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1978 Cattlemen's Day

Kansas Agricultural Experiment Station

The Cattlemen's Fate in '78

Cattlemen's Day
March 3,1978

Report of Progress 320 • Department of Animal Sciences & industry • Weber Hall
Agricultural Experiment Station • Kansas State University, Manhattan • Floyd W. Smith, director

65th Annual
CATTLEMEN'S DAY
The Cattlemen's Fate In '78

FRIDAY, MARCH 3, 1978

8:00 a.m. Weber Hall Arena

Registrations—Exhibits
(Coffee and Donuts served)

Sorting Chute: Your questions for K-State Specialists

9:45 a.m. Weber Hall Arena

Dr. Don L. Good, Head Department of Animal Sciences and Industry, KSU, presiding.

Welcome: Dr. Floyd Smith, Director, Agricultural Experiment Station

Cow-Calf Panel
Moderator, Mr. Herman Westmeyer, S. E. Kansas Area Director, Cooperative Extension Service

Wheat-Milo-Soybean and Corn Residues for Beef Cows—Dr. Miles McKee, Department of Animal Sciences and Industry, KSU

Energy Levels for Bred Heifers—Dr. Larry Corah, Department of Animal Sciences and Industry, KSU

Evaluating Breeding Behavior in Young Sires—Dr. Robert Schalles, Department of Animal Sciences and Industry, KSU

Practical Applications of Heat Synchronization—Dr. Guy Kiracofe, Department of Animal Sciences and Industry, KSU

Stocker-Feeder-Feedlot Panel
Moderator, Dr. Ben Brent, Department of Animal Sciences and Industry, KSU

Effects of Rations and Time on Feed on Carcass Desirability, Dr. Del Allen, Department of Animal Sciences and Industry, KSU

My Experience with Intensive Grazing Programs—Mr. Harold Engle, Jr., Madison, Kansas

The Farmer Feeder of the Future—Mr. Richard Pringle, Yates Center, Kansas

Feasibility of Feeding Cull Beef Cows in Feedlot—Dr. Jack Riley, Department of Animal Sciences and Industry, KSU

12:15 p.m. Weber Hall Arena

Lunch: Roast Beef—Served by Block & Bridle Club
Sorting Chute Continued

1:00 p.m. Weber Hall Arena

Introduction of Guest Speakers:
Dr. Don L. Good

Remarks
Mr. Floyd Fairleigh, President, Kansas Livestock Association, Scott City, Kansas

"The Cattlemen's Fate in 78"

As seen by a representative of National Cattlemen's Association, Mr. Wray Finney, Fort Cobb, Oklahoma

As seen by a marketing specialist, Dr. Robert Lewis, Larned, Kansas

Wray Finney

2:15 p.m. Tour at Beef Research Center
(about 2 miles north at end of College Avenue)

Research, Outlook, Health and Production topics

8:00 p.m. KSU-NIRA RODEO, WEBER ARENA

FOR THE LADIES

FRIDAY, MARCH 3, 1978

9:30 a.m. Weber Hall, Staff Memorial Library

Coffee

10:30 a.m. Tour new International Student Center and Dairy Processing Facility,
Adjacent to Weber Hall.

12:15 a.m. Weber Hall Arena

Lunch: Roast Beef—Served by Block & Bridle Club

C O N T E N T S

Effect of Age and Type of Testosterone Treatment on Cows Used for Heat Detection

G. N. Laaser, G. H. Kiracofe, M. D. Heekin, H. S. Ward, and K. G. Odde

Summary

Twelve cows were given a preliminary treament of testosterone proprionate and were used to help us detect other cows in heat. We used two types of testosterone booster treatments to maintain male sex behavior in both age groups of cows. Two cows from each treatment or age group were paired and placed with 40 to 60 cows for 30 to 50 days.

Two hundred forty-nine cows were observed in heat and 240 (96.4%) were marked by the detector cows. In this experiment, testosterone proprionate boosters maintained cows as heat detectors more effectively than testosterone enanthate boosters. Also, old cows marked more cows in heat than did young cows.

Introduction

Several aids have been developed to help improve heat detection and artificial insemination. Most aids can be classified as: (1) devices attached to females being observed or (2) devices attached to detector animals.

Disadvantages of devices attached to females being observed are false positives from crowding or another cow in heat mounting a cow not in heat, loss of aids, and delayed detection. But the aids are superior to cntinuous observation or observing dairy during milking time.

Detector animals can be prepared several ways. A vasectomized bull can be used but problems with venereal disease and some cases of fertility have resulted. Bulls sometimes lose sex drive if the penis is amputated, adhered to the sheath, or physically blocked (penal block). Surgical displacement of the penis sometimes causes edema and irritation from urine in association with the tunnel formed for the penis. Heat detection with surgically altered bulls, however, is superior to a herdsman's observations.

Cows culled because of low mothering ability, infertility, or low production can be used as detector animals. Injecting 200 mg. testosterone proprionate every other day for 20 days then injecting long-acting testosterone enanthate one month and two months later induces pronounced male sexual behavior in cows. They are as efficient as vasectomized bulls.

Testosterone enanthate is more expensive and less readily available to producers than is testosterone proprionate, so we wanted to determine: (1) if testosterone proprionate could be substituted for testosterone enanthate as the booster injection; and (2) whether age of cows is a factor in their effectiveness as heat detectors.

Materials and Methods

Twelve Hereford, Polled Hereford, and crossbred Simmental cows were treated with testosterone and used as heat detectors. Each received intramuscular injections of 200 mg. testosterone proprionate on alternate days until 10 injections had been given. Cows were classified as aged (6 to 8 years) or young (2 to 4 years), and allotted to the following groups: (1) aged cows, 200 mg. testosterone proprionate every 10 days; (2) aged cows, 1 gm testosterone enanthate every 14 days; (3) young cows, 200 mg. testosterone proprionate every 10 days; or (4) young cows, 1 gm. testosterone enanthate every 14 days. A cow from each treatment was paired with a cow from another treatment. Each had a chin-ball marker with a different color from her partner. All possible pairs were made among the four treatment groups. Once paired, treated cows were not separated during the experiment. Each pair was placed in a pasture with 40 to 60 open, beef cows suckling calves. The cows were checked for marks and other signs of heat twice daily for 30 to 50 days. Testosterone proprionate was purchased from Burns-Biotic, Oakland, CA., and testosterone enanthate, from Sigma Chemical Co., St. Louis, MO.

Results and Discussion

The aged cows injected with testosterone proprionate marked the highest percentage of cows in heat. Aged cows injected with testosterone enanthate were next then young cows in the same treatment order as the old cows (Table 1.1). Age of cow and type of testosterone significantly affected heat detection. Mature cows were more active than young ones. Part of the increased sexual activity is likely a "learned response". This study, it appeared that age and treatment were additive. Old detector cows marked 20.9 percent more cows in heat than young detector cows did. Cows treated with testosterone proprionate marked 16.4 percent more cows than those treated with testosterone enanthate. The combination resulted in the aged, testosterone-proprionate cows marking 37.4 percent more cows than young testosterone-enanthate cows did.

Of the 249 observed heats, 240 were marked by treated cows and were artificially inseminated at this heat. One cow conceived, one cow did not return to heat for the remaining observation period, and seven returned to heat, were marked again, and all seven then conceived. This enforces two points: (1) treated cows were marking cows in heat, and (2) cows that were not marked may not have been in heat when judged so.

Pairing had varied effects on detection efficiency (Table 1.2). The young, testosterone-proprionate cow paired with a young, testosterone-enanthate cow marked 97.5% of the estrual cows, while the young testosterone-proprionate cow paired with a more aggressive, aged, testosterone-proprionate cow marked only 37.3% of the estrual cows. Since aged cows treated with testosterone proprionate were more aggressive than young cows treated with testosterone proprionate and young cows treated with testosterone proprionate were more aggressive than young cows treated with testosterone enanthate, the young testosterone-proprionate detector may have had no opportunity to mount. An aggressive detector may protect an estrual cow. However, when more than one cow was in heat, an aggressive detector could not protect all of them. Also, standing heat is longer when more than one cow is in heat, which would give a less aggressive cow more opportunities to mount.

Since testosterone proprionate maintained male behavior in heat detector animals more effectively than testosterone enanthate, we concluded that it can be used effectively because testosterone enanthate previously was superior to or equal to any other heat detection method. Older cows were more effective heat detectors than young cows. Detection aids, of course, are only aids to heat detection and must not be relied on entirely.

Table 1.1. Age of cows and type of testosterone related to efficiency of detector cows.

Age and treatment[1] detectors	No. of cows in heat	No. of cows marked
Aged TP	153	136 (88.9%)
Aged TE	112	82 (73.2%)
Young TP	134	92 (68.7%)
Young TE	99	51 (51.5%)
Aged	265	218 (82.3%)
Young	233	143 (61.4%)
TP	287	228 (79.4%)
TE	211	133 (63.0%)
Total	249	240 (96.4%)

[1]Aged cows (6 to 8 years) and young cows (2 to 4 years) were given a preliminary treatment of 200 mg. testosterone proprionate (TP) every other day for 20 days then booster injections of either 200 mg. TP every 10 days or 1 gm. testosterone enanthate (TE) every 14 days.

Table 1.2 . Age pairing effect of detector cows and type of testosterone used in heat detection.

Age and treatment detectors	No. of cows in heat	No. of cows marked
Young TP Young TE	40	39 (97.5%) 21 (52.5%)
Aged TP Young TP	59	58 (98.3%) 22 (37.3%)
Aged TP Young TE	38	31 (81.6%) 17 (44.7%)
Aged TP Aged TE	56	47 (83.9%) 32 (57.1%)
Aged TE Young TP	35	32 (91.4%) 31 (88.6%)
Aged TE Young TE	21	18 (85.7%) 13 (61.9%)

Evaluating the Breeding Potential of Yearling Bulls (Progress Report)

Larry Corah, Guy Kiracofe, Vicki Bridson, Miles McKee, and R. R. Schalles[1]

Summary

Although this is based on only one year's results, it indicates that the breeding potential of yearling bulls can be determined before they are run with a cow herd. In this test one bull sired the majority of the calves and generally was the bull predetermined to be the active breeder.

Results of the test suggest that a good, active, breeding yearling bull is capable of breeding more than 12 to 15 cows as is normally recommended. In our studies, one yearling bull sired up to 36 calves in a 45-day breeding season. Possible adverse effects of using a yearling bull that much are being evaluated.

Important in evaluating the reproductive performances of a cow herd is the percentage of cows that calve the first 21 days of the calving season. Early born calves are generally the heaviest at weaning time. A goal of 60 to 65% of the cows calving the first 21 days should be feasible for most herds. In the four cooperating herds involved in this study the range was from 45.7 to 76.3%.

Introduction

When a cow herd operator purchases a bull on appearance and performance records, he does not know how active a breeder the bull will be. Producers often try to compensate for poor breeding bulls by using more bulls than would be expected to be needed.

Recent Australian studies indicate that the number of cows a bull is capable of breeding may be determined before the bull is turned out with the cow herd. In their studies a bull is held in a teasing pen for 20 to 60 minutes and then turned in with a heifer in heat or with heifers tied in a stanchion for a period of 10 to 60 minutes. Activities of the bull during this period are observed and recorded. Based on this test the breeding potential of bulls has been fairly accurately determined.

To test that concept, we designed a trial to study if the breeding potential of yearling bulls could be determined. In addition, we wanted to find out how many cows yearling bulls were capable of breeding. The

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[1]Appreciation is expressed to following cooperating Kansas ranchers: Leonard Robl, Claflin; Melvin Hopp, Marquette; Ed Keller, Zurich and to Wes Ibbetson of SE Branch Experiment Station for his assistance.

study also allowed us to learn more about the level of reproductive performance being achieved on Kansas ranches.

Experimental Procedure

Purebred Hereford, Polled Hereford, Angus, and Simmental yearling bulls raised at the KSU Purebred Beef Unit were used in the study to determine the breeding potential of a group of bulls representing each breed.

The procedure for determining breeding potential was as follows:

1. Semen quality of each bull was determined by electro-ejaculation; and no bull with questionable semen quality was used.
2. The bulls were held in a teasing pen for 10 to 15 minutes before being turned in with a heifer in heat.
3. One bull was turned into a pen with a cycling heifer and the length of time required for mounting and copulation to occur was recorded.
4. When a bull did not breed the heifer in 20 minutes, he was removed and held in an adjoining teasing pen another 20 to 40 minutes, then placed in another pen with a different cycling heifer with his breeding activities again observed and recorded.

Within a month after evaluation, a bull classified as having high breeding potential was paired with a bull of low breeding potential of another breed. Both these bulls were turned out with a herd of 35 to 40 mature cows. Herds on three cooperating commercial ranches and one herd at the Southeast Branch Experiment Station were used in the evaluation.

At three of the four locations, activities of the bulls were checked in the morning and evening to determine which were active breeding bulls and to observe the number of cows actually bred during the first 21 days of the breeding season. To aid in detecting breeding activity, each bull wore a chin ball harness with marking ink.

At calving time the date of birth and sire of each calf was recorded. Bull pairs had been selected to avoid problems in identification of the calves' sire.

Results and Discussion

Time required to mount and breed a cow varied widely among bulls in each breed. Some bulls bred the heifers within minutes of entering the pen when they were evaluated. Other bulls showed no breeding activity during either 20 minute evaluation period.

In each of the four herds, one yearling bull sired most of the calves. One bull sired 36 of 38 calves; another 32 of 34 calves; another 21 of 22 calves; and another 29 of 32 calves in herds 1 through 4, respectively. In three of the four herds, the bull evaluated as having the highest breeding potential sired the most calves. In the fourth herd both bulls were observed to be breeding the cows as they came in heat, but most of the calves (36 or 38) were sired by the bull ranked low at evaluation time. In general, however, the results were encouraging, indicating that the breeding potential of bulls may be able to be determined before they are run with the cow herd.

The high number of calves yearling bulls were capable of siring (21 to 36) tends to refute current recommendations on yearling bulls. In one herd, only 22 of the 35 cows produced calves from the yearling bulls, which may have resulted from cows not cycling rather than the inability of the yearling bulls to breed the cows.

There, also, was a wide variation that existed in the reproductive performance present in the four herds. In one herd 98% of the cows were observed in heat the first 21 days of the breeding season. In another herd only 35% were observed cycling in the first 21 days and 45.7% produced calves in the first 21 days of the calving season.

Table 2.1. Breeding record on the herd involved in the yearling bull evaluation project.

	Herd 1	Herd 2	Herd 3	Herd 4
Number cows	41	40	40	48
Length of breeding season	45 days	107 days	135 days	
% Observed bred by:				No
Dominant bull	22.5	84.0	35	Heat
Less dominant bull	7.5	5.4	54	Check
Both bulls	70.0	11.0	?	Data
% Cows observed cycling by:				
21 days of breeding season	98	45	35	
30 days of breeding season	98	58	50	
45 days of breeding season	100	58 (stopped checking at 30 days)		
% Actually calving 1st 21 days	76.3 (29/38)	70.5 (24/34)	45.7 (16/35)	60 (24/40)
No. cows left to calve	41	39	35	40
No. calves sired by yearling bulls	38	34	22	32
No. calves by dominate yearling bull	36	32*	21*	29*
No. calves by less dominate yearling bull	2*	2	1	3

*Evaluated to be the dominant sire.

Effect of Post-Partum Breeding Interval on Conception Rates in Beef Cows

K. G. Odde and G. H. Kiracofe

Summary

We analyzed data on 1536 fall calving Angus cows to determine the effect of post-partum breeding interval on conception rates in beef cows. Normal fertility was observed for cows showing heat 40 or more days post-partum.

Introduction

Calving interval is an important economic consideration in a cow-calf operation. To maintain a yearly calving interval, management pressure must be placed on getting cows bred as early as possible after calving.

Beef cows have an indefinite non-cycling period after calving. In addition, fertility is low with heats expressed shortly after calving. A minimum post-partum interval is required for uterine involution and for recovery of the uterine mucosa. Many factors, including nutrition level before and after calving, calf suckling, and milk production influence the length of time from calving to conception. We studied the specific relationship between post-partum breeding interval and conception rate in beef cows.

Experimental Procedure

Breeding and calving records for 1970-1972 were provided by Ramsey Ranch, El Dorado, Kansas. Data were analyzed for 1536 fall calving Angus cows that were bred artificially or by a clean-up bull. Breeding dates were verified by subsequent calving dates. Conception rate was defined as number of cows conceived/number of services.

Results and Discussion

Conception rate was highest for cows bred 100-109 days post-partum; next were those bred 90-99 days. Conception rates were lowest and the fewest cows showed heat 10-30 days post-partum. This would be expected, as uterine involution occurs then. Conception rate was unexpectedly high, 63%, 40-49 days post-partum. A possible reason for this observation is that a number of the highly fertile cows may have shown their first heat and conceived during this period. The number of cows showing heat 40-49 days was not high compared with 60-100 days. The conception rate declined 110-140 days post-partum, probably because of a number of problem breeders.

These data indicate that, under good management, normal fertility can be expected when cows in heat are bred 40 or more days post-partum.

Table 3.1 . Effect of post-partum interval on conception rate in beef cows.

