	55.6	55.9	54.8	55.4	68.8	68.9	67.0	68.2	18.8	19.3	21.4	19.8	12.4	11.8	11.6	11.9
	Average	57.0	56.3	55.8	56.4	70.0	69.4	67.9	69.1	17.4	18.3	20.2	18.6	12.7	12.3	11.9	12.3
Average	Hereford	54.6	53.8	54.3	54.2	67.5	66.7	66.4	66.9	19.8	21.3	21.8	21.0	12.7	12.0	11.8	12.2
of all	Angus	54.0	52.7	53.4	53.4	67.2	65.5	65.6	66.1	20.7	23.2	23.2	22.4	12.1	11.3	11.2	11.5
sirebreeds	Average	54.3	53.2	53.9	53.8	67.3	66.1	66.0	66.5	20.3	22.3	22.5	21.7	12.4	11.6	11.5	11.8

[a] Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, and adjusted for age of dam.

[b] Cutability. % = Actual yield of boneless, closely trimmed beef from the round, loin, rib, and chuck.

[c] Retail Product. % = Actual yield of boneless, closely trimmed beef from the, carcass.

Table 9.
Least squares means for Warner-Bratzler shear and taste panel evaluation of cooked steaks[a], 1971 calf crop.

Breed of sire	Breed of dam	Warner-Bratzler shear, lb.[b]				Taste panel tenderness[c]				Taste panel flavor[c]				Taste panel juiciness[c]				Taste panel acceptability[c]			
		200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.	200	242	284	Avg.
Hereford	Hereford	7.1	6.7	7.0	6.9	7.3	8.4	8.1	7.9	7.5	7.8	7.7	7.7	7.0	8.0	7.8	7.6	7.2	8.1	7.9	7.7
Angus	Angus	7.2	7.8	7.7	7.6	7.7	6.6	7.4	7.2	7.7	7.3	7.6	7.5	7.3	6.8	7.6	7.2	7.5	6.8	7.5	7.3
	Average	7.2	7.3	7.4	7.3	7.5	7.5	7.8	7.6	7.6	7.6	7.7	7.6	7.2	7.4	7.7	7.4	7.4	7.5	7.7	7.5
Angus	Hereford	6.5	8.4	6.9	7.3	7.6	7.1	7.7	7.5	7.4	7.4	7.8	7.5	7.5	7.2	7.8	7.5	7.5	7.2	7.8	7.5
Hereford	Angus	7.7	7.0	6.9	7.2	7.5	7.6	7.2	7.4	7.1	7.4	7.6	7.4	7.1	7.3	7.4	7.3	7.2	7.5	7.4	7.4
	Average	7.1	7.7	6.9	7.2	7.6	7.4	7.5	7.5	7.3	7.4	7.7	7.5	7.3	7.3	7.6	7.4	7.4	7.4	7.6	7.5
Jersey	Hereford	7.2	7.9	7.4	7.5	7.1	6.8	8.0	7.3	7.9	7.5	7.2	7.5	7.7	7.0	7.8	7.5	7.5	7.1	7.5	7.4
	Angus	6.5	6.5	6.7	6.6	7.6	7.3	6.5	7.1	8.0	7.4	7.7	7.7	7.6	7.3	7.4	7.4	7.7	7.3	7.1	7.4
	Average	6.9	7.2	7.1	7.1	7.4	7.1	7.3	7.2	8.0	7.5	7.5	7.6	7.7	7.2	7.6	7.5	7.6	7.2	7.3	7.4
South Devon	Hereford	8.2	8.1	7.7	8.0	7.3	7.0	7.3	7.2	7.6	7.5	7.4	7.5	7.1	7.0	7.6	7.2	7.3	7.2	7.2	7.2
	Angus	7.1	6.4	6.8	6.8	7.1	7.4	7.3	7.3	7.2	7.3	7.6	7.3	7.6	7.1	7.4	7.4	6.9	7.3	7.4	7.2
	Average	7.7	7.3	7.3	7.4	7.2	7.2	7.3	7.2	7.4	7.4	7.5	7.4	7.3	7.1	7.5	7.3	7.1	7.3	7.3	7.2
Limousin	Hereford	8.2	7.7	8.4	8.1	6.8	7.1	6.2	6.7	7.4	7.4	7.6	7.5	7.6	6.8	7.4	7.2	6.8	7.0	6.6	6.8
	Angus	7.7	7.4	9.1	8.1	7.2	7.6	6.4	7.1	7.6	7.7	7.6	7.6	6.6	7.2	7.3	7.0	7.1	7.5	7.2	7.3
	Average	8.0	7.6	8.8	8.1	7.0	7.4	6.3	6.9	7.5	7.6	7.6	7.6	6.9	7.0	7.4	7.1	7.0	7.3	6.9	7.1
Simmental	Hereford	8.3	8.0	8.1	8.1	6.9	7.0	7.4	7.1	7.4	7.6	7.4	7.5	7.5	6.9	7.1	7.2	7.3	7.1	7.3	7.2
	Angus	8.0	7.8	8.4	8.1	7.1	7.7	6.4	7.1	7.3	7.7	7.5	7.5	7.0	7.7	7.3	7.3	6.9	7.7	6.9	7.2
	Average	8.2	7.9	8.3	8.1	7.0	7.4	6.9	7.1	7.4	7.7	7.5	7.5	7.3	7.3	7.2	7.3	7.1	7.4	7.1	7.2
Charolais	Hereford	6.6	7.8	7.9	7.4	6.0	6.8	7.2	6.7	7.6	7.4	7.8	7.6	6.3	7.2	7.5	7.0	6.2	7.1	7.4	6.9
	Angus	7.4	7.1	8.1	7.5	7.1	6.6	6.9	6.9	7.4	7.4	7.3	7.4	7.0	6.8	7.0	6.9	7.3	6.9	7.1	7.1
	Average	7.0	7.5	8.0	7.5	6.6	6.7	7.1	6.8	7.5	7.4	7.6	7.5	6.7	7.0	7.3	7.0	6.8	7.0	7.3	7.0
Average of all sire breeds	Hereford	7.4	7.8	7.6	7.6	7.0	7.2	7.4	7.2	7.5	7.5	7.6	7.5	7.2	7.2	7.6	7.3	7.1	7.3	7.4	7.3
	Angus	7.4	7.1	7.8	7.4	7.3	7.3	6.9	7.2	7.5	7.5	7.6	7.5	7.2	7.2	7.4	7.3	7.2	7.3	7.2	7.2
	Average	7.4	7.5	7.7	7.5	7.2	7.3	7.2	7.2	7.5	7.5	7.6	7.5	7.2	7.2	7.5	7.3	7.2	7.3	7.3	7.3

[a]Data for all carcass traits adjusted by regression on birth date to the average age of each slaughter group, and adjusted for age of dam.

[b]Pounds of force required to shear one-half inch cores of steaks cooked at 350°F to 150°F internal temperature and cooled 30 minutes at room temperature. Warner-Bratzler shear values obtained on steaks from all 334 steers.

[c]Taste panel scores based on a 9-point scale; higher scores indicate greater acceptability. Taste panel traits measured on steaks from 4 steers per breed group per slaughter date (168).

Table 10. Postweaning growth and reproductive performance of yearling heifers, 1971 calf crop.

Breed of sire	Breed of dam	No. heifers	200-day postweaning avg. daily gain, lb.	Adj. 400-day wt., lb.[a]	Adj. 550-day wt., lb.[b]	% reaching puberty by 15 mos.	Avg. age at puberty days[c]	% pregnant[d]
Hereford	Hereford	16	0.99	616	742	81	415	88
Angus	Angus	21	1.07	653	764	100	370	90
	Average	37	1.03	635	754	92	393	89
Angus	Hereford	27	1.18	665	783	96	394	89
Hereford	Angus	24	1.13	681	782	96	385	92
	Average	51	1.16	674	783	96	390	90
Jersey	Hereford	27	1.01	609	723	100	348	93
	Angus	21	0.99	620	736	100	326	76
	Average	48	1.00	614	729	100	337	85
South Devon	Hereford	20	1.21	664	788	100	381	95
	Angus	23	1.16	680	778	100	345	91
	Average	43	1.19	673	784	100	363	93
Limousin	Hereford	14	1.11	656	763	64	427	57
	Angus	28	1.08	678	769	100	383	96
	Average	42	1.10	668	767	88	405	83
Simmental	Hereford	31	1.16	681	836	97	376	94
	Angus	28	1.22	720	829	100	362	86
	Average	59	1.19	700	832	98	369	90
Charolais	Hereford	20	1.17	679	826	85	422	70
	Angus	12	1.18	704	813	100	393	92
	Average	32	1.18	693	821	91	408	78
Average of all sire breeds	Hereford	155	1.12	653	781	92	395	86
	Angus	157	1.12	677	782	99	366	89
	Average	312	1.12	665	781	96	380	88

[a] Adjusted 400-day weight = Adjusted 200-day weight + (200-day postweaning average daily gain x 200 days).
[b] Adjusted 550-day weight = Adjusted 200-day weight + (350-day postweaning average daily gain x 350 days).
[c] Includes only heifers reaching puberty by 15 months and should be interpreted in relation to the percentage reaching puberty by 15 months.
[d] Breeding period was 46 days by artificial insemination and 24 days by natural service.