Days post-partum	Number of services	Number conceived	Conception rate (%)
10-19	4	1	25.0
20-29	22	8	36.4
30-39	45	23	51.1
40-49	92	58	63.0
50-59	175	97	55.4
60-69	253	148	58.5
70-79	436	251	57.6
80-89	419	255	60.9
90-99	351	231	65.8
100-109	181	125	69.1
110-119	127	75	59.1
120-129	72	35	48.6
130-139	39	17	43.6
Total	2216	1324	59.7 (average)

Effect of Energy Level During Late Gestation On The Performance of Heifers Calving For The First Time (3 Year Summary)

Larry R. Corah, Arnold Fleck, Miles McKee, and R. R. Schalles

Summary

Effect of varying energy levels fed during gestation on reproduction and calf performance were studied in three trials involving 266 first calf heifers. Reducing energy during mid-gestation did not adversely affect the performance of the heifers when they were fed properly for at least 50 days before calving. Heifers on restricted levels of energy during mid-gestation and then elevated tended to have both higher first-service conception rates and total conception rates. Restricting energy throughout the gestation period reduced reproductive performance, causing lighter calves at birth and weaning emphasizing the importance of energy in the diet of first calf heifers.

Introduction

Feed is the major cost involved in any cow-herd operation. The most costly nutrient is energy (TDN).

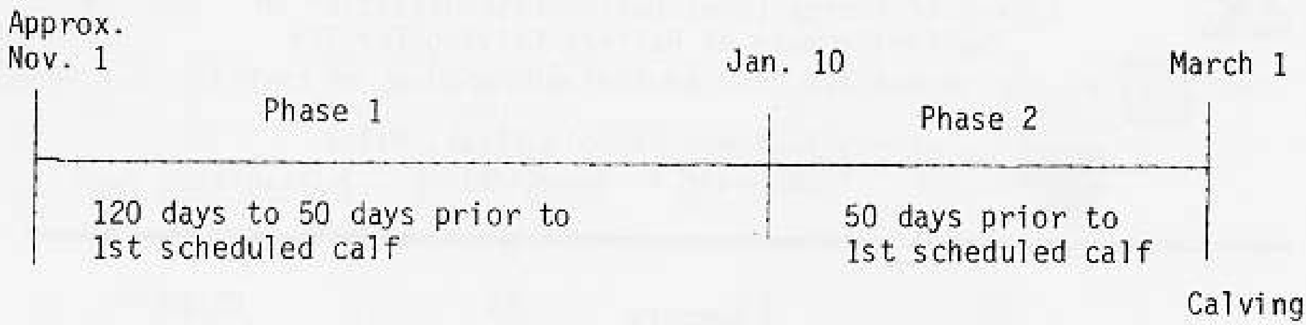
Previous research has clearly shown that cows fed inadequate energy (TDN) after calving have greatly reduced conception rates and calves that grow slower. If inadequate energy (TDN) is fed during gestation, the cows will be slower to show heat after calving, their milk production will be reduced which will decrease calf gains, and calf vigor at birth may be reduced. During gestation the major portion of the fetal development is 50 to 60 days before calving. That leads to the question, could the level of energy (TDN) be reduced during mid-gestation without reducing cow and calf performances provided the cow is properly fed the last 1½ to 2 months before calving.

Three research trials were conducted with first calf beef heifers to study effects of different energy (TDN) levels during gestation on cow and calf performances.

Experimental Procedure

In all three trials the gestation period of first calf heifers was divided into two phases. As the heifers were fed as a group, the two phases were designed around the start of the calving season (March 1) each year. As can be noted in the following table Phase 1 was from 120 days to 50 days before the first scheduled calf. Phase 2 was the last 50 days before the first scheduled calf or up until the heifer calved which may have been 75 to 100 days in some cases.

Table 4.1. Breaking the last 120 days of pregnancy into two phases.



The heifers in Trials 1 and 2 were fed in small, grass pastures but the grass available for intake was of little effect on the results. In trial 3 the heifers were fed in drylot. In each trial three different levels of energy (TDN) were compared. The energy (TDN) content of the ration was estimated based on the amount of alfalfa hay, milo, or protein supplement fed. Levels of energy (TDN) fed were:

% NRC		Lbs. TDN/head/day
70	=	5.8 Lbs. TDN
100	=	8.5 Lbs. TDN
120	=	10.1 Lbs. TDN

All rations were formulated to be equal in protein and mineral content and after the heifers calved all were fed in one group a balanced ration to meet NRC requirements for TDN, protein, and minerals.

Only two-year-old heifers scheduled to calve for the first time were involved in the study. The heifers were Polled Hereford, Hereford, Angus, or Simmental breeding and were allotted to one of three treatments by breed, weight, and scheduled calving date. All heifer weights were recorded after 15 hours off feed and water. The heifers were bred (A.I.) the first 45 days of the breeding season and exposed to bulls the last 15 days of a 60 day breeding season.

Trial 1

Trial 1 involved 87 heifers. The trial started on November 7, 1974; the three treatments were:

	Energy (TDN) Level Fed	
	Phase 1	Phase 2
Treatment 1	100% NRC	100% NRC
Treatment 2	70% NRC	100% NRC
Treatment 3	70% NRC	120% NRC

Trial 2

Trial 2 involved 71 heifers. The trial started on November 10, 1975; the three treatments were:

	Energy (TDN) Level Fed	
	Phase 1	Phase 2
Treatment 1	100% NRC	100% NRC
Treatment 2	70% NRC	100% NRC
Treatment 3	70% NRC	120% NRC

Trial 3

Trial 3 involved 108 heifers. The trial started on November 6, 1976; the three treatments were:

	Energy (TDN) Level Fed	
	Phase 1	Phase 2
Treatment 1	100% NRC	100% NRC
Treatment 2	70% NRC	100% NRC
Treatment 3	70% NRC	70% NRC

Condition was visually scored (1 = very thin, 10 = excessively fat) at the start of the trial and at the ends of Phase 1 and Phase 2.

Milk production data was collected from the Polled Hereford heifers (55% of the heifers) by weighing the calves before and after suckling.

Results

Trial 1

The heifers on the higher level of energy during early gestation (Phase 1) gained more weight, 38 lbs., than those on the low level of energy (70% NRC). During late gestation (Phase 2) heifers on the highest energy level (120% NRC) gained the most weight (Table 4.2).

We observed no effect of energy levels on birth weight. Even though a lower percentage of the heifers in Treatment 2 (70% NRC then 100% NRC) showed heat at the start of the breeding season compared to heifers on 100% NRC throughout, they had the best first-service conception and overall conception rates.

Trial 2

Level of energy had no significant effect on heifer weight gains in this trial, although those heifers on the lowest levels of energy during both phases (Treatment 2) gained the least (Table 4.3).

Again the energy levels had no effect on birth weight of the calves but both the groups of heifers on the low level of energy during mid-gestation and then evaluated in late gestation had a higher percentage of heifers cycling at the start of the breeding season, conceiving at first breeding, and conceiving during the breeding season than heifers fed the NRC recommended level of energy throughout gestation.

Trial 3

As expected, heifers on the highest level of energy during Phase 1 (100% NRC) gained the most, while those heifers on low energy during mid-gestation (Treatment 2) but high energy during Phase 2 gained the most weight during Phase 2. Heifers on low energy throughout gestation gained the least and lost the most condition.

Calf birth weights and cow's milk production tended to be lower for the cows restricted on energy throughout the gestation period. The reduced milk production resulted in the calves being 35 and 42 lbs. lighter than calves in Treatment 1 and 2, respectively.

Conception at first service was inexplainably low in all three groups. Heifers restricted on energy during gestation had the lowest first-service and overall conception rates.

Table 4.2. Effects of indicated energy levels during gestation on cow and calf performance - Trial 1

Phase 1 - 116 to 50 days Precalving	100% NRC	70% NRC	70% NRC
Phase 2 - last 50 days Precalving	100% NRC	100% NRC	120% NRC
Heifer weight change			
Phase 1	38.7	22.7	26.2
Phase 2	63.8	55.2	91.9
Total	102.5	77.9	118.1
Calf birth weights, lbs.	75.9	78.1	77.4
% difficult births	71.4	59.3	67.8
% cycling 1st 25 days of breeding season	84.6	72.4	85.7
% 1st service conception	50.0	63.6	40.0
% conception rate, 60 day breeding season	84.6	93.1	89.3

Table 4.3. Effects of indicated energy levels during gestation on cow and calf performance - Trial 2

Phase 1 - 116 to 50 days Precalving	100% NRC	70% NRC	70% NRC
Phase 2 - last 50 days Precalving	100% NRC	100% NRC	120% NRC
Heifer weight change			
Phase 1	38.5	30.8	32.8
Phase 2	56.8	30.4	50.6
Total	95.3	61.2	83.4
Calf birth weight, lbs.	81.0	81.8	78.5
% difficult births	65.2	66.7	78.3
% cycling 1st 25 days of breeding season	80.0	96.0	92.0
% 1st service conception	40.0	50.0	56.5
% conception rate, 60 day breeding season	72.0	88.0	92.0

Table 4.4. Effects of indicated energy levels during gestation on cow and calf performance - Trial 3

Phase 1 - 116 to 50 days Precalving	100% NRC	70% NRC	70% NRC
Phase 2 - last 50 days Precalving	100% NRC	100% NRC	70% NRC
Heifer weight change			
Phase 1	+60.1	-15.4	+14.6
Phase 2	+85.7	+130.9	+75.6
Total	145.8	115.5	90.2
Heifer condition change			
Start of Phase 1	4.7	4.7	4.7
End of Phase 1	4.7	4.3	4.4
End of Phase 2	5.2	5.1	4.3
Calf birth weight, lbs.	72.9	71.3	69.3
Weaning weight, lbs.	411.4	418	376
% heifers with calving difficulty	45	28	18
% calf survival at birth	85	94	97
Milk production, Lbs./24 hour period	11.1	11.9	9.8
Conception at first service	37	48	25
Conception rate, 60 day breeding season	80	82	68

Effect of Using One Versus Two Growth-promoting Implants During the Suckling Period on the Weaning Weights of Nursing Calves

Larry R. Corah, R. Ted Wary[1], Frank Schwartz[2], Miles McKee, and R. R. Schalles[3]

Summary

Three trials were conducted to study the effect on calf weight gains from using two 36-mg. Ralgro implants during the suckling period.

Two Ralgro implants 60 to 90 days apart improved the average weight gain during the suckling period by 39.4, 43, and 46.6 pounds for the three trials. A single Ralgro implant improved suckling gains by 33.5, 22.1, 28.4 and 27.9 lbs. for the four test groups. Ralgro implants used at birth gave the same response as when first used when calves were 4 months old. A 15-mg. DES implant used in trial one improved suckling gains 23.4 lbs.

These results suggest that at least one implant during the suckling period is a management practice cow-herd operators cannot afford to forego. Two implants during the suckling period gives an even more economical response.

Introduction

Previous research here and at other Universities showed that implants like DES or Ralgro during the suckling period improved weaning weights 15 to 25 pounds. A year ago (Prog. Rpt. 291) we reported that one 36-mg. Ralgro implant improved weaning weight 8.4 pounds, but that implanting with a 36-mg. Ralgro implant within 1½ months of birth and again 70 days later improved weaning weights 43 pounds.

Since two implants during the suckling period substantially improved weaning weights, we conducted three additional trials this year to verify the previous results.

Experimental Procedure

Trial 1. One hundred and twenty-five Polled Hereford, Hereford, or Simmental heifer calves were divided into four groups based on breed and

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[1]County Agent in Cherokee Co. who conducted Trial 2.

[2]NW Area Livestock Specialist who along with Russell Co. Agent, Dell Jepsen conducted Trial 3.

[3]Appreciation is expressed to the IMC Chemical Corp. for implants and funding support and to Moore Johnson, Columbus, Kansas and the Haise Ranch at Russell, Kansas for serving as cooperating ranches.

age. The four treatments were:

Treatment 1 -- Control group - not implanted.
Treatment 2 -- One 36-mg. Ralgro implant when the calves were approximately 2 months old.
Treatment 3 -- One 15-mg. DES implant when the calves were approximately 2 months old.
Treatment 4 -- Two 36-mg. Ralgro implants, one when the calves averaged 27 days of age and the second 89 days later.

The Polled Hereford heifer calves suckled cows on native grass; the Hereford and Simmental heifer calves suckled cows confined in drylot. All calf weights recorded were full weights directly off the cow.

Trial 2. Twenty-seven steer calves and 39 heifer calves were grouped by sex and randomly allotted to three groups:

Treatment 1 -- Control group - not implanted.
Treatment 2 -- One 36-mg. Ralgro implant at the start of the trial on November 19, 1976, when the calves were approximately 2 to 3 months old.
Treatment 3 -- Two 36-mg. Ralgro implants, one at the start of the trial on November 19, 1976, and the second 63 days later.

The trial was conducted on the Moore Johnson farm at Columbus, Kansas. The calves were mixed Hereford and Angus crossbred calves and were 2 to 3 months old at the start of the trial on November 19, 1976. The trial ran for 152 days and all calf weights recorded were full weights directly off the cow.

Trial 3. Seventy-seven steer calves were randomly assigned at birth to one of four groups:

Treatment 1 -- Control group - not implanted.
Treatment 2 -- One 36-mg. Ralgro implant when the calves were approximately 4 months old.
Treatment 3 -- One 36-mg. Ralgro implant at the time the calves were born.
Treatment 4 -- Two 36-mg. Ralgro implants, one at birth and the second implant when the calves were approximately 4 months old (second implant given when group 2 calves were initially implanted).

The trial was conducted at the Haise Ranch near Russell, Kansas. The Hereford-Angus calves were born predominately during the month of March. All calves were weighed 3 times: at birth, July 26 when treatment 2 and 4 calves were implanted, and at weaning time October 21. All calf weights recorded were full weights directly off the cow. All calves were castrated May 10.

Results

Trial 1. Heifer calves receiving one 36-mg. Ralgro or one 15-mg. DES implant gained 33.5 and 23.4 pounds more, respectively, by the end of the suckling period than calves not implanted. The responses are slightly higher than responses in previous trials. Calves receiving two 36-mg. Ralgro implants 80 days apart gained 39.4 pounds more than the non-implanted calves, which is consistent with last year's 43 extra pounds.

No side effects from any implant were observed. Most of the heifer calves will be saved as replacement heifers to see if implants affect later breeding. However, implanting replacement heifers at any time is not a recommended practice.

Trial 2. Calves receiving one 36-mg. Ralgro implant were 22.1 lbs. heavier at weaning than non-implanted calves while calves receiving two implants 63 days apart were 53 lbs. heavier at weaning than calves not implanted. After 63 days implanted calves were significantly heavier than calves not implanted.

No side effects were observed during the trial.

Trial 3. Steer calves implanted once either at birth or when 4 months old with 36-mg. of Ralgro gained 27.9 lbs. and 28.4 lbs. more from birth to weaning than non-implanted calves. Calves receiving two implants during the suckling period gained 46.6 lbs. more weight from birth to weaning than non-implanted calves which is similar to ther response in trials 1 and 2.

No side effects were observed.

Table 5.1. Gains of the calves during the suckling period in Trial 1.

Treatment	No. calves	Average age at implanting	No. days implanting to weaning	Birth weight	Weaning wt.*	Gain birth*-weaning lbs.	Treatment advantage
Not implanted	31	--	--	70.5	416.5	346.0	--
One 36-mg. Ralgro implant during suckling period	32	61	136	68.9	448.4	379.5**	+33.5**
One 15-mg. DES implant during suckling period	31	61	136	72.8	442.2	369.4**	+23.4**
Two 36-mg. Ralgro implants during suckling period	31	27	173	74.8	460.4	385.6**	+39.4**

*Weaning weights and pounds gained were adjusted based on age of calf.
**$P<.05$.

Table 5.2. Gains of the calves during the suckling period in Trial 2.

Treatment	Wt. at start of trial	No. calves	Wt. at weaning	Wt. gain	Treatment advantage
Not implanted	161.6	22	396.8[a]	235.2[a]	
One 36-mg. Ralgro implant	178.1	24	435.4[b]	257.3[b]	+22.1[a]
Two 36-mg. Ralgro implants	175.5	20	464.8[c]	289.3[c]	+53.1[b]

[a,b,c]Means in the same column with different superscripts differ significantly (P<.05).

Table 5.3. Weight gains of calves during suckling period in Trial 3.

Treatment	No. calves	Birth wt.	Wt. 7-26*	Wt. 10-21**	Gain- birth to 7-26	Gain- 7-26 to 10-21	Gain- birth to 10-21	Treatment advantage
Non-implanted control	21	69.7	320.9	452.6	251.2	131.6[a]	382.8[a]	--
At approximately 4 mos. of age	20	73.3	319.0	484.6	245.6	165.6[b]	411.2[b]	+28.4[a]
One 36-mg. Ralgro implant at birth	18	73.9	336.7	484.1	263.3	147.4[a]	410.7[b]	+27.9[a]
Two 36-mg. implant at birth and 4 mos.	18	72.0	337.2	500.9	265.2	163.7[b]	428.9[c]	+46.6[b]

[a,b,c]Means in the same column with different superscripts differ significantly ($P<.05$).

*Calves in treatment 2 and 4 implanted.

**Calves weaned and weights adjusted to eliminate any variation due to calf's age.

Factors Influencing Sickness at Central Bull Test Station

D. S. O'Banion, Keith O. Zoellner, and R. R. Schalles

Summary

Pre-test management was studied on 351 bulls from 54 herds that were tested at the Kansas Bull Test Station at Beloit, Kansas. Charolais, Hereford, Polled Hereford, and Simmental bulls were sick more days than Angus or Limousin between delivery and start of test. Starting ages and weights correlated significantly with sickness. Bulls sick the least had been vaccinated with BVD, IBR, PI_3, Pasturella, Blackleg, malignant edema, and lepto before arriving for test.