Table 11. Calving difficulty for the first calf crop of F_1 2-year-old females calving during 1972[a].

Cow genotype		No. of calves			Birth wt., lb.[b]	Type of parturition, %				Dead at or shortly after birth (No.)
Breed of sire	Breed of dam	Total	Males	Females		No difficulty[c]	Calf-puller	Caesarean	Abnormal presentation	
Hereford	Hereford	17[c]	10	6	63.3	50.0	25.0	6.3	18.8	1
Angus	Angus	18[d]	11	6	63.2	52.9	35.3	0.0	5.9	0
	Average	35	21	12	63.3	51.5	30.3	3.0	12.1	1
Angus	Hereford	18	7	11	70.3	55.6	38.9	5.6	0.0	0
Hereford	Angus	23	10	13	67.3	65.2	30.4	4.3	0.0	2
	Average	41	17	24	68.8	61.0	34.1	4.9	0.0	2
Jersey	Hereford	27	12	15	65.3	85.2	14.8	0.0	0.0	
	Angus	14	8	6	59.7	78.6	21.4	0.0	0.0	
	Average	41	20	21	62.5	82.9	17.1	0.0	0.0	1
South Devon	Hereford	11	7	4	71.5	36.4	63.6	0.0	0.0	0
	Angus	13	8	5	73.6	38.5	53.8	7.7	0.0	2
	Average	24	15	9	72.6	37.5	58.3	4.2	0.0	2
Limousin	Hereford	22	14	8	67.7	59.1	36.4	0.0	4.5	1
	Angus	23	9	14	70.1	52.2	43.4	4.3	0.0	2
	Average	45	23	22	68.9	55.6	40.0	2.2	2.2	3
Simmental	Hereford	20	10	10	70.9	45.0	50.0	5.0	0.0	0
	Angus	19	14	5	71.5	52.6	36.8	10.5	0.0	1
	Average	39	24	15	71.2	48.7	43.6	7.7	0.0	1
Charolais	Hereford	27[d]	14	13	73.8	63.0	25.9	7.4	3.7	0
	Angus	12[d]	7	4	77.2	45.5	45.5	0.0	9.1	1
	Average	39	21	17	75.5	57.9	31.6	5.3	5.3	1
Average of all sire breeds	Hereford	142	74	67	69.0	59.6	33.3	3.5	3.5	2
	Angus	122	67	53	68.9	56.3	37.8	4.2	1.7	9
	Average	264	141	120	69.0	58.1	35.4	3.8	2.7	11

[a] Calves from these cows sired by Hereford, Angus, Devon, Holstein and Brahman bulls.
[b] Unweighted for calf sex.
[c] No assistance or minor hand assistance.
[d] One premature birth.

Table 12. Calving and breeding of 2-year-old females during 1972[a].

Cow genotype: Breed of sire	Cow genotype: Breed of dam	No. exposed to breeding in 1971	Calving in 1972: No.	Calving in 1972: %	% detected in estrus[b]	% bred by AI[b]	Postpartum interval, Days	% pregnant[b]	Cow wt. at 2½ yrs., lb.
Hereford	Hereford	26	17	65.4	94.1	76.5	80.6	94.1	853
Angus	Angus	23	18	78.3	100.0	88.9	86.4	83.3	834
	Average[c]	49	35	71.9	97.1	82.7	83.5	88.7	844
Angus	Hereford	22	18	81.8	94.4	83.3	89.4	88.9	874
Hereford	Angus	24	23	95.8	95.7	95.7	75.3	87.0	914
	Average[c]	46	41	88.8	95.1	89.5	82.4	88.0	894
Jersey	Hereford	29	27	93.1	100.0	88.9	82.9	96.3	800
	Angus	16	14	87.5	100.0	100.0	76.4	85.7	755
	Average[c]	45	41	90.3	100.0	94.5	79.7	91.0	778
South Devon	Hereford	18	11	61.1	90.9	90.9	75.8	81.8	912
	Angus	17	13	76.5	100.0	92.3	80.8	100.0	930
	Average[c]	35	24	68.8	95.5	91.6	78.3	90.9	921
Limousin	Hereford	30	22	73.3	90.9	63.6	73.2	86.4	899
	Angus	26	23	88.5	95.7	91.3	73.0	69.6	911
	Average[c]	56	45	80.9	93.3	77.5	73.1	78.0	905
Simmental	Hereford	27	20	74.1	90.0	85.0	86.4	75.0	948
	Angus	22	19	86.4	94.7	89.5	89.2	73.7	933
	Average[c]	49	39	80.3	92.4	87.3	87.8	74.4	941
Charolais	Hereford	34	27	79.4	100.0	81.5	86.4	88.9	970
	Angus	16	12	75.0	91.7	91.7	93.0	66.7	1076
	Average[c]	50	39	77.2	95.9	86.6	89.7	77.8	1023
Average of all sire breeds	Hereford	186	142	76.3	94.3	81.4	82.1	87.3	894
	Angus	144	122	84.7	96.8	92.8	82.0	80.9	908
	Average[c]	330	264	80.5	95.6	87.1	82.1	84.1	901