Introduction

Pre-test management and herd differences seem to influence performance of bulls at central test stations. Some bulls take-off without problem; others get sick and need treatment. Pre-delivery management that would reduce treatment needs would improve performance and reduce test costs.

Procedure and Results

Letters were sent to breeders who had bulls in the Kansas Bull Test at Beloit, Kansas, during fall 1974 and fall 1975. Fifty-four breeders with 351 bulls responded providing the following information: number of calves weaned, percentages of calves sick at the ranch before and after weaning, percentages of bulls and cows brought into the herd each year, vaccinations given before bulls were delivered to the station, and whether or not the calves were creep fed. Health records kept for each bull while on test were obtained. Data were analyzed by least squares analyses of variance.

Sixty-five percent of the bulls required treatment sometime between arrival and the end of the test; 73.3% of the bulls were sick during the three week period between delivery and start of test, and 21.6% were sick between the start of the test and day 28 on test. The remaining 5.1% were sick after day 28 on test.

Number of sick bulls differed significantly among breeds. Simmental, Hereford, Polled Hereford, and Charolais bulls were sick more than Angus or Limousin bulls between delivery and start of test and between start of test and day 28 on test (Table 6.1).

For each percent of breeder's calves that were sick before weaning there was a 10% increase in the number of bulls sick between delivery and start of test, and a slight increase in number sick after the test started.

For each month older the bulls were when they started the test there was 1.3% decrease in the number of bulls sick between delivery and start of test and 0.2% decrease between 28 days and 56 days on test.

Starting weight influenced the number of bulls sick between delivery and start of test and between day 28 and day 56 on test. For every 100 pounds increase in starting weight there was 28% less sickness between delivery and start of test but 4% increase in sickness between day 28 and day 56 on test.

Vaccinations given before delivery significantly affected the amount of sickness during the test. Table 6.2 shows the average number of days that bulls given indicated vaccinations were sick.

Bulls vaccinated against either BVD, IBR, PI_3, or Pasturella were sick significantly less than bulls that did not receive these vaccinations or had no vaccinations (Table 6.3).

None of the preventative treatments significantly influenced sickness after day 28 on test. Bulls that were sick the least had been vaccinated with Blackleg, malignant edema, BVD, IBR, PI_3, Pasturella, or IBR, PI_3, Pasturella in combination.

Table 6.1. Mean number of days sick per animal for breeds tested.

Breed	No. bulls	Delivery-start	Start-28
Hereford	44	1.76	.73
Polled Hereford	26	1.19	.69
Simmental	127	1.04	.43
Charolais	37	.89	.06
Angus	55	.28	.29
Limousin	21	.16	0

Table 6.2. Mean number of days sick per animal for each pre-test vaccination indicated.

Vaccination treatment	No. bulls	Delivery-start	Start-28
None	18	2.01	.25
Blackleg, IBR	6	1.82	1.20
Blackleg, malignant edema	110	1.55	0
Blackleg, malignant edema, IBR, lepto	24	1.44	.10
Blackleg, 4 way and 7 way	57	1.43	.29
Blackleg, malignant edema, lepto	6	1.41	.28
Blackleg, malignant, edema, IBR	5	.90	.21
4 way Blackleg, malignant edema, IBR, Pasturella and Blackleg, malignant edema, IBR, Vibrio	5	.89	1.22
Blackleg, lepto	10	.90	.31
Blackleg, malignant edema, IBR, BVD, PI_3, lepto	58	.76	.02
Blackleg, malignant edema, IBR, BVD	6	.60	.24
Blackleg, malignant edema, IBR, PI_3, Pasturella	7	.50	.20
7 way Blackleg, malignant edema, IBR, BVD, PI_3, lepto	7	.50	0
Blackleg, BVD, lepto + Blackleg, lepto + 4 way Blackleg, IBR, lepto	6	.07	.92

Table 6.3 . Mean number of days sick per animal; four pre-test vaccinations with control (no vaccination).

Vaccination	No. of bulls	Days sick
No vaccination	18	1.92
No BVD	236	1.32
BVD	82	.88
No IBR	189	1.36
IBR	129	.88
No PI_3	235	1.31
PI_3	82	.76
No Pasturella	294	1.21
Pasturella	24	.98

Weaning Calves Early from Drylot

Miles McKee and Galen Fink

Summary

Percentage Simmental and Hereford calves gained slightly more (13 lbs./head) while nursing their mothers than 83 herd mates that were weaned early at 49 (± 27) days of age.

Percentage Simmental cows whose calves were weaned early had a higher conception rate than percentage Simmental cows that nursed calves (93% vs. 89%). Dams of calves weaned early rebred 17.6 days sooner than nursing dams.

Introduction

This is the second year of a study to gain information to formulate into recommendations for early weaning. The first year's results were published in the 1977 Cattlemen's Day report.

We do not think early weaning is advisable for all calves. However, there are situations when weaning calves early might be advantageous. These situations could include: (1) cows maintained in confinement, (2) emergency conditions such as drouth, (3) induced twinning, (4) fall calving where heavy winter feeding is required, (5) selling old cows before they nurse down, and (6) to accelerate rebreeding.

Experimental Procedure

Seventy-nine part Simmental and 58 Hereford calves were used in this 170-day trial (April 19 to October 6). All calves were from cows in the confinement study. Calves were weighed April 19 so they could be allotted to an implant study, and weaned early (May 12) when their dams were allotted to rebreeding studies. All dams of Hereford calves weaned early were sold May 12 so effects of early weaning on rebreeding of Hereford cows could not be studied.

Calves weaned early were housed indoors in groups of 10 with access to fresh water and their creep ration was as listed in Table 7.3 . Fourteen days after weaning, all calves were moved outdoors into one lot with access to creep feed, fresh water, and salt. All calves weaned early received approximately 4 lbs. per head per day of high quality native grass hay the last 90 days of the experiment.

Calves that continued to nurse their mothers did so in drylot. Starting May 12 these calves had access to the creep feed listed in Table 7.3 , and to salt and fresh water. As the calves got larger, they ate from the feed bunk with their mothers.

Cows were bred artificially during 32 days starting May 22, then they ran with a bull for the next 29 days.

Results and Discussion

Calves nursing their mothers gained slightly, but not significantly more during the test than calves weaned early. In 1976 the calves weaned early gained slightly more than those that continued to nurse their mothers. Results from the two trials indicate that calves can be weaned early successfully.

A respiratory illness affected both early-weaned and nursing calves during the summer of 1977. Death loss in the calves weaned early was 2.7%; for nursing calves it was 8.1%.

Dams of calves weaned early had a slightly higher conception rate than dams of nursing calves (93% vs. 89%) and rebred 17.6 days earlier. The difference, although not statistically significant, indicates an advantage for early weaning related to rebreeding the calves' mothers.

Table 7.1. Performances of early-weaned and nursing calves.

		Weaned early			Nursing		
Breed	Sex	No.	Total gain (lbs.)	ADG (lbs.)	No.	Total gain (lbs.)	ADG (lbs.)
Percentage Simmental	bull	12	443.6	2.61	11	425.0	2.50
	steer	5	385.0	2.26	3	334.7	1.97
	heifer	28	281.7	2.25	14	406.6	2.39
Total		45	398.6	2.34	28	406.1	2.39
Hereford	bull	6	327.3	1.93	8	356.4	2.10
	steer	8	369.6	2.17	6	371.3	2.18
	heifer	24	333.3	1.96	5	325.8	1.92
Total		38	340.0	2.00	19	353.1	2.08
Average, all calves		83	371.7	2.19	47	384.7	2.26

Table 7.2. Effect of weaning calves early on their mothers' rebreeding.

	Calves weaned early	Calves nursing dams
Total no. cows	42	27
No. cows not rebreeding	3	3
Cows not rebreeding, %	7	11
No. cows rebred	39	24
Avg. days from calving to rebreeding	86.4	104.0
Advantage (days)	-17.6	

Table 7.3. Creep rations for early-weaned and nursing calves.

Ingredient	Early-weaned calves' creep ration (lbs.)	Nursing calves' creep ration (lbs.)
Rolled oats	436	1300
Rolled corn	742	366
Dehydrated alfalfa		92
Calf Manna[1]	305	
Wet molasses	65	61
Dicalcium phosphate	11	
Limestone	11	
Soybean oil meal	436	84
Dry molasses		51
Pre-mix[2]	22	
Salt	22	10
Aureo-10	15	14

[1]By Albers Milling Co.

[2]Pre-mix, lbs. per 1000 lbs.: soybean oil meal, 444; ground oats, 443; vitamin A, 33; Aureomycin-10, 30; trace mineral, 50.

Sources of Forage Adjusted to Temperature Changes for Wintering Cows in Drylot

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Summary

Cows in mid-to-late gestation gained weight when fed either milo stover silage or alfalfa hay-wheat straw but lost weight when the forage source was milo-stover bales. When supplemented with additional corn grain as temperature decreased, cows receiving milo stover silage or alfalfa hay-wheat straw gained more weight, and cows receiving milo stover bales lost less weight than cows receiving the same forages but fed to NRC (1976) requirements.

Introduction

To more accurately formulate maintenance rations, we need to evaluate nutritive values of forages used to winter beef cows.

Cows in mid-to-late gestation are normally managed for slight to modest gains. Estimated gains, based on NRC requirements, and actual gains vary because of cold temperatures. It is important to have data to indicate how energy intake should be varied as temperature varies to insure that cows reach desired weights.

Experimental Procedure

Ninety mature cows (Simmental x Hereford and Hereford) in mid-to-late gestation were allotted by weight, condition score, breed, and calving date to six treatments: (1) dry harvested milo stover, (2) dry harvested milo stover plus additional energy during cold stress, (3) milo stover silage, (4) milo stover silage plus additional energy during cold stress, (5) 33% alfalfa hay and 67% wheat straw, and (6) 33% alfalfa hay and 67% wheat straw plus additional energy during cold stress.

The 61-day trial began December 2, 1976, and ended February 1, 1977. Cows in all treatments were fed to gain 0.5 to 0.75 lb. per day, as determined by NRC (1976) requirements for their weights and stages of gestation.

Additional energy for maintenance during cold stress (treatments 2, 4, and 6) was supplied by corn grain fed when effective (wind-chill) temperature dropped below the cow's critical temperature (when she must produce additional heat to maintain internal temperature). Effective temperature was determined daily with a 7 a.m. dry-bulb temperature reading and average wind speed the previous 24 hours. Critical temperature was estimated to be -1.11 C (30 F). An additional 1.8% of recommended NRC (1976) energy intake was added for each 1 C (1.8 F) below critical temperature (see page 97).

No protein supplement was used but all cows had access to a 50% dicalcium phosphate, 50% salt mixture.

Results and Discussion

Analyses of forages fed and weight response of the cows are listed in tables 8.1 and 8.2 . With energy treatments pooled in each forage group, cows fed milo stover silage or alfalfa hay-wheat straw gained more weight ($P<.05$) than cows fed dry harvested milo stover. Cows fed additional energy during cold stress gained more weight ($P<.05$) than cows fed to NRC (1976) requirements.

Milo stover silage or alfalfa hay-wheat straw are suitable forages for cows in mid-to-late gestation. Either intake of dry harvested milo stover must be increased or additional supplementation with protein and/or energy must be provided if cow weight gains are to equal those of cows on the other forages.

Corn was fed to cows whose rations were adjusted for cold stress 43 of the 61 days of this trial. Total corn intake was 31 lbs. per cow. Energy-adjusted cows gained 24 pounds more than the NRC-fed cows or 0.4 lb. more per day. Condition of cows at the start of the winter feeding period could make the additional weight gain critical for satisfactory calving, nursing, and re-breeding.

Table 8.1. Analyses of forages fed in cold-stress feeding trial.

	Dry matter %	Crude protein	Crude fiber	Ether extract	Ash	Acid detergent fiber	Protein insoluble in hot water	Ca	Phos.
		% dry matter basis							
Dry harvested milo stover	75.0	5.1	33.1	1.4	15.4	56.5	3.1	.37	.14
Milo stover silage	38.0	8.0	25.1	2.2	9.4	38.2	5.0	.39	.25
33% alfalfa + 67% wheat straw[1]	90.0	8.3	37.4	1.8	9.3	49.5	4.8	.60	.17

[1]Calculated from separate analysis of alfalfa and wheat straw.

Table 8.2. Performance of pregnant cows on NRC rations and NRC rations adjusted for cold stress.

Forage and energy treatments	No. cows	Initial wt., lbs.	Forage dry matter intake, lbs.	Wt. change lbs.
Dry harvested milo stover				
NRC	15	1099	23.4[1]	-69
Adjusted energy	15	1083	20.9[1]	-50
Milo stover silage				
NRC	15	1128	17.4	13
Adjusted energy	15	1154	17.4	33
Alfalfa hay-wheat straw				
NRC	15	1156	17.4	21
Adjusted energy	15	1125	17.4	47
Treatments pooled				
Dry harvested milo stover	30	1091	22.2[1]	-60[b]
Milo stover silage	30	1141	17.4	23[a]
Alfalfa hay-wheat straw	30	1140	17.4	34[a]
Energy sources pooled				
NRC	45	1128	19.4	-13[b]
Adjusted energy	45	1121	18.6	11[a]

[a,b]Weights within a group with different superscripts differ significantly ($P<.05$).

[1]For dry harvested milo stover disappearance is assumed as intake (waste estimated at 15%).

Fate of Calcium Crystals in Alfalfa Fed to Cattle

L. H. Harbers and G. M. Ward

Summary

Calcium crystals were located in parallel rows surrounding vascular bundles in alfalfa leaves and under the epidermis of alfalfa stems. The crystals remain intact on vascular bundles in the rumen. Most crystals are dislodged in fecal matter, and free crystals can be recovered. These data support previous work here showing that calcium from alfalfa may be less available to ruminants than previously thought.

Introduction

We used a scanning electron microscope equipped with an energy dispersive X-ray analyzer to define and identify crystals surrounding vascular bundles of various legumes. Studies by biologists, entomologists, and geologists at Kansas State University made the identifications. Earlier studies here indicated that calcium in alfalfa was less available than previously believed. We used the microscope to confirm presence of the crystals in alfalfa and to study their fate in ruminants.

Methods

Alfalfa-leaf residues were obtained from rumen and feces of fistulated steers maintained on a diet of alfalfa hay and salt. We isolated vascular tissue and crystalline material by dilution and centrifugation, then air-dried, mounted, and coated samples with carbon. Using a scanning electron microscope, we made secondary photographs and elemental dispersion maps.

Results and Discussion

A photograph of a vascular bundle from an alfalfa leaflet (figure 1.1 a) shows crystals intact in the bundle sheath cells. The crystals are primarily calcium as shown in the corresponding calcium-dot map (figure 1.1 b). The calcium crystals remain intact in the rumen.

Many crystals are removed from the vascular bundle sheaths by the time the material passes in feces (figure 1.1c). Crystals of the same type or shape (figures 1.1d, e) can be recovered from the feces, where some appear to be digested to various degrees, but extracting intact crystals suggests that many pass through the gastrointestinal tract undisturbed by mechanical, chemical, or enzymatic digestion.

If so, the calcium from alfalfa is less available than previously thought. Other work indicated that the calcium is about 60% as available as calcium from inorganic sources.

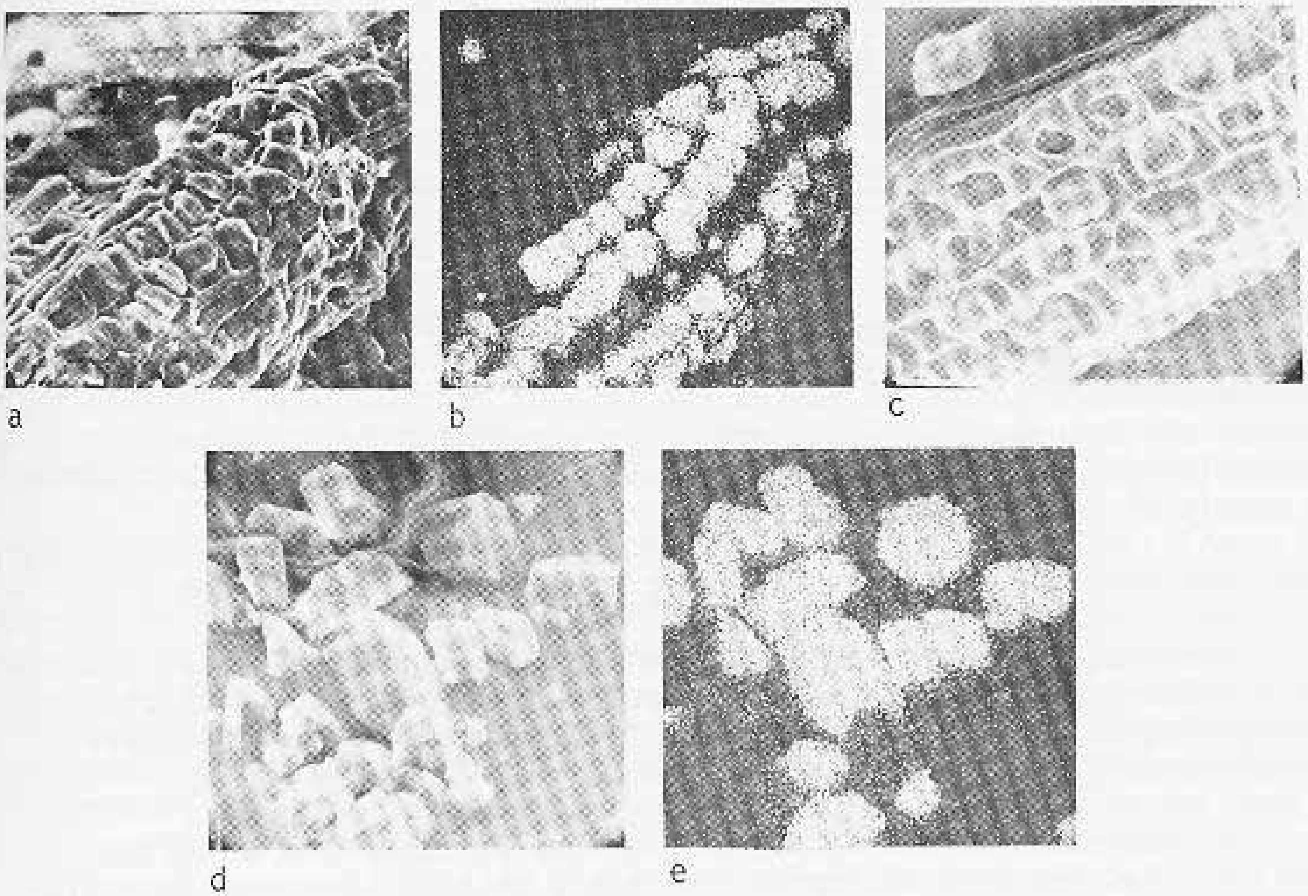

Figure 1.1. Photomicrographs of calcium crystals in alfalfa. a) Vascular bundle from alfalfa leaflet shows crystals surround the bundle that remains intact in the rumen (700X). b) A concentration map of the bundle shows the crystals are composed of calcium. c) A vascular bundle isolated from feces indicates that some crystalline material was removed after passing from the rumen (1200X). d) Crystals recovered from the feces of a steer fed alfalfa resemble those on vascular bundles (1500X). e) An X-ray dispersion map shows that the crystals are calcium.

Mineral Contents of Native Bluestem Pastures

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Summary

Handclipped and esophageal samples of burned and control native bluestem pastures were taken monthly. Burning increased phosphorus (P) and magnesium (Mg) and decreased iron (Fe). These studies indicate that burned and unburned pastures need to be supplemented with potassium (K), magnesium (Mg), and possibly phosphorus (P) during late fall and winter. A supply of sodium (Na) is necessary continuously.

Introduction

Previous work here indicated that Na supplement (salt) was necessary on bluestem pastures but Ca and P supplements (bone meal, dicalcium phosphate, etc.) did not improve cow-calf operations. Trace mineral supplements have not affected performance.

A comprehensive evaluation of the mineral content of bluestem pastures has not been attempted previously because laborious techniques gave inconsistent results. With the station's atomic absorption spectrophotometer, we now can analyze a variety of elements with great accuracy.

Methods

Burned and control pastures were sampled monthly by handclipping or from esophageally-fistulated steers. Samples were analyzed for calcium, phosphorus, magnesium, potassium, sodium, iron, manganese, zinc, and copper. Results are reported in the tables on a dry basis.

Results and Discussion

Mineral compositions are shown in two tables according to sampling method. Table 9.1 is for handclipped samples. That procedure assumes that animals graze all plants to 1 inch above ground level, which obviously is not accurate. Table 9.2 is for data that resulted from analyzing plants the animals actually consumed. Salivary contamination causes errors in that procedure. Large increases of sodium and phosphorus are found in esophageal samples. Magnesium, on the other hand, was leached out, possibly in salivary juices lost during collection.

Macroelements are given in percentages and microelements (trace minerals) in milligrams per 100 grams of dry materal.

Calcium: The Ca content of these pastures was highest during winter months, lowest in September. But September values were above the recommended values for growing steers (0.30-0.44%) and for gestating and lactating cows (0.16-0.24%). No Ca supplement is needed.

Phosphorus: The P content was higher in burned than unburned pastures and higher in winter and spring than in summer or fall. Handclipped samples were lower than recommended levels (0.18-0.22%) every month of the year. The esophageal samples show that salivary contamination produces a bolus above recommended levels. So the body pool of P is enough to maintain adequate P. Previous studies here showed that even though blood P may be below normal at certain times of the year, supplementing pastures with phosphorus made no differences in performance (cow weight, calf birth, or weaning weight).

Ca/P ratio: The Ca/P ratio is recognized as important in animal nutrition and a suitable ratio is within 2.0 to 0.5. The ratio obtained in this study varied from about 6.0 to 1 to 6.6 to 1, much wider than the 2.0 to 0.5. The only time the Ca/P ratio narrowed to 4 to 1 was in May. While 6.0 to 1 may be considered wide, the NRC has reported 7 to 1 as satisfactory.

Magnesium: Burning increased Mg content, and Mg trended higher from winter to spring and fall, with a minor reduction in summer. Our data indicate that Mg in bluestem pastures meets the requirement of 0.06 to 0.15%.

Sodium: The Na content in handclipped samples did not meet the NRC requirement of 0.25% but esophageal samples averaged 1.6%, more than adequate. Animals samples had access to salt blocks during the year. Salt should be kept available because Na turns over rapidly in the body pool.

Potassium: Burning did not significantly affect K; however, its monthly variation in bluestem pastures may be significant. It was below recommended levels of 0.6 to 0.8%. No minimum recommendation is given bv NRC but 1 lb. of soybean meal plus 3 to 6 lbs. of milo in winter will not supply 0.6% of K. That finding prompted us to measure the response of cattle to K in a test now in progress (1978 winter).

Iron: Burning reduced the iron content of the pastures, which was highest in early spring and had declined by July. Most cattle feeds range from 8 to 80 mg. Fe/100 g., which is thought to be adequate. The lowest iron value we recorded was 13.9 mg. in handclipped samples and 16.3 in esophageal samples.

Copper: Copper tended to rise from March to a peak in May and then decline. Values indicate that the pastures contain adequate copper during most of the grazing season. Copper from esophageal samples suggest copper in the body pool may overcome low levels in winter. Supplementing copper is questionable, but we need a performance trial before making recommendations.

Manganese: All of Mn values were above the 0.1-1.0 mg./100 g. recommended by the NRC.

Zinc: All Zn values were above the NRC requirement of 1.0-3.0 mg./100 g. for cattle.

Conclusion

Findings in this experiment indicate that supplementing with salt (NaCl) the year round is advisable. Other minerals that may be deficient and need further study include potassium (K) and copper (Cu).

Table 9.1. Mineral contents of forage samples handclipped from Flint Hills pastures.

Months	Ca	P	Mg	Na	K	Fe	Cu	Mn	Zn
	Percentage					mg./100 g.			
1. Burned pasture									
1975 Oct.	.542	.094	.178	.009	.715	23.1	.237	3.33	2.90
Nov.	.542	.082	.121	.017	.194	24.1	.277	3.04	3.46
Dec.	.575	.106	.077	.006	.113	28.0	.371	3.79	3.35
1976 Jan.	.489	.063	.081	.006	.087	28.7	.230	3.61	3.16
Feb.	.517	.061	.079	.007	.095	31.8	.442	3.04	3.09
Mar.	.504	.059	.069	.007	.116	47.1	.646	4.61	3.38
Apr.	.451	.056	.056	.012	.165	42.9	.499	3.75	3.75
May	.546	.117	.146	.018	1.790	47.1	.991	5.65	3.93
Jun.	.385	.069	.168	.008	1.230	18.4	.709	7.23	2.67
Jul.	.517	.060	.138	.008	1.100	13.9	.621	3.28	2.78
Aug.	.516	.060	.157	.007	.870	22.9	.614	5.03	3.49
Sept.	.342	.062	.171	.005	.737	14.2	.363	8.12	1.88
Mean	.494	.074	.120	.009	.601	28.5	.500	4.54	3.15
2. Pasture not burned									
1975 Oct.	.731	.171	.128	.057	.739	22.1	.494	3.83	3.89
Nov.	.661	.074	.077	.006	.133	21.9	.245	3.10	2.92
Dec.	.819	.096	.108	.007	.153	61.6	.346	5.05	4.29
1976 Jan.	.697	.097	.088	.007	.174	38.6	.262	3.34	3.69
Feb.	.424	.075	.057	.014	.089	28.0	.292	4.67	2.59
Mar.	.467	.058	.053	.007	.079	40.7	.331	4.96	3.39
Apr.	.527	.058	.052	.007	.312	61.0	.367	4.94	4.68
May	.582	.121	.130	.011	1.540	61.6	.991	5.12	4.57
Jun.	.429	.092	.111	.006	1.420	10.9	.622	2.15	2.61
Jul.	.491	.084	.130	.009	1.090	14.4	.653	2.85	2.31
Aug.	.482	.073	.113	.006	.931	14.7	.727	4.11	2.56
Sept.	.342	.092	.117	.006	.639	17.0	.408	4.66	2.08
Mean	.554	.091	.097	.012	.608	32.71	.478	4.07	3.30

Table 9.2. Mineral contents of forage samples collected from fistulated steers on Flint Hills pastures.

Months	Ca	P	Mg	Na	K	Fe	Cu	Mn	Zn
	Percentage					mg./100 g.			
1. Burned pasture									
1975 Oct.	1.143	.300	.110	1.47	.645	43.2	.278	4.47	5.73
Nov.	.542	.270	.047	1.65	.395	28.4	.493	3.39	3.22
Dec.	.537	.241	.046	1.95	.271	21.8	.298	2.77	3.04
1976 Jan.	.570	.264	.056	1.60	.277	32.9	.235	2.95	5.31
Feb.	.548	.262	.049	1.52	.322	46.5	.175	3.71	4.02
Mar.	.487	.213	.051	1.62	.283	45.4	.253	3.34	3.29
Apr.	.560	.278	.088	1.50	1.025	71.0	.401	6.26	5.19
May	.630	.351	.109	1.54	1.700	89.8	.649	6.87	5.78
Jun.	.694	.208	.155	1.45	1.120	30.4	.687	7.77	3.27
Jul.	.464	.201	.106	1.92	1.264	26.7	.526	4.08	2.89
Aug.	.636	.168	.118	1.55	.594	21.3	.621	5.14	2.37
Sept.	.899	.194	.122	1.62	.776	27.1	.666	7.89	2.93
Mean	.643	.246	.088	1.62	.722	41.2	.440	4.89	3.92
2. Pasture not burned									
1975 Oct.	1.865	.420	.148	1.57	.760	22.5	.526	5.44	6.72
Nov.	.644	.285	.058	1.51	.496	28.2	.318	3.68	4.18
Dec.	.567	.219	.051	1.44	.313	29.7	.622	3.82	4.06
1976 Jan.	.538	.223	.046	1.72	.502	20.8	.225	2.99	3.99
Feb.	.621	.248	.046	1.58	.301	36.6	.400	4.09	3.83
Mar.	.485	.216	.053	1.58	.351	65.0	.331	4.87	4.35
Apr.	.670	.271	.077	1.86	1.088	74.2	.644	5.41	7.36
May	.655	.377	.099	1.42	1.560	68.6	.614	6.92	5.28
Jun.	.998	.261	.113	1.55	1.274	56.0	1.001	3.32	4.01
Jul.	.631	.221	.074	1.37	.624	16.3	.357	3.31	2.44
Aug.	.761	.204	.099	1.64	.668	26.5	.478	4.41	3.09
Sept.	1.743	.238	.222	1.67	.908	33.8	.862	6.46	3.59
Mean	.848	.265	.091	1.58	.737	39.0	.532	4.56	4.41

Following Half-season Intensive Grazing on Native Pasture with Alfalfa or Sudangrass Grazing and/or Feedlot Finishing

R. M. Helsel, G. L. Posler, J. G. Riley,
E. F. Smith, and G. M. Ward

Summary

Late summer grazing of alfalfa or sudangrass by cattle coming off half-season, double-stocked native grazing showed no advantage over immediate feedlot finishing. Late-summer grazers gained less in the feedlot and required about the same feeding period as those animals taken to the feedlot in midsummer.

Introduction

Half-season, double stocking of native pasture is feasible as measured by weight gains and pasture recovery. Feeding systems that complement removing growing cattle from native pasture in midsummer need to be investigated.

Mid- to late-season grazing of alfalfa or sudangrass is possible in this area, and is reliable where irrigation is available.

We compared alfalfa pasture and sudangrass pasture, each followed by finishing in feedlot with immediate feedlot finishing after cattle were removed from native pasture in midsummer.

Experimental Procedure

Thirty-three steers and three heifers coming off native pasture July 15 were assigned to three groups. One group went to the feedlot for finishing; one, to rotational alfalfa grazing; and one, to rotational sudangrass grazing. Grazing continued 61 days. The grazed groups were finished in the feedlot later.

Six 1½-acre plots of each species were rotationally grazed for 5 days, then clipped and rested 25 days. The plots were irrigated as required to maintain active growth. Poloxalene block, a bloat preventative, was available to the grazing cattle.

The feedlot ration consisted of 83% cracked corn, 13% corn silage, and 4% supplement. Target weight in the feedlot was 1050 lb.

Results and Discussion

The alfalfa grazers averaged 1.18 lb. gain per day for the 61 days compared with .95 lb. per day by those on sudangrass. The animals were in good flesh at the beginning of the trial; better grazing gains in late summer by fleshy cattle is not probable. No bloat was observed.

Feedlot gains were faster for the cattle that went directly from native grass to the feedlot in midsummer (Table 10.1). In fact, they were marketed two months earlier than the two grazed groups. Their faster gains in the feedlot offset any advantage gained by the 61-day grazing in late summer. Nearly identical quantities of feed were required in the feedlot for all groups whether they grazed in late summer or not. Carcass quality was nearly identical for all groups.

Although the study needs to be repeated before recommendations are made, immediate finishing after early-summer grazing appears to be advantageous.

Table 10.1. Performance by animals going under indicated feeding systems from half-season, intensive grazing.

	Management		
	Feedlot	Alfalfa-feedlot	Sudan-feedlot
No. of animals	12	12	12
Weight into native pasture, lb.	531	534	533
Weight from native pasture, lb.	651	649	651
Weight gain, 80 days, lb./day	1.50	1.44	1.48
Weight after grazing alfalfa or sudan, lb.		721	709
Weight gain, 61 days, lb./day		1.18	.95
Days in feedlot	114	112	112
Finished weight, lb.	1066	1082	1073
Weight gain, lb./day	3.62	3.08	3.01
Feed used*, lb.	2838	2928	2897
lbs. feed/lb. gain	6.87	8.40	8.59
Carcass grade			
Choice	7	8	8
Good	5	4	4

*83% cracked corn, 13% corn silage, 4% supplement.

Response of Yearling Cattle to Burning and Fertilizing Bluestem Pasture and Intensively Stocking Early

E. F. Smith, Clenton Owensby, Bob Schalles,
Len Harbers, and Richard Pruitt

Summary

Long term (28 years) annual, late spring burning of bluestem pasture produced the most daily gain of all pasture treatments but not significantly more than stocking intensively early. Nitrogen applied to a late-spring-burned pasture did not significantly increase daily cattle gains over those from a similarly burned pasture not fertilized. But the nitrogen increased gain per acre by increasing carrying capacity of the pasture. Performance of animals on pasture stocked at twice the normal rate the first half of the season (intensive stocking early) did not differ from performance under normal stocking (burned with no nitrogen added) for the entire season. But for the period April 28 to July 15 intensive stocking early was superior in rate of gain and gain per acre.

Pastures burned annually produced better range plant composition than unburned pastures. The best range plant composition was on the pasture intensively stocked early.

Introduction

Late spring burning has increased desirable warm season grasses in bluestem pastures and increased steer gains. Nitrogen fertilization has increased forage production but also changed stand composition toward cool-season, lower producing species and weedy forbs.

Experimental Procedure

We used six native bluestem pastures, totaling 328 acres, five miles northwest of Manhattan in this study. All were managed the same as the previous five years. One burned, nonfertilized pasture, and one nonburned, nonfertilized pasture have had the same management the last 28 years, to study long term effects. Burned pastures were burned April 26 this year, and ammonium nitrate (34% nitrogen) was applied aerially April 28.

The pasture receiving nitrogen was stocked at a heavier rate in an attempt to equalize forage utilization. Pastures grazed the entire summer season were stocked from April 28 to Sept. 30. The pasture intensively grazed early was stocked from April 28 to July 15 at twice the normal rate. All were stocked with Hereford, Angus, some crossbred steers, and a few Hereford heifers averaging 538 lbs. randomly distributed among the pastures. Equal numbers of animals on each pasture were implanted with either Ralgro or Stilbestrol and some were reimplanted at mid-summer. All were gathered the first of each month, penned overnight without feed or water, and weighed the next morning.

Plant census was taken by a modified step-point system in early summer on range sites of loamy upland and breaks in each pasture. Perennial grass, weeds, and brush remaining after grazing were estimated by clipping 15 randomly placed 1/10,000 acre plots on loamy upland and breaks in each pasture.