[a] Calves from these cows sired by Hereford, Angus, Devon, Holstein and Brahman bulls.

[b] Percentage of those that calved.

[c] Unweighted means.

WIND CHILL FOR CATTLE[a]

David R. Ames

Summary

Cattle hides were exposed to cold-wind combinations ranging from -10°F to 35°F and 0 to 35 mph. Heat flow through hides (including hair) was measured and plotted as a function of wind velocity. Prediction equations for heat flow at different cold-wind combinations were formulated and compared with the human wind-chill index used by the U. S. Weather Bureau. Results indicate that wind-chill effects for humans and cattle are similar at low wind velocities (less than 25 mph) but differ at wind velocities greater than 25 mph. Over the range of wind velocities studied, a cubic relationship was found for cattle hides rather than the quadratic relationship of the human wind-chill index.

Introduction

Energy requirements of cattle during cold stress are increased by wind velocity (lowered effective temperature[1]). Recent attempts to account for increased maintenance costs during cold and wind have used the U. S. Weather Bureau wind-chill index. It is valid for bare skinned animals but its relevance to animals with external insulation (hair of cattle) is questioned. We attempted to test the validity of the U. S. Weather Bureau wind-chill index for cattle and to provide a prediction equation for cattle.

Experimental Procedure

A model system was used to determine rate of heat flow through cattle hides exposed to combinations of wind and cold. An insulated water bath maintained at 100°F was the "animal" heat source and hide sections represented animal insulatory barriers. Heat flow was measured by a RDF Model 20460 sensor placed between the water bath and hide. Wind velocity was created by a squirrel cage fan and controlled by a variable transformer. Freezers, coolers, and environmental conditions were used to obtain desired temperatures. A total of 140 observations was conducted on four cattle hides at temperatures ranging from -10°F to 35°F and wind velocities from 0 to 35 mph. All data were analyzed using regression analysis.

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[1]Effective temperature refers to the cooling or heating power of the environment and takes into account wet bulb temperature, radiation, and wind velocity in addition to dry bulb temperature.

[a]Research supported by Livestock and Meat Industry Council

Results and Discussion

Heat loss from cattle exposed to cold is minimized by insulatory barriers. Cattle have tissue insulation (I_T), external insulation from hair (I_E), and the insulatory property of the air layer surrounding the animal (I_A). The insulatory barriers are additive so any factor that destroys or reduces one of the three reduces total insulation, increases rate of heat loss, and ultimely decreases production efficiency.

Air velocity increases heat loss by reducing insulation. The wind-chill effect results initially from reduced or destroyed I_A. With bare skinned animals, I_A is the only insulatory barrier affected by wind because I_E doesn't exist and I_T is not vulnerable to wind. Consequently, the effect of wind on I_A is responsible for the wind-chill effect for bare skinned animals. Human wind-chill indicies are shown in Figure 1a. The human wind-chill is quadratic with wind velocities above 30 mph having little added effect on the rate of heat loss. Since I_A is already destroyed, higher velocities have no additional effect.

When cattle hides where exposed to cold wind combinations using the model system described, air velocity increased the rate of heat loss. However, the rate of increase plotted as a function of wind velocity differed from that for bare skinned animals, assuming a cubic relationship (Figure 1b). Critical evaluation of the difference between the quadratic and cubic relationships for bare skinned and haired animals, shows that during low wind velocities (less than 25 mph) change in rates of heat loss are similar. However, at wind speeds greater than 25 mph, little additionaleffect is noted for the human wind-chill but substantial increases are measured for cattle hides. So when wind velocity exceeds 25 mph, wind-chill effects on cattle are different than for humans. This difference in wind-chill effect is explained by high velocity (greater than 25 mph) winds destroying I_E in cattle. The absence of I_E in bare skinned animals eliminates further insulatory destruction. Absolute heat loss is lower for animals with hair or fur in still air because of their greater total insulation.