Results and Discussion

Long term annual burning (28 years) increased daily gain over other treatments except intensive stocking, which produced gains not significantly different. Nitrogen applied to a burned pasture did not significantly affect daily gain but increased gain per acre from 74 to 107 lbs. because of the increased stocking rate (2.2 acres per steer). Performance of animals on the intensively stocked pasture did not differ significantly from performance from normal stocking the entire season. But performance was better on the intensively stocked pasture the first half of the season. Usually performance declines during late season, but in 1977 daily gains in late seasons were good. Good rains prompted adequate, green growing grass into September.

During spring burning, approximately 80 percent of the pasture stocked intensively early burned compared with 40 percent or less of the other pastures where grass was too sparse to carry the fire.

Pastures burned annually had better range plant composition than unburned pastures did; best range plant composition was on the pasture intensively stocked early (Table 11.2).

Most pastures were similar in herbage remaining after grazing but the fertilized pasture had significantly less herbage remaining than other pastures (Table 11.3).

Table 11.1. Effects on steer gains from burning and fertilizing native bluestem pasture and from stocking intensively early.

	Daily gain per steer, lbs.	Gain per acres, lbs.	Acres per steer	Steer grazing days per acre
Not burned				
28 years	1.27 [a]	59	3.3	46
6 years	1.22 [a]	57	3.3	46
Burned April 26				
28 years	1.77 [d]	81	3.3	46
10 years	1.60 [bc]	74	3.3	46
40 lb. N/acre	1.53 [b]	107	2.2	70
Intensively stocked April 28 to July 15 (78 days)	1.71 [cd]	75	1.7	45
Stocked normally April 28 to July 15 (78 days)	1.49 [b]	35	3.3	23

[a,b,c,d] Figures with like superscripts do not differ significantly ($P<.05$)

Table 11.2. Botanical composition (%) and basal cover (%) of indicated plant species on loamy upland bluestem range under indicated management. Data collected in June, 1977.

Species	Management					
	Not burned		Burned April 26			
	28 yrs.	6 yrs.	28 yrs.	10 yrs.	40 lb. N/acre	Intensive stocking
Big bluestem						
Bot. comp.	17.9	17.4	25.4	25.7	24.7	30.6
Basal cover	0.99	1.44	1.68	1.56	1.48	1.67
Little bluestem						
Bot. comp.	7.9	18.9	15.3	14.4	5.4	10.8
Basal cover	0.44	1.56	1.01	0.87	0.32	0.59
Indiangrass						
Bot. comp.	9.8	7.8	12.4	11.0	7.9	19.1
Basal cover	0.55	0.64	0.82	0.67	0.48	1.05
Sideoats grama						
Bot. comp.	7.8	3.8	8.9	11.8	8.4	6.8
Basal cover	0.43	0.31	0.59	0.72	0.50	0.37
Kentucky bluegrass						
Bot. comp.	27.9	17.9	3.0	5.7	2.5	3.8
Basal cover	1.55	1.48	0.20	0.35	0.15	0.21
Sedges						
Bot. comp.	7.7	11.8	7.6	7.4	13.8	5.0
Basal cover	0.43	0.97	0.50	0.45	0.82	0.28
Perennial forbs						
Bot. comp.	11.0	11.0	15.1	13.9	14.4	10.3
Basal cover	0.62	0.93	1.01	0.83	0.86	0.54

Table 11.3. Grass and forbs dry matter (lb./acre) remaining after grazing under indicated management. Data collected in October, 1977.

Management	Loamy upland		Breaks	
	Grass	Forbs	Grass	Forbs
Not burned				
28 years	2414	396	1626	821
6 years	2106	398	2069	170
Burned				
28 years	1912	392	1890	379
10 years	2057	145	1952	101
40 lb. N/acre	1319	507	1078	789
intensive stocking	1736	157	1859	264

Results From One and Two Implants Compared with Yearling Cattle on Summer Pasture

Richard Pruitt, Arnold Fleck, E. F. Smith,
Larry Corah, and Clenton Owensby

Summary

Reimplanting Ralgro in mid-July after implanting in late April did not improve daily summer gains compared to a single implant.

Introduction

Growing cattle on summer pasture have consistently shown a gain response to such implants as Diethylstilbestrol (DES), Synovex, and Ralgro. This trial was planned to see if a second implant in mid-summer would be desirable.

Experimental Procedure

We implanted 83 yearling, Hereford, Angus, and crossbred steers with Ralgro (36 mg.) on April 28. On July 15, 44 steers were reimplanted. All cattle grazed native bluestem pasture from April 28 to September 30, 1977 (155 days) Weights were taken in the morning after cattle were penned without feed or water overnight.

Results

Results of the trial are reported in Table 12.1. Reimplanting with Ralgro in mid-summer after an initial implant in spring did not significantly improve weight gains.

Table 12.1. Results from one and two implants compared with yearling steers on summer pasture.

	Spring	Spring and mid-summer
No. cattle	39	44
Starting wt., lbs.	552	544
Final wt., lbs.	785	779
Lbs. gained	233	235
Average daily gain	1.50[1]	1.52[1]

[1]Figures for ADG with the same superscript do not differ significantly (P<.10).

Feeding Monensin to Yearling Cattle on Summer Grass

E. F. Smith, Richard Pruitt, Jack Riley,
Larry Corah, and Clenton Owensby

Summary

The feed additive, Monensin, was self-fed in a feed block to yearling cattle on summer pasture. Consumption of the block (0.29 lb. daily) supplied 116 mg. of Monensin daily, which failed to improve the cattle's performance.

Introduction

During the 1976 summer, Monensin was included in a feed block and offered free choice to yearling steers grazing summer bluestem pasture. The gain was 0.28 lb. more per steer daily compared to other steers receiving a feed block without Monensin.

This experiment repeated the 1976 trial.

Experimental Procedure

We randomly allotted 35 Hereford, Angus, and crossbred steers into two groups with one Hereford heifer in each group. Half the animals in both groups were implanted with Ralgro; half, with 30 mg. Stilbestrol, and each group grazed a 60-acre native bluestem pasture from April 27 to September 30, 1977. They had available in covered boxes commercial feed blocks[1] composed primarily of cane molasses; soybean meal, 20%; salt, 16-20%; and other feed ingredients. One group had Monensin added to the feed block at 400 mg. per pound. All animals were gathered the first of each month, penned overnight without feed or water, weighed the next morning, and rotated between pastures each month.

Results and Discussion

Gain was the same for both groups; average feed block intake was the same, 0.29 lb. per head daily, or 116 mg. of Monensin per head daily. We cannot explain the difference in performance during the 1976 trial (when gain was increased with Monensin) and this trial. Late summer gains in 1977 were better than usual due to late summer rains.

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[1]Feed blocks supplied by A. E. Staley Mfg. Co., Decatur, IL, whose support is greatly appreciated.

Wheat, Barley, and Oat Silages for Beef Cattle

Keith Bolsen and Jim Oltjen

Wheat, barley, or oat silages can provide excellent alternatives to corn and sorghum silages for beef cattle.

After six years of research and practical experience with cereal silages, we believe the following conclusions or recommendations can be made:

1. Harvesting and feeding cereals as silage produces more beef per acre than grain.
2. For the best silage, ensile cereals at 60 to 65% moisture.
3. As cereals mature from boot to dough stages, silage yield increases but silage crude protein decreases.
4. Harvest cereals in the mid-dough stage of maturity for maximum TDN and beef production per acre.
5. Winter wheat, winter barley, and spring oats have similar dough-stage silage yields--6 to 9 tons per acre.
6. Cereal silages are usually about 2 percentage units higher in protein than corn or sorghum silages.

When fed to growing cattle in high silage rations

7. Barley and corn silages are about equal in feeding value.
8. Wheat silages support about 80% the level of performance of corn silage.
9. The higher the grain content of wheat, barley, and oat silages, the higher the silage feeding value.

When fed to finishing cattle in high grain rations

10. Wheat and corn silages support similar feedlot performance.

Feeding Value of Wheat, Barley, Oat and Corn Silages for Beef Cattle

Wheat, barley, oat, and corn silages were fed to steers in seven trials for the past five years (Prog. Rpt. 210, 230, 262, and 291, Kansas Agr. Expt. Sta.). The forages were whole plant and had been harvested in the dough stage except as indicated. Silage was made in concrete silos (10 x 50 feet). When necessary, water was added to provide a moisture content of at least 60% in the ensiled forage. Cereal silage varieties included soft red winter, awnless wheats, Blue Boy, Blue Boy II, and Arthur; hard red winter, awned wheats, Parker, Eagle and Sage; winter, awned barleys, Paoli and Kanby, and spring oats, Trio and Lodi.

Growing Rations

In the five growing trials, steers were fed to appetite twice daily a ration of 86% silage and 14% supplement (on a dry-matter basis). Rations were fed five successive falls and winters.

Trial 1, 63 Angus steers (average initial weight, 516 pounds), 1972-73.

Trial 2, 126 Hereford, Angus, and mixed breed steers (average initial weight 586 pounds), 1973-74.

Trial 3, 120 Hereford steers (average initial weight, 588 pounds), 1974-75.

Trial 4, 74 mixed breed steers (average initial weight, 666 pounds), 1975-76.

Trial 5, 108 Hereford and Angus steers (average initial weight, 640 pounds), 1976-77.

Each year the steers grazed native bluestem range for five months before being put on the silage rations. Results are summarized in Table

In all five trials, steers fed corn silage gained faster and more efficiently than steers fed any of the wheat silages. In trials 2, 3, and 5, steers receiving corn silage outperformed those receiving barley silage, but in Trial 4 gain and efficiency were slightly better for steers fed barley silage.

In Trial 1, steers fed Blue Boy wheat-head silage consumed more feed and gained faster than did steers fed Parker wheat-head silage.

In Trial 2, Paoli barley silage, Arthur wheat silage, and a mixture of equal parts corn silage and Parker wheat-head silage produced similar performances. Steers fed Parker wheat silage or Parker wheat-head silage gained the slowest, consumed the least feed, and tended to be the least efficient.

In Trials 3 and 5, steers fed barley silage outperformed steers fed any of the wheat silages. In Trial 3, steers fed Blue Boy II wheat silage gained slower and less efficiently than did steers fed either Arthur or Eagle wheat silages. In Trial 5, steers fed Arthur or Sage wheat silages performed similarly.

In Trial 5, steers fed Trio or Lodi oat silages had the lowest performance. They consumed about 10 pounds less wet silage daily and gained 1.0 to 1.5 pounds less per day than did steers fed corn, barley or wheat silages. Droughty weather in mid-June caused very low grain content of the oat silages and undoubtedly contributed to their poor showing in Trial 5.

Feeding values of cereal silages were established from the rate and efficiency of gain results presented in Table 13.1. When corn silage was given a value of 100 (Table 13.2), barley silage rated 92 to 110; wheat silage, 64 to 96, and oat silage, 46 to 50. Because of its higher grain content, higher digestibility, and greater consumption barley had superior feed value to wheat.

Wheat varieties differ in feeding value. It is not a simple difference of hard red winter versus soft red winter or awned (bearded) versus awnless (no beards). Differences exist among hard red winter, awned varieties. For example, Eagle has a higher feeding value and is consumed in greater amounts than Parker. Likewise, in the awnless soft red winter, Arthur has a higher feeding value than Blue Boy II. One reason for the differences may be that grain to forage ratios differ among wheat silage varieties.

Finishing Rations

Two finishing trials were used to compare wheat silage and corn silage as sources of roughage in feedlot rations.

In Trial 6, 60 Angus, Hereford, and crossbred yearling steers (average initial weight, 724 pounds) were fed corn silage or Parker wheat-head silage 123 days during the winter and spring, 1973. Each silage was fed at 10 and at 20% of the ration on a dry matter basis. Grain in the rations was equal parts of dry rolled corn and steam-flaked milo.

In Trial 7, 40 yearling crossbred steers (average initial weight, 864 pounds) were fed corn silage or Eagle wheat silage during the winter and spring of 1976. Each silage was fed at 13% of the ration on a dry matter basis. The grain in the rations was either dry rolled milo or high-moisture milo.

Results are summarized in Table 13.3. In Trial 6, steers fed corn silage or wheat-head silage had similar performances. However, in Trial 7, corn silage supported a slightly faster and more efficient gain than wheat silage. In neither trial were dressing percentages, carcass qualities, or yield grades affected by silage treatment.

Tips for Making and Feeding Cereal Silage

Preserving maximum nutrients per acre from cereal silages requires careful forage and silo management. These six recommendations are based on our experiences:

1. Harvest in the dough stage.
2. Chop fine, using a recutter screen or short-length cut.
3. Ensile at about 65% moisture, adding water or a wetter forage if necessary.
4. Fill the silo rapidly.
5. Pack well to exclude air.
6. Cover and seal the surface to reduce spoilage.

Optimum silage harvest time is shorter for wheat, barley, or oats than for corn or sorghum. Harvesting at the dough stage, a critical 10 to 14 days, requires good management. It may help to start early when moisture is 65 to 70%, so harvest does not extend beyond the dough stage of maturity. As harvest draws to a close, the drier forage may require that water be added or that a wet forage, like direct-cut alfalfa, be blended with it at the silo.

Usually harvest must begin early in the dough stage or even the late milk stage to allow harvest to be completed during the optimum stage. Rain may delay harvest, which is another reason to start early and "make silage while the sun shines."

But as cereals mature, moisture decreases rapidly. Start adding water to the forage when it drops below 60% moisture, usually about the mid-dough stage. How much water to add or whether to add any depends on type and size of silo.

A 50 to 65% moisture content in the ensiled material is desirable for most silos. However, large upright, concrete silos; horizontal trench and bunker silos, or oxygen-limiting silos may permit 50 to 60% moisture cereals to be ensiled satisfactorily.

Despite their slightly lower feed values, wheat and barley silages contain more protein and require less supplementation than corn or sorghum silages. Although wheat, barley, and oat silages vary more in protein than corn or sorghum silages, under proper fertilization and a normal growing season, it would be reasonable to expect 9 to 11 percent protein in whole-plant dough cereal silages. That means much less supplemental protein in beef growing rations. For example, if a growing ration required 12.5 percent protein and the cereal silage supplied is 10.5 percent protein, supplemental protein costs at $8 per hundred-weight soybean meal and $4 per hundred-weight milo would be about 13 to 14 cents per day. Supplemental protein costs for corn or sorghum silages containing only 8 percent protein would be 17 to 18 cents per day. In any event, it is important to take a protein analysis of each silage before feeding it in growing rations.

Table 13.1. Performance of growing steers fed wheat, barley, oat, or corn silage.

Silage	Avg. daily gain, lbs.	Daily feed intake, lbs.[1]	Feed/lb. gain, lbs.[1]	Silage DM %	Silage CP%[1]	Forage harvest date
	Trial 1 (122 days) 1972-73					
Corn	1.92	15.3	8.1	33.4	8.7	----
Blue Boy wheat-head[2]	1.53	14.4	9.5	35.7	13.6	June 11
Parker wheat-head	1.43	13.4	9.5	36.6	13.2	June 9
	Trial 2 (100 days) 1973-74					
Corn	2.48	18.6	7.5	40.9	8.3	----
Barley	2.29	17.4	7.7	32.9	9.5	June 1
Arthur wheat	2.09	17.4	8.5	36.9	7.5	June 8
Parker wheat	1.54	14.7	9.6	34.6	7.4	June 6
Parker wheat-head	1.75	14.8	8.1	41.2	9.9	June 7
Corn + Parker wheat-head	2.22	18.0	8.1	----	----	----
	Trial 3 (90 days) 1974-75					
Corn	2.83	19.3	6.8	34.5	9.1	----
Barley	2.60	17.5	6.9	34.8	12.0	May 29
Arthur wheat	1.91	15.0	7.9	32.2	11.2	June 5
Blue Boy II wheat	1.55	14.3	9.5	36.9	11.2	June 5
Eagle wheat	1.91	16.3	8.5	34.3	9.6	June 5
	Trial 4 (87 days) 1975-76					
Corn	2.45	18.8	7.7	37.8	7.6	Aug. 29
Barley	2.70	18.9	7.0	35.3	11.5	June 4
Arthur wheat	2.32	18.3	7.9	36.9	10.8	June 13
Eagle wheat	2.11	16.9	8.1	37.8	8.4	June 14
Eagle wheat-milk stage	1.97	16.0	8.2	33.8	9.9	June 5
	Trial 5 (89 days) 1976-77					
Corn	2.52	19.1	7.6	37.2	8.3	Aug. 20
Barley	2.33	19.5	8.4	35.7	9.0	June 2
Arthur wheat	2.06	18.7	9.1	39.2	11.2	June 7
Sage wheat	1.96	19.2	9.9	41.2	8.3	June 9
Trio oats	1.09	14.6	13.5	30.1	12.6	June 17
Lodi oats	1.02	14.7	14.5	31.2	10.1	July 2

[1] 100% dry matter basis.
[2] Upper ½ of plant.

Table 13.2. Relative feeding values of wheat, barley, and corn silages.[a]

Silage	Relative value, corn silage = 100
Barley (dough stage)	98[b] (range: 92 to 110)
Wheat (dough stage)	81[c] (range: 64 to 96)
Oats (dough stage)	48[d] (range: 46 to 50)

[a]Feeding values established from rate and efficiency of gain data in the feeding trials.

[b]Four barley silages in four trials; [c]twelve wheat silages in five trials; [d]two oat silages in one trial.

Table 13.3. Performance of finishing steers fed corn or wheat silages.

Silage	Avg. daily gain, lbs.	Daily feed intake, lbs.[1]	Feed/lb. gain, lbs.[1]
	Trial 6 (123 days) 1973		
10% corn silage	2.40	17.4	7.02
20% corn silage	2.68	18.6	6.96
10% Parker wheat-head silage	2.54	18.2	7.32
20% Parker wheat-head silage	2.47	18.6	7.53
	Trial 7 (82 days) 1976		
Corn silage	2.60	20.5	7.99
Eagle wheat silage	2.41	20.9	8.76

Forage and Grain Yields and Forage Composition of Barley, Wheat, and Oats

Jim Oltjen, Keith Bolsen, and Walter Moore[1]

Summary

We harvested barley, wheat and oat varieties at the dough stage. Average yields in tons of 65% moisture forage/acre were 9.3 (barley), 10.2 (hard wheat), 9.5 (soft wheat), and 10.0 (oats). Barley variety yields varied most because of winter kill. Barley forages were the most digestible; oats, the least digestible. Crude fiber and grain contents of the forages were highly correlated with digestibility.

Barley yielded highest in digestible dry matter, but hard wheat yields were more consistent from year to year.

Introduction

Barley, wheat, and oat forages are potential livestock feeds. Cereals harvested as whole-plant hay or silage usually yield more dry matter than grain harvest or pasture grazing yields. Under some economic conditions cereal forage is more profitable than cereal grain. Previous KSU research has shown corn and barley silages about equal in feeding value, with wheat silage worth somewhat less. We harvested the cereal silages at the dough stage of maturity for highest TDN yield per acre.

Here we used barley, wheat, and oat varieties common to Kansas and determined forage dry matter yields, forage composition, grain yields, and in vitro digestibilities.

Experimental Procedure

Three field experiments were conducted at the South Central Kansas Experiment Field, Hutchinson, in 1975, 1976, and 1977. Plot areas received 32 lb. nitrogen and 40 lb. phosphorus per acre each fall before seeding.

Winter barley varieties were Paoli and Kanby all three years; soft red winter wheat varieties were Arthur-71 all three years, plus Blue Boy II in 1975 and Abe in 1976 and 1977; hard red winter wheat varieties were Eagle and Sage all three years; and spring oat varieties were Pettis and Lodi in 1976 and 1977. Barley, wheat, and oat varieties were seeded at rates of 90, 75, and 60 lb./acre, respectively. Planting dates for barley and wheat were October 2, 1974, October 2, 1975, and October 13, 1976; planting dates for oats were

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March 19, 1976, and March 2, 1977. Varieties were replicated four times.

Forage harvest was at the dough stage (Table 14.1). Plants were hand-harvested by mower clipping a 60-square-foot area of each plot. Dry matter, proximate analysis, Van Soest fiber analysis, and in vitro dry matter digestibility were determined for each variety. Grain yields were measured from three, 12-square-foot areas of each plot.

Results

Forage and grain yields (Table 14.2) are tons of 65%-moisture forage per acre, and bushels of 12%-moisture grain per acre. Overall forage yields show hard wheat or oats yielded more forage than barley or soft wheat ($P<.05$). Yields in 1977 were less than in 1975 or 1976 ($P<.01$). Difference in variety yields were not consistent. For example, Kanby barley yielded more than 10 tons/acre in 1975 and 1976, but only 6.8 tons in 1977 because an extremely cold winter reduced the stand. Grain yields were highest for barley and lowest for oats. Grain contents (DM basis) were 45.6% for barley, 29.7% for soft wheat, 32.1% for hard wheat, and 20.2% for oats.

Table 14.3 shows forage crude protein, crude fiber, and in vitro dry matter digestibility averaged over years for each variety. The crude protein values are about 2% lower than for similar forages machine-harvested. Oat forage protein, although higher on average, varied more and was lower than barley forage protein in 1977. Variation between varieties was small. Crude fiber values were lowest for barley and highest for oats. Wheats were intermediate in crude fiber; soft wheats had less than hard wheats. Crude fiber values of barley and wheat tended to be less when forage yields were highest. In vitro dry matter digestibility was highest for barley. Paoli barley was consistently more digestible than Kanby barley (62.7 vs. 59.9%). Other varietal differences were less pronounced, except for low digestibility of Blue Boy II one year. Soft wheats tended to be more digestible than hard wheats, but both were more digestible than oats. In vitro dry matter digestibility, the best measure of feeding value in these experiments, is inversely related to crude fiber with a correlation of $r = -.83$. Crude protein content did not affect ($r = -.13$) digestibility. Higher grain content of the forage also is associated with increased digestibility ($r = +.64$).

Digestible dry matter yield per acre (IVDMD x forage dry matter yield) is shown for specie and year in Figure 2.1. Year affected ranking of species, with barley yielding highest in 1975 and 1976, but lowest in 1977. Hard wheat digestible dry matter yields were the most consistent, and exceeded soft wheat yields in 1975 and 1977.

Table 14.1. Dates of forage harvests.

Specie	1975	1976	1977
Barley	May 26	May 20	Nay 23
Wheat	June 5	June 4	June 1
Oats, Pettis	--	June 16	June 10
Oats, Lodi	--	June 22	June 20

Table 14.2. Forage and grain yields of barley, wheat, and oat varieties.[1]

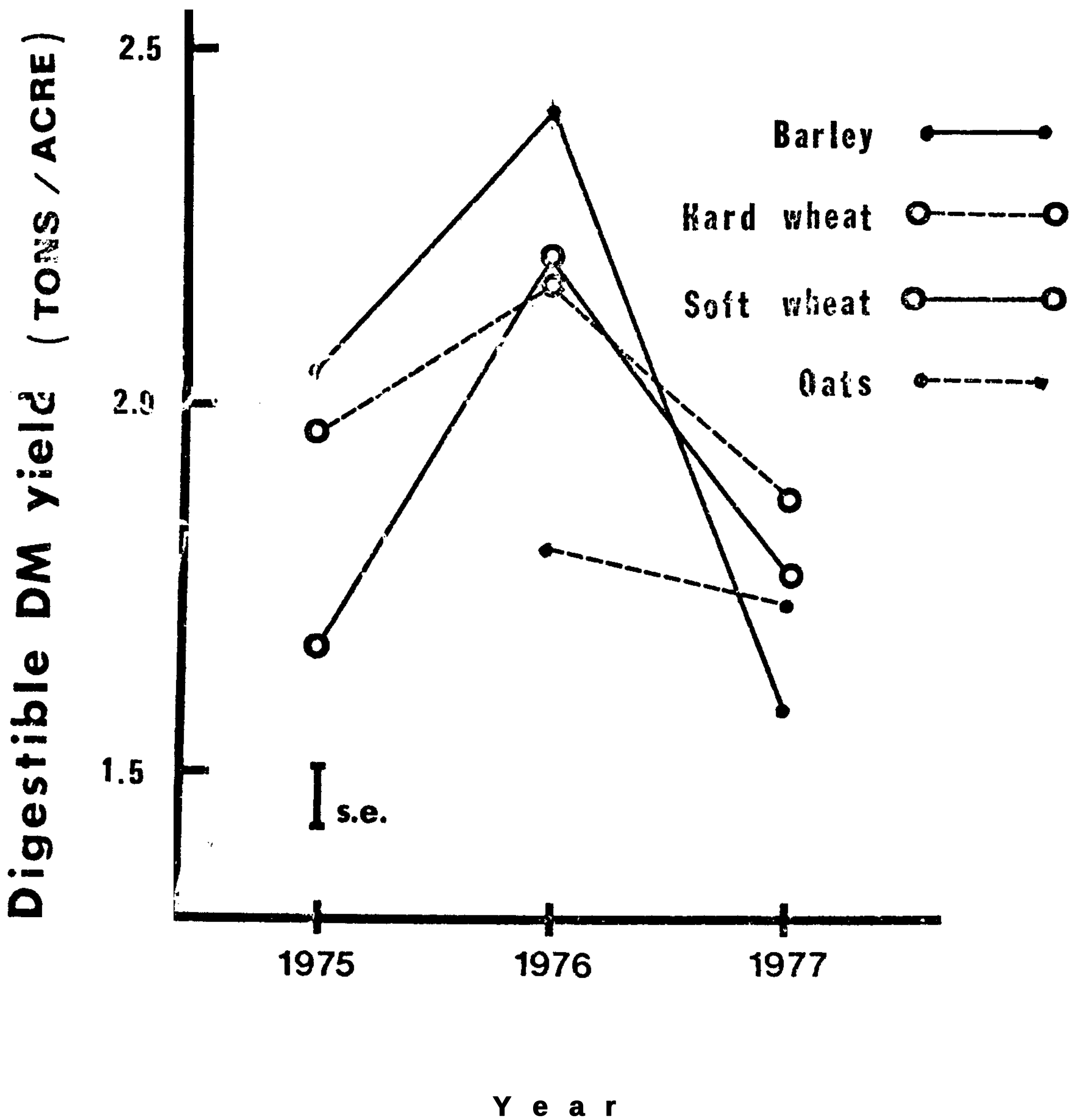
Specie and variety	1975		1976		1977		Average	
	Forage	Grain	Forage	Grain	Forage	Grain	Forage	Grain
Barley							9.3	71 (3408 lbs.)
Paoli	9.4	85	9.8	66	8.6	66		
Kanby	10.3	79	11.1	79	6.8	48		
Soft Wheat							9.5	50 (3000 lbs.)
Arthur-71	8.5	46	10.6	56	9.0	47		
Blue Boy II	10.3	49	--	--	--	--		
Abe	--	--	10.3	55	8.5	49		
Hard Wheat							10.2	44 (2640 lbs.)
Eagle	10.6	42	9.8	41	9.7	46		
Sage	10.5	44	10.8	51	9.6	37		
Oats							10.0	50 (1600 lbs.)
Pettis	--	--	10.7	73	9.6	53		
Lodi	--	--	9.2	35	10.3	39		

[1]Forage yields are in tons of 35% DM forage per acre; grain yields in bushels of 12%-moisture grain per acre (barley, 48 lbs./bu.; wheat, 60 lbs./bu.; oats, 32 lbs./bu.).

Table 14.3. Crude protein, fiber and *in vitro* DM digestibility of barley, wheat, and oat forages.

Specie and variety	Crude protein %	Crude fiber %	*In Vitro* DM diestibility %
Barley			
Paoli	7.5	23.6	62.7
Kanby	7.1	26.1	59.9
Soft wheat			
Arthur-71	6.5	26.6	56.1
Blue Boy II	6.6	28.8	50.5
Abe	7.2	24.8	58.2
Hard wheat			
Eagle	6.4	29.6	55.9
Sage	6.5	31.0	56.4
Oats			
Pettis	8.2	31.8	50.8
Lodi	8.6	34.8	50.1

Fig. 2.1. Digestible DM yield of barley, wheat, and oat forages.



Milo Stover, Forage Sorghum, and Protein Levels Compared for Growing Calves

Keith Bolsen, Jim Oltjen, and Harvey Ilg

Summary

Milo stover silage, baled milo stover or forage sorghum silage was fed in 10, 12, or 14% protein rations to 120 calves in a 95-day growing trial, December 9, 1976, to March 14, 1977.

Calves fed forage sorghum silage outperformed those fed milo stover silage or baled milo stover. Ensiled and baled milo stover supported similar performances. Calves fed 10% protein gained slower and less efficiently than those fed 12 or 14% protein. Observed gain and efficiency for a ration containing equal parts of milo stover silage and forage sorghum silage exceeded predicted gain and efficiency by 7.8% and 15.4%, respectively.

Introduction

Milo stover and forage sorghum silages were compared in four previous heifer growing trials at this station (Prog. Rpt. 210, 230, 262,and 291, Kansas Agr. Expt. Sta.). Results show: (1) growing calves fed milo stover silage should gain about 1.0 lb. per day and require 10 to 14 lbs. of dry matter per lb. of gain, (2) milo stover silage has a feeding value of 63 to 67% that of forage sorghum silage, (3) milo stover silage is a better feed for growing calves fed in combination with forage sorghum silage than when fed alone, and (4) supplying supplemental protein is a large cost in milo stover silage rations because the stover usually contains so little protein.

This trial was to verify previous results from feeding a combination of milo stover and forage sorghum silages, to compare ensiled and dry-baled milo stover, and to evaluate three levels of supplemental protein in milo stover growing rations.

Experimental Procedure

Shown below are the four forage treatments and three protein levels compared in the 95-day growing trial (December 9, 1976, to March 14, 1977).

Forage treatment	Protein, % of the ration
Milo stover silage (MSS)	10, 12, and 14
Baled milo stover (BMS)	10, 12, and 14
Forage sorghum silage (FSS)	12
½ MSS + ½ FSS	10, 12, and 14

One hundred and twenty calves (91 heifers and 29 steers) averaging 462 lbs. were allotted by breed, sex, and weight into 20 pens of six calves each. Breeds included Angus, Hereford, Angus x Hereford, and Hereford x Simmental. Two pens were assigned to each of the 10 rations. Compositions of the rations are shown in Table 15.1. All rations were formulated on a fixed percentage basis to be equal in minerals, vitamins, and additives, and all were mixed and fed to appetite twice daily.

All calves were fed the same amount of prairie hay for 5 days before initial weighing and the same amount of experimental ration for 2 days before final weighing. All feed and water were withheld 16 hours before weights were taken.

Forage sorghum was a high-grain variety harvested in the dough-stage at 68 to 70% moisture. Milo stover was from dry-land milo and the grain had been harvested about 30 days before stover was harvested. The forage sorghum and milo stover silages were stored in concrete silos (10 ft. x 50 ft.). The baled milo stover was swathed and field-dried before baling in large rectangular and round bales about 1500 to 2000 lbs. each. Milo stover silage was about 65% moisture at harvest; baled milo stover, about 30 to 35% moisture at harvest. Some heating occurred in the bales but mold and visual deterioration were not excessive. The baled stover was processed in a tub grinder before being fed.

Results

Dry matter (%), crude protein (%, DM basis), and crude fiber (%, DM basis), respectively, for the three forages were: 36.9, 4.3, 32.8 for milo stover silage; 71.6, 3.6, 35.4 for baled milo stover, and 31.9, 5.2, 23.7 for forage sorghum silage.

Performances of calves fed each ration are shown in Table 15.2. Forage sorghum silage (12% protein) supported faster and more efficient gains than the 12% protein rations of the other three forage treatments.

Performances of calves fed milo stover silage, baled milo stover, or MSS + FSS average across protein levels are shown in Table 15.3. Calves fed MSS + FSS gained faster ($P<.05$) and more efficiently ($P<.05$) than those fed milo stover silage or baled milo stover. Ensiled and baled stover supported similar performances although feed intake was higher ($P<.05$) for milo stover silage than for baled milo stover.

Performances of calves fed each protein level averaged across forage treatments are shown in Table 15.4. Calves receiving 10% protein gained slower ($P<.05$) and less efficiently ($P<.01$) than calves receiving 12 or 14% protein. Performance was similar for the 12 and 14% protein rations. There were no interactions between forage treatment and protein level. However, the milo stover silage and baled milo stover rations gave more response to additional protein than did the MSS + FSS rations. Daily feed costs and feed cost per lb. of gain can be estimated for calves fed each level of protein. When the price of soybean meal is low compared with the price of grain, the economic advantage of feeding 12 or 14% protein is greater than it is when the price of soybean meal is high compared with the price of grain.

Observed gains and feed efficiencies for the 100% MSS (12% protein) and 100% FSS (12% protein) rations were used to calculate predicted gain and efficiency for the 50% MSS + 50% FSS (12% protein) ration (Table 15.5). Observed gain exceeded predicted gain by .10 lb. per day or 7.8%, and observed feed efficiency exceeded predicted efficiency by 1.86 lbs. of feed per lb. of gain or 15.4%. These results agree with results from two previous trials at this station that showed 10.7% improved gain and 12.8% improved feed efficiency by feeding combinations of milo stover and forage sorghum silages.

Table 15.1. Compositions of rations and supplement used to compare milo stover, forage sorghum, and protein levels.

Ingredient	Rations[1] 100% MSS	50% MSS 50% FSS	100% FSS	100% BMS
Milo stover silage	73.0	36.5	--	--
Forage sorghum silage	--	36.5	73.0	--
Baled milo stover	--	--	--	73.0
Milo + soybean meal concentrate	22.0[a]	22.0[a]	22.0	22.0[a]
Supplement[2]	5.0	5.0	5.0	5.0

[1]% on a 100% dry matter basis.

[2]Lbs. per ton, air-dry basis: rolled milo, 1675; dicalcium phosphate, 122; limestone, 50, salt, 100; fat, 20; trace minerals, 5; antibiotic, 23, and vitamin A premix, 5.

[a]Ratio of milo and soybean meal adjusted to provide 10, 12, and 14% protein.

Table 15.2. Performances of calves fed the 10 rations for the 95-day trial, December 9, 1976, to March 14, 1977.