Practical attempts to predict the cooling power of cold, windy environments for cattle with wind-chill indicies prepared for bare skinned animals are valid only at wind velocities less than 25 mph. Data presented suggest that wind velocities greater than 25 mph require wind-chill tables prepared specifically for cattle. To date, such equivalent temperature tables are not available. Until tables are available, those who use human wind-chill indicies are cautioned against underestimating the wind-chill factor for cattle exposed to wind velocities over 25 mph. In addition, the data suggest that management techniques that eliminate high wind velocities (greater than 25 mph) are more valuable than previously thought for cattle.

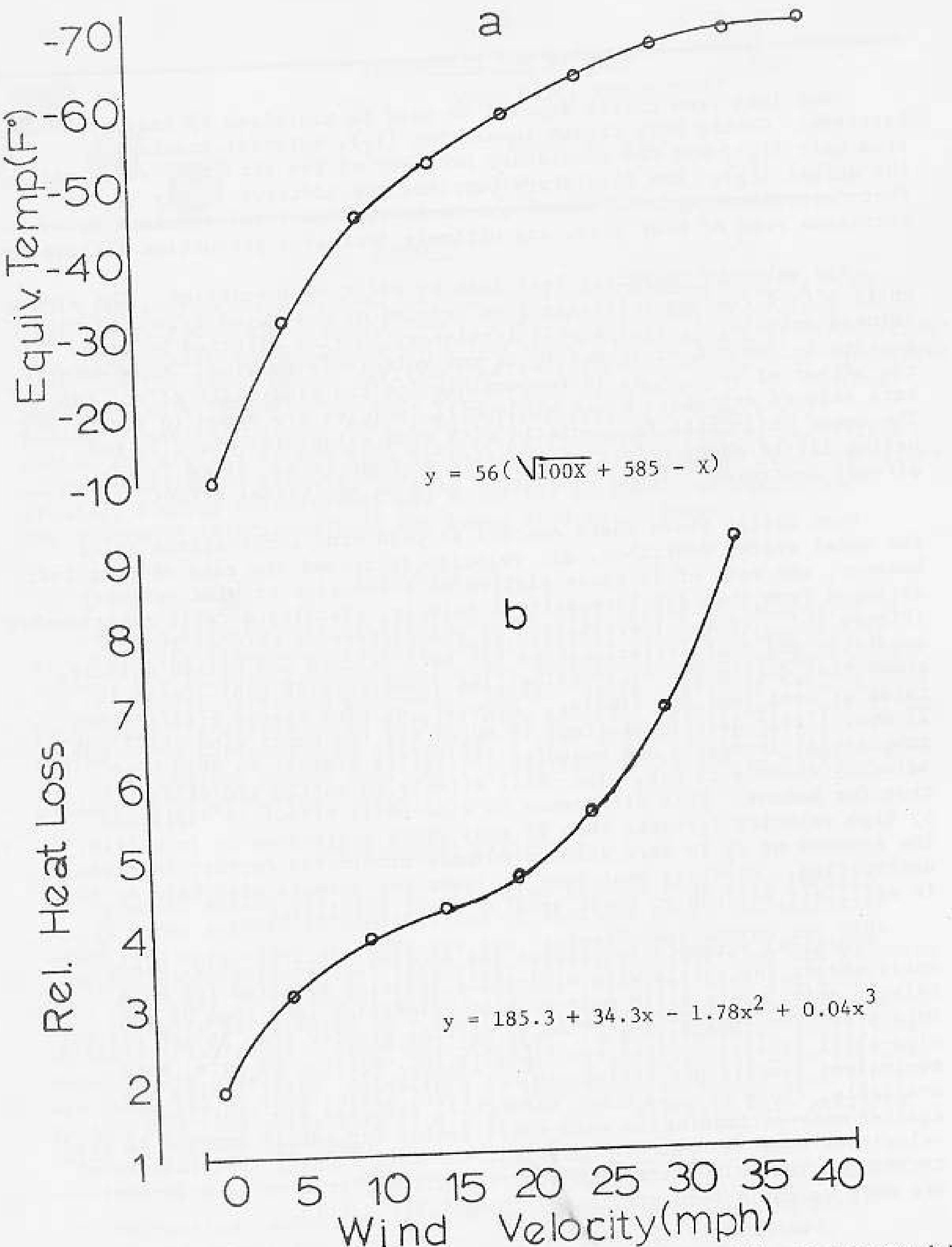

Figure 1. Wind-chill factor at $-10^{o}F$ for bare skinned animals (a) and for cattle (b).