Item	Forage treatment and protein % FSS 12	MSS 10	MSS 12	MSS 14	DMS 10	DMS 12	DMS 14	MSS + FSS 10	MSS + FSS 12	MSS + FSS 14
No. of calves	12	12	12	12	12	12	12	12	12	12
Initial wt., lbs.	469	474	457	457	459	464	469	471	458	455
Final wt., lbs.	629	546	539	548	525	548	550	590	589	594
Avg. total gain, lbs.	160	72	82	91	66	84	81	119	131	139
Avg. daily gain, lbs.	1.68	.76	.87	.96	.70	.89	.85	1.25	1.38	1.46
Avg. daily feed, lbs.										
FSS	11.02	--	--	--	--	--	--	5.20	5.14	5.49
MSS	--	9.79	9.67	9.54	--	--	--	5.20	5.14	5.49
DMS	--	--	--	--	8.77	9.35	9.07	--	--	--
milo	1.13	1.49	.74	--	1.25	.52	--	1.71	.91	--
soybean meal	2.19	1.46	2.17	2.88	1.39	2.30	2.74	1.41	2.18	3.30
supplement	.75	.67	.66	.65	.60	.64	.62	.71	.70	.75
total	15.09	13.41	13.24	13.07	13.01	12.81	12.43	14.23	14.07	15.03
Feed/lb. of gain, lbs.[1]	8.98	17.83	15.21	13.75	17.43	14.47	14.76	11.43	10.24	10.30

[1]100% dry matter basis.

Table 15.3. Performances of calves fed forage treatments: MSS, BMS, or MSS + FSS.

Item	Forage treatment		
	MSS	BMS	MSS + FSS
No. of calves	36	36	36
Avg. daily gain, lbs.	.86[b]	.81[b]	1.36[a]
Avg. daily feed, lbs.[1]	13.24[b]	12.42[c]	14.44[a]
Feed/lb. of gain, lbs.[1]	15.60[b]	15.55[b]	10.66[a]

[1]100% dry matter basis.

[a,b,c]Means in the same row with different superscripts differ significantly (P<.05).

Table 15.4. Performances of calves fed the three protein levels.

Item	Protein %		
	10	12	14
No. of calves	36	36	36
Avg. daily gain, lbs.	.90[b]	1.05[a]	1.09[a]
Avg. daily feed, lbs.[1]			
forage	9.66	9.76	9.87
milo	1.45	.72	--
soybean meal	1.45	2.22	2.97
supplement	.66	.67	.67
total	13.22	13.37	13.51
Feed/lb. of gain, lbs.	15.56[d]	13.31[c]	12.94[c]

[1]100% dry matter basis.

[a,b]Means in the same row with different superscripts differ significantly (P<.05).

[c,d]Means in the same row with different superscripts differ significantly (P<.01).

Table 15.5. Observed vs. predicted rates and efficiencies of gain by calves fed 100% MSS, 50% MSS + 50% FSS, or 100% FSS.

Item	Ration		
	100% MSS	50% MSS 50% FSS	100% FSS
No. of calves	12	12	12
Avg. daily gain, lbs.			
observed	.87	1.38	1.68
predicted	--	1.28	--
improvement, lbs.[1]		+.10	
improvement, %		+7.8	
Feed/lb. of gain, lbs.			
observed	15.21	10.24	8.98
predicted		12.10	
improvement, lbs.[1]		-1.86	
improvement, %		+15.4	

[1]Observed minus predicted.

KSU

Protein Supplementation for Cows Wintered on Milo Stubble

Miles McKee, Kris Kimple, and Larry R. Corah

Summary

Cows in mid-to-late gestation gained significantly (P<.05) more while grazing milo stover supplemented on alternate days with 4 lbs. per head of a natural protein than cows with no protein supplement. Although protein supplementation stimulated extra gain, the cows receiving no protein supplement gained weight and maintained adequate condition for mid-to-late gestation. When quality and quantity of milo stover are satisfactory, satisfactory performance can be acheived by cows in mid-to-late gestation without supplemental protein.

Introduction

Milo stover is economically important to cow-herd operators. Previous research at KSU has shown that pregnant cows can maintain weight while grazing standing milo stover with no supplementation other than salt or mineral. This study further evaluated the need for and benefit from feeding protein supplement to pregnant cows grazing milo stalks.

Experimental Procedure

Forty mature Hereford and Simmental x Hereford cows in mid-to-late gestation were allotted into 4 groups by weight, condition score, breed, and calving date. All groups grazed milo stover. Two groups received 4 lbs. of a 16% natural protein supplement on alternate days, 2 groups did not receive protein supplement. The 2 groups receiving protein supplement each had 15 acres of milo stover; the 2 nonsupplemented groups each grazed 20 acres of milo stover. Estimated stover yields were lowest in the 20-acre fields.

The 61-day trial began December 2, 1976, and ended February 1, 1977. The cows were scheduled to start calving March 1, 1977. All cows had access to a 50% dicalcium phosphate, 50% salt mineral mix. Cows received wheat straw 17 days when snow reduced grazing.

Results and Discussion

Milo stover analysis, 16% natural protein supplement formulation, and cow performance are presented in Tables 16.1, 16.2, and 16.3.

Cows supplemented with 16% natural protein while grazing milo stover gained more (P<.05) than cows not supplemented. Protein did not affect condition score.

Milo stover appeared to be excellent in quality. Although cows on protein supplement gained significantly more than cows not supplemented, those not supplemented exceeded required gains. The results indicate that when milo stover is of excellent quality cows will perform satisfactorily without protein supplementation.

Table 16.1. Analysis of milo stover winter grazed by pregnant cows.

	Crude protein	Crude fiber	Ether extract	Ash	Acid detergent fiber	Protein insoluble in hot water	Calcium	Phos.
	% dry matter basis							
Milo stover (15-acre fields)								
Leaves	4.4	32.9	2.0	17.1	66.9	2.6	.56	.14
Stalks	3.4	34.3	1.4	12.3	56.0	1.6	.30	.10
Milo stover (20-acre fields)								
Leaves	6.4	33.4	2.0	12.6	57.2	3.6	.55	.18
Stalks	5.1	36.5	1.6	10.5	50.9	2.1	.41	.11

Table 16.2 Formulation of 16% natural protein supplement.

Ingredient	% as-fed
Soybean oil meal	15.0
Milo, rolled	54.9
Molasses	7.5
Vitamin A premix	.1
Dehydrated alfalfa	20.0
Dicalcium phosphate	2.6
Pellet binder	.05

Table 16.3 Performance of pregnant cows grazing milo stubble.

	No. cows	Initial wt. lbs.	Initial condition[1]	Wt. gain lbs.	Condition change[1]
16% natural protein	19	1010	5.17	113[a]	.45[a]
No supplement	21	1080	5.60	76[b]	.34[a]

[1]Scores based on a scale of 1-10: 1=very thin, 10=very fat.

[a,b]Means with different superscripts differ significantly (P<.05).

Sudangrass, Sorghum-sudan, Forage Sorghum, and Corn Silages and Three Protein Levels for Growing Yearling Steers

William Thompson, Jim Oltjen, Keith Bolsen,
Harvey Ilg, and Jack Riley

Summary

Sudangrass, sorghum-sudan, forage sorghum, and corn silages were full-fed to yearling steers for 70- or 91-day growing periods. For both periods, steers fed corn silage outperformed steers fed any other silage. In the 70-day period silages from both sudangrass and sorghum-sudan cut at 45- and 60-inch plant heights, respectively, supported performance similar to forage sorghum silage. For both periods steers fed sorghum-sudan (dough) silage gained slowest and least efficiently.

For the 91-day period, rations containing 12.0% crude protein supported better performance than rations containing 10.5 or 9% protein and 10.5% protein rations supported better performance than 9% protein rations.

Introduction

Sudangrass and sorghum-sudan are summer annuals commonly used for mid-to-late summer grazing in Kansas. They might be harvested for hay or silage but few data concerning their feeding value or effects of different maturity stages on cattle performance are available.

Information on adding or reducing protein in growing and finishing cattle rations is needed because protein prices fluctuate widely.

These trials evaluated various protein levels in growing cattle rations and compared sudangrass and sorghum-sudan silages with forage sorghum and corn silages for growing cattle.

Experimental Procedure

Five silages were harvested and ensiled in the summer of 1977.

Silage and maturity	Harvest dates
Corn (hard-dent)	August 4 and 5
Sudan (vegetative-45 inches)	July 18, August 9, September 9
Sorghum-sudan (vegetative-60 inches)	July 20, September 7
Sorghum-sudan (dough)	September 8
Forage sorghum (dough)	October 3

Corn, sorghum-sudan (dough), and forage sorghum were direct cut; sudangrass and sorghum-sudan were harvested in vegetative growth at approximately 45 and 60 inch heights, respectively, after they were field-wilted to 65 to 70% moisture. Cultivars were NK Trudan-6 hybrid sudangrass, Dekalb 7+ sorghum-sudan, and Dekalb FS 25_a + forage sorghum. All forages were ensiled in concrete silos.

Seventy-five mixed breed yearling steers averaging 765 pounds were used in a trial beginning October 12, 1977, to compare silages and protein levels on steer performance.

Each silage was fed to three pens of five steers each in fixed percentage ration containing 84% silage, 12% milo-soybean meal, and 4% supplement[1,2] (dry-matter basis).

One of three protein levels (9, 10.5, and 12%) was assigned to each of three pens by adjusting amounts of milo and soybean meal fed. Sudangrass and sorghum-sudan (60 inches) rations contained about 12% protein---crude protein content of these silages was too high to be used in the protein comparisons. Also, steers fed sudangrass and sorghum-sudan (60 inches) were weighed off test after 70 days when the supply of those silages ran out. The other three silages were fed 21 days longer (91 day trial ending January 11, 1978).

All steers were fed the same amount of prairie hay for 6 days before initial weighing and the same amount of experimental ration for 2 days before final weighing. All feed and water were withheld 16 hours before weights were taken.

Results

Dry matter, protein, and crude fiber contents of the five silages are shown in Table 17.1.

70-day Performance. Performances of the steers fed the 12% protein rations are shown in Table 17.2. Steers fed corn silage gained more (3.04 lbs. per day, $P<.05$), and were more efficient (7.02 lbs. of feed per lb. of gain, $P<.10$) than steers fed any of the other four silages. Sudangrass, sorghum-sudan (60 inches), and forage sorghum silages supported similar gains, but efficiency of gain was slightly better for forage sorghum silage. Steers fed sorghum-sudan (dough) silage gained slower ($P<.05$), tended to consume less feed, and were less efficient ($P<.05$) than steers fed any of the other four silages.

91-day Performance. Performances of the steers are shown in Table 17.3. Averaged across protein levels, steers fed corn silage gained faster ($P<.05$) consumed more feed ($P<.05$), and gained more efficiently ($P<.05$) than those fed sorghum-sudan (dough) or forage sorghum silages. As in the 70-day test, steers fed sorghum-sudan (dough) silage gained the least and were the least efficient.

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[1]Supplement fed with sudangrass, sorghum-sudan (60 inches), forage sorghum and corn silages, lbs./ton: milo, 1656; dicalcium phosphate, 160; salt, 125; fat, 30, trace minerals, 5; aurofac-10, 20; and vitamin A, 4.

[2]Supplement fed with sorghum-sudan (dough) silage, lbs./ton: soybean meal, 1686, dicalcium phosphate, 130; salt, 125; fat, 30; trace minerals, 5; aurofac-10, 20; vitamin A, 4.

Compared with corn silage, forage sorghum and sorghum-sudan (dough) silages supported 28 and 50% slower gains, respectively, and 27 and 73% less efficient gains, respectively. There was no interaction between silage and protein level.

Steers receiving 12% protein rations gained faster ($P<.10$) and tended to gain more efficiently than those receiving 10.5 or 9% protein rations. Steers fed 10.5% protein tended to gain faster and more efficiently, though not significantly so, than steers fed 9% protein. Feed intakes of rations of all three protein levels were similar.

Table 17.1. Analyses of the five silages (70 day period).

Silage	Dry matter, %	Crude protein	Crude fiber
		%, dry matter basis	
Corn	34.6	9.5	20.9
Sorghum-sudan (dough)	39.5	6.5	33.0
Forage sorghum	28.0	9.1	26.9
Sudangrass	30.0	14.8	28.9
Sorghum-sudan (60 inches)	32.3	12.5	28.9

Table 17.2. Effects of silages on 70-day steer performances.

Item	Silage				
	Sudan-grass	Sorghum-sudan (60 inches)	Corn	Sorghum-sudan (dough)	Forage sorghum
No. of steers	15	15	5	5	5
Initial wt., lbs.	768	759	757	771	759
Final wt., lbs.	936	930	1013	908	945
Avg. total gain, lbs.	168	171	256	137	186
Avg. daily gain, lbs.	2.41[b]	2.43[b]	3.04[a]	1.71[c]	2.41[b]
Avg. daily feed, lbs.					
silage[1]	55.23	54.69	51.26	46.71	48.54
silage[2]	19.33	19.14	17.94	16.35	16.99
milo[2]	.88	.85	.65	0	.63
SBM[2]	1.65	1.61	1.88	2.21	2.26
supplement[2]	.94	.92	.86	.76	.83
total[2]	22.80[d]	22.52[de]	21.33[de]	19.32[f]	20.71[ef]
Feed/lb. gain, lbs.	9.46[e]	9.27[e]	7.02[d]	11.30[f]	8.59[e]

[1] 35% dry matter basis.

[2] 100% dry matter basis.

[a,b,c] Means in the same row with different superscripts differ significantly (P<.05).

[d,e,f,g] Means in the same row with different subscritps differ significantly (P<.10).

Table 17.3. Effects of silages and protein levels on 91-day steer performance.

Item	Silage: Corn	Silage: Sorghum-sudan (dough)	Silage: Forage sorghum	Protein, %: 9	Protein, %: 10.5	Protein, %: 12
No. of steers	15	15	15	15	15	15
Initial wt., lbs.	764	769	758	762	766	762
Final wt., lbs.	997	887	926	917	930	955
Avg. total gain, lbs.	233	118	168	155	164	193
Avg. daily gain, lbs.	2.57[a]	1.29[c]	1.85[b]	1.71[e]	1.88[e]	2.12[d]
Avg. daily feed, lbs.						
silage[1]	52.31	45.80	47.66	46.71	49.63	49.43
silage[2]	18.31	16.03	16.68	16.35	17.37	17.30
milo[2]	1.54	.82	1.43	2.03	1.32	.44
SBM[2]	1.20	1.47	1.16	.49	1.18	2.15
supplement[2]	.88	.77	.83	.79	.84	.84
total[2]	21.93[a]	19.11[b]	20.09[b]	19.66	20.72	20.72
Feed/lb. gain, lbs.	8.61[a]	14.90[c]	10.93[b]	12.17	11.93	10.35

[1] 35% dry matter basis.

[2] 100% dry matter basis.

[a,b,c] Means in the same row with different subscripts differ significantly (P<.05).

[d,e] Means in the same row with different subscripts differ significantly (P<.10).

Utilizing Wheat Straw and Wheat Tailings with Beef Cows

Bruce Peverley, Larry Corah, and Miles McKee[1]

Summary

Ninety-one Simmental-Hereford and Hereford cows in early gestation were used to compare three rations in a 106-day trial: (1) wheat straw, (2) wheat tailings, and (3) soaked wheat straw. Each was fed to groups of lactating and nonlactationg cows. Cows fed the soaked wheat straw and those fed wheat tailings out-gained those on wheat straw by 28 and 16.7 pounds, respectively. All cows' condition score decreased during the trial period. Two-year-old heifers did not perform as well as the mature cows on the straw rations. Dry cows out-gained the lactating cows on both straw and tailing rations.

Introduction

Reducing cow feed costs is a major concern of cattlemen. One feeding alternative to offset high feed costs is use of crop residues. Development of large, package harvesting systems has made stored crop residue more appealing and useable in cow herd operations.

Both dry cows and lactating cows in early gestation were used to evaluate wheat straw and wheat straw tailing residue as a feedstuff.

Experimental Procedure

The wheat residue was harvested in two methods: straw was collected in large round bales soon after the grain was harvested, and wheat straw tailings collected at harvest by Foster Buncher Wagon attached behind the combine. Both materials were ground before feeding. Grinding was to eliminate feed wastage to get a better measure of consumption.

Ninety-one Hereford and Simmental-Hereford cross cows in early gestation were allotted by weight and condition into three groups, then divided into each group (dry and lactating) for the 160-day trial. Cows were weighed on and off trial after no feed or water for 14 hours. These cows are maintained in drylot the year round.

The three forage groups were wheat straw, wheat tailings, and soaked wheat straw. The straw was soaked by adding water to chopped straw to runoff. Average dry matter of the soaked straw at feeding was 36 percent.

[1]Appreciation is expressed to the Foster Mfg. Co. for funding support and equipment.

The rations were formulated and fed daily.

As the cows were weighed on and off test, each cow was visually appraised for condition by three persons. Each cow was scored between 1 and 10: 10 = very fat; 1 = very thin. The three scores were averaged to give each cow a condition score.

Wheat straw and wheat tailings, both, were analyzed for crude protein, calcium, phosphorus, and acid detergent fiber.

Results and Discussion

Analysis of the composition of the wheat straw and wheat straw tailings is shown in Table 18.1. Crude protein ran approximately 2 percent higher and calcium ran .2% higher for wheat tailings than for wheat straw. Phosphorus content for the straw and tailings were approximately the same. Acid detergent fiber analysis for wheat tailings ran 2 percent lower than wheat straw. A lower acid detergent fiber indicates an increased amount of energy.

Dry matter intake of all six rations is shown in Table 18.2; cow performance, in Table 18.3 and 18.4. All cows in the trial gained weight. During the 106 days the cows on either soaked straw or tailings out-gained those on straw, 28 and 16.7 pounds, respectively.

Although cows on each ration gained weight, all decreased in condition. General appearance of the cows visably decreased suggesting that additional energy and protein were needed in their rations.

The dry cows, as would be expected, out-gained the lactating cows through the trial.

Soaked straw was eaten in half the time it took cows to clean up straw or tailings.

Table 18.1. Composition of roughage fed cows in drylot.

Nutrient	Wheat straw	Wheat tailings
Crude protein, %	4.00	5.85
Calcium, %	.268	.402
Phosphorus, %	.114	.145
Acid detergent fiber, %	59.74	57.77

Table 18.2. Daily intake of indicated rations by dry and lactating beef cows.

	Intake, lbs. of D.M. fed			
	Residue	Alfalfa	Milo	Cow supplement*
Dry cows				
Wheat tailings	13.83	2.78	1.86	.5
Wheat straw	13.06	2.83	1.86	.5
Soaked wheat straw	13.06	3.03	1.86	.5
Lactating cows				
Wheat tailings	12.21	3.48	5.24	.5
Wheat straw	12.55	3.33	5.24	.5
Soaked wheat straw	12.7	3.54	5.24	.5

*Cow supplement consisted of lbs./ton soybean meal, 1070; rolled milo, 491; salt, 200; bone meal, 134; urea, 64; 2-10 trace mineral, 20; aurofac 10, 15; vitamin A, 6; wet molasses, 40.

Table 18.3. Effects of type of wheat residue on cow performance.

	Wheat straw		Wheat tailings		Soaked wheat straw	
	Lactating	Dry	Lactating	Dry	Lactating	Dry
Number of cows	14	17	14	17	13	16
Average starting weight (lbs.)	1010.3	992	1000	1009.2	1004.8	1020.4
Average ending weight (lbs.)	1045.3	1040.4	1041.1	1083.1	1049.2	1111.8
Total weight change (lbs.)	35.0	48.4	41.1	73.9	44.5	91.4
Average starting condition*	5.5	4.9	5.1	4.8	5.3	4.8
Average ending condtion*	4.7	4.0	4.7	4.3	4.4	4.5
Total condition change*	-0.8	-0.9	-0.6	-0.5	-0.9	-0.3

*Condition socre is an average visual appraisal by three men with 1 = extremely thin, 10 = extremely fleshy.

Table 18.4. Summary of effect of type of residue.

	Wheat straw	Wheat tailings	Soaked wheat straw
Number of cows	31	31	29
Average weight change (lbs.)	42.35	59.08	70.38
Average condition change*	-0.85	-0.55	-0.6
Advantage compared to straw, lbs.		+16.73	+28.03

*Condition score is an average visual appraisal by three men with 1 = extremely thin, 10 = extremely fleshy.

Feeding Cull Beef Cows in Feedlots

Jack Riley

Summary

I conducted two trials during 1977 using 115 cows culled from KSU cow herds. Dry cows on lush brome grass gained 1.6 pounds per head per day. Those on a 60% concentrate ration averaged 2.2 pounds/day; those on 80% concentrate ration, 3.7 pounds/hd./day. The cull, dry cows ate between 25 and 30 pounds of dry matter/day. Cows fed during the Dec. 15 - Feb. 15 trial required 2.5 lbs. more feed dry matter per pound of gain than cows fed during the May 17 - June 21 trial. Fastest and most efficient gains were from the 80% concentrate rations. Length of feeding period should coincide with optimum slaughter weight. Results of these trials showed optimum slaughter weight was obtained when a cow weighed 22 pounds per inch of height at the withers.

Introduction

Approximately 300,000 cows are culled from beef herds in Kansas each year. Since 50% of the calves are born during February, March, and April, October and November is the most popular weaning time. Producers are encouraged to pregnancy check cows weaning calves and sell the "open" cows. Fall-calving cows diagnosed as open when their calves are weaned in late spring also should be culled. It is important to cull before the expensive winter feeding period and before the summer grazing season. At least two questions should be asked: (1) are cull cows being sold to the producer's best advantage, and (2) is there an opportunity to profitably feed the cows additional energy to obtain a better slaughter weight? The two trials during 1977 were to help answer those questions.

Procedure

All cows used in the trials were culled from KSU cow herds and were predominantly of Hereford breeding. Trial 1 used 49 cows fed 62 days, Dec. 15 - Feb. 15. Trial 2 used 66 cows fed 35 days, May 17 - June 21, 1977. Table 19.1 shows rations fed. Cows were sold on a grade-and-yield basis with carcass data obtained for each cow. Actual prices for cows and feed ingredients were used for the economic calculations.

Results

Feedlot performance is shown in Table 19.2. Increasing the concentrate from 60 to 80 percent resulted in 1.3 to 1.5 lbs. more gain per cow per day. Mature cows weighing approximately 900 lbs. apparently have a high maintenance requirement, therefore, if gains exceeding 3 lbs. a day are desired, the ration must have a high percentage of grain.

The most efficient gains also were obtained with the 80%-concentrate ration. Cull cows fed Dec. 15 to Feb. 15 required 2.5 lbs. more feed dry matter per pound of gain than cull cows fed during May - June.

Cull cows are usually sold on expected carcass value. Table 19.3 shows the effect that ration and number of days on feed had on carcass grade. Optimum time on feed should coincide with optimum carcass value. Carcass value and length of feeding influence economic returns. A summary of the economic results of the 2 trials is shown in Table 19.4.

It is obvious from the table that feeding cull cows is potentially risky. Cull cows are vulnerable to price fluctuations during short feeding periods, and the opportunity for profits from feeding cull cows is not large even when they are managed well and fed properly. Most profits result from purchasing thin cows with potential for large compensatory gain, and from grazing crop residues or other economical forage.

In these trials, optimum slaughter weight was when a cow weighed 22 lbs./inch of height at the withers. A random sample of cows could be measured when purchased or culled and the feeding program concluded at the optimum slaughter weight.

Table 19.1. Rations fed to cull beef cows.

Ration Information	% Concentrate				
	Trial 1*		Trial 2**		
	60	80	60	80	0
Daily intake/cow:					
Sorghum silage	33.4	17.8	27.7	14.3	brome
Milo	19.6	28.6	16.3	22.3	pasture
Supplement	.9	.4	.4	.4	free
Ration dry matter	52.6	66.1	51.2	63.7	choice
Daily D.M./cow	28.4	31.2	22.7	24.0	----

*62-day trial: Dec. 15 - Feb. 15, 1977.
**35-day trial: May 17 - June 21, 1977.

Table 19.2. Feedlot performance of cull beef cows.

% Concentrate	Trial 1		Trial 2		
	60	80	60	80	0
No. cows	25	24	18	18	15
Initial wt., lbs.	931.4	942.5	884.7	850.3	847
Final wt., lbs.	1069	1162	961	984.3	904
ADG	2.22	3.54	2.18	3.83	1.63
D.M./gain	12.8	8.8	10.4	6.2	---

Table 19.3. Effects on carcass grade of ration and days on feed.

Carcass grade	Cutter	Boner	Breaker
Treatment:	No. (%)	No. (%)	No. (%)
0 days on feed	11 (74)	2 (13)	2 (13)
Brome grass - 35 days	12 (80)	3 (20)	---
60% concentrate 35 days	9 (50)	8 (44)	1 (6)
60% concentrate 62 days	1 (4)	14 (56)	10 (40)
80% concentrate 35 days	6 (33)	12 (67)	---
80% concentrate 62 days	0 (0)	8 (33)	16 (67)

Table 19.4. Economic results of feeding trials with cull cows.

% Concentrate	Trial 1		Trial 2		
	60	80	60	80	0
Initial value/cow*	$196.35	$198.87	$224.91	$216.35	$215.39
Feed cost/cow	66.34	83.08	27.65	31.50	8.75**
Initial value + feed	262.69	281.95	252.56	247.85	224.14
Value/cow final**	273.49	289.40	237.56	238.18	219.42
Return above feed cost/cow	$10.80	$7.45	(-15.00)	(-9.67)	(-4.72)

*Based on cow market at start of trial.
**Actual grade and yield payment.
***Pasture charge.

Effect of Aureomycin and Rumensin on Performance of Finishing Heifers

Jack G. Riley and Ron Pope

Summary

We used 210 yearling Hereford heifers to evaluate the efficacy of Aureomycin[1] and Rumensin[2] fed alone and in combination. Each product is cleared by the FDA for use in feedlot rations as an individual feed additive, however, additional clearance must be obtained to use the two products in combination in the same ration. Aureomycin effectively controlled liver abscesses, and Rumensin improved feed efficiency by 8.7%.

Introduction

AUREOMYCIN is recognized for its ability to reduce the incidence of liver abscess in feedlot cattle. RUMENSIN has gained acceptance in feedlot rations as an additive that improves feed efficiency. Clearance from the Food and Drug Administration must be obtained before the two feed additives can legally be sold for use in the same supplement or complete feed.

Procedure

We used 210 yearling Hereford heifers in this study. They were purchased from one ranch and had been on wheat pasture as a group since the late fall of 1976 and until delivery to the beef research unit on May 8, 1977. The heifers were weighed individually and placed into either a light or heavy replicate. Heifers within each replicate were randomly allotted to 16 pens of 6 heifers per pen.

A 4 x 4 factorial design was used resulting in 16 treatments for each replicate. Aureomycin levels of 0, 70, 140,and 280 mg./head/day were factorialized across Rumensin levels of 0, 10, 20,and 30 grams per ton of complete feed. The 112-day trial began May 10 and ended August 30, 1977. Composition of the ration and supplement is shown in Table 20.1. The premixes providing the Aureomycin and Rumensin were withdrawn on the 111th day, and all heifers received a non-medicated ration until September 7, 1977, at which time they were shipped to Dugdale Packing Co., St. Joseph, Missouri. Carcass and liver data was obtained for

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[1] Aureomycin is registered trademark name for chlortetracycline produced by American Cyanamid Co. Aureomycin and partial financial assistance provided by American Cyanamid Co., Princeton, NJ.

[2] Rumensin is registered trademark name for monensin sodium produced by Elanco Products Co., Indianapolis, IN.

each heifer.

Results

The heifers averaged 557 pounds initially and 904 pounds after the 112-day feeding period. The effect of Aureomycin and Rumensin on daily gain and feed efficiency is shown in Table 20.2. Aureomycin did not significantly affect rate or efficiency of gain. Rumensin at 20 grams per ton signficantly increased daily gain and all Rumensin levels were significantly more efficient than the controls.

Only one liver from the 48 heifers on the 140 mg. and one liver from the 48 heifers fed 280 mg. Aureomycin per head per day was condemned. The incidence of liver abscess is shown in Table 20.3.

More complete results of this study are available on request.

Table 20.1. Ration and supplement composition.

Ration:	Ingredient	%, as fed basis
	Cracked corn	83
	Corn silage	13
	Supplement	4
	Premix[1]	--
Supplement:		lbs. per ton of supplement
	Soybean oilmeal	1000
	Rolled milo	286
	Limestone	300
	Urea	200
	Salt	150
	Fat	30
	Dyna K	20
	Trace mineral	10
	Vitamin A	4

[1]Premix was pulverized corn fortified with the appropriate levels of Aureomycin and/or Rumensin to provide the treatment levels specified in the experimental design. A total of 2 pounds of premix was fed per heifer per day.

Table 20.2. Effect of Aureomycin and Rumensin on performance of feedlot heifers.

	Aureomycin, mg./hd./day									
	0		70		140		280		Mean	
	ADG	Eff.	ADG	Eff.	ADG	Eff.	ADG	Eff.	ADG	Eff.
Rumensin gm/ton										
0	3.19	6.98	3.08	6.98	2.91	7.33	2.86	7.24	3.01[a]	7.13[a]
10	3.08	6.80	3.02	6.88	3.22	6.96	3.04	6.73	3.09[a]	6.84[b]
20	3.22	6.48	3.11	6.64	3.29	6.49	3.20	6.54	3.23[b]	6.52[c]
30	2.90	6.79	3.14	6.30	3.12	6.44	3.14	6.52	3.08[a]	6.51[c]
Mean	3.10	6.76	3.09	6.70	3.14	6.78	3.08	6.76		

[a,b,c]Numbers in some vertical row with different superscripts differ significantly (P<.05).

Table 20.3. Effect of Aureomycin and Rumensin or incidence of liver abscess in feedlot heifers.

	No. condemned livers per treatment group of 12 heifers				
	Aureomycin, mg./hd./day				
	0	70	140	280	Mean
Rumensin gm./ton					
0	2	0	0	1	0.75
10	0	2	1	0	0.75
20	1	0	0	0	0.25
30	1	3	0	0	1.00
Mean	1	1.25	0.25	0.25	

Effect of Ronnel® on Performance of Feedlot Steers

Jack Riley and Dwight Tobyne

Summary

We used 180 yearling Hereford and Angus x Hereford crossbred steers averaging 643 pounds in a 139-day, feedlot trial to evaluate steer performance when the systemic grub control pesticide Ronnel was fed at 5 levels: 0, 16, 32, 64, and 128 grams per ton of complete feed. Ronnel increased daily feed intake an average of 2.5%; 64 grams/ton produced gains 8.5% faster and 5.8% more efficiently than the controls (0 Ronnel) and was the most beneficial dose. No significant differences were observed in carcass traits. This product is presently not cleared for use in feedlot cattle.

Introduction

An organophosphate, commonly known by its trademark of Ronnel, has been used for several years as a very effective insecticide. Recent research by USDA and the Agricultural Research division of Dow Chemical Co.[1] has indicated that Ronnel may increase growth and feed efficiency in feedlot cattle.

Procedure

One hundred eighty yearling Hereford and Angus x Hereford crossbred steers averaging 643 pounds were allotted by weight to 30 pens of six steers each. Six pens were assigned to each of 5 Ronnel treatments: (1) 0, (2) 16, (3) 32, (4) 64 and (5) 128 grams of Ronnel per ton of complete feed. All steers were fed a 50% concentrate ration for 56 days and then increased to 85% concentrate for the final 83 days. The trial began April 15 and ended September 1, 1976.

Results

Effects of Ronnel on performance of feedlot steers is summarized in Table 21.1. Ronnel increased daily feed intake an average of 2.5%. The 64 gram/ton level was the most effective and produced gains 8.5% faster and 5.8% more efficiently than the controls. Feeding 128 grams/ton proved to be too much and resulted in depressed animal performance. The 16 and 32 gram/ton treatments appeared to be too low. No significant differences were observed in carcass traits.

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[1]Ronnel® is a registered trademark name of Dow Chemical Co., Midland, Mich. Ronnel® and some financial assistance provided by Dow Chemical Co.

Table 21.1. Effect of Ronnel on performance of feedlot steers.

	Grams Ronnel/ton				
	0	16	32	64	128
No. steers	36	36	36	36	36
Init. wt., lbs.	643.2	642.1	642.4	643.7	645.2
Final wt., lbs.	1003.2	1020.2	1026.0	1034.3	994.1
Gain, lbs.	360.0	378.1	383.6	390.6	348.9
Daily gain, lbs.	2.59^{ab}	2.72^{abc}	2.76^{bc}	2.81^{c}	2.51^{a}
Daily feed, lbs.	20.8	21.6	21.2	21.1	21.2
Feed/lb. gain, lbs.	8.00^{cd}	7.95^{cd}	7.67^{bd}	7.54^{b}	8.48^{a}

^{a,b,c,d}Means on same row with different superscripts are significant ($P<.05$).

Effects of Soybean Oil and Corn Oil Alone or in Combination With RUMENSIN®, on Methane and VFA Production, *In Vitro*

Jack G. Riley and Steven L. Newby

Summary

Soybean oil or corn oil when fed at 0, 2, 4, or 6% of the ration did not significantly reduce methane production or alter the ratios of volatile fatty acids. Soybean oil was superior to corn oil in reducing methane, and soybean oil produced a more desirable acetate:propionate ratio. Rumensin was compared at levels simulating 0, 15, and 30 grams per ton of complete ration. Rumensin at either concentration signficantly reduced methane and significantly improved the acetate:propionate ratio.

Introduction

Rumensin has consistently increased propionic acid and reduced acetic acid production in the rumen, which creates a more favorable acetate:propionate ratio and enables ruminants to derive more energy from a ration. A recent study indicated that Rumensin reduces methane production, which should also improve feed efficiency. Research in England with unsaturated fats (including several vegetable oil sources) indicated that methane production was reduced and volatile-fatty-acid ratios were altered with fat added up to 8 percent of a ration.

This project was to determine if Rumensin would reduce methane production and if combinations of Rumensin and either soybean oil or corn oil would give a beneficial response.

Experimental Procedure

Gas production and volatile fatty acids were measured on *in vitro* incubations of strained bovine rumen fluid. Twenty-four fermentation bottles were allotted to treatments according to a recognized design to compare two oil sources (soybean and corn oil), 4 oil levels (0, 2, 4, and 6% of the ration) and three Rumensin levels (0, 15, and 30 grams/ton). Results of eleven fermentation studies are summarized.

Results

By significantly reducing methane production and creating a more favorable acetic:propionic ratio, soybean oil was more desirable than corn oil. Rumensin additions significantly reduced methane production, increased propionic acid, reduced acetic acid and, therefore, gave a more desirable acetate:propionate ratio. No advantage was found in combining either soybean or corn oil with Rumensin. Table 22.1 shows some of the results.

Rumensin is registered trademark name for monensin sodium produced by Elanco Products Co., Indianapolis, IN.

Table 22.1. Effects of oil source and Rumensin on methane and production.

	Oil source		Rumensin, gm/ton		
	Soybean	Corn	0	15	30
Methane, ml.	117.4[a]	120.9[b]	125.3[A]	115.9[B]	116.1[B]
Acetic, molar %	52.2[a]	53.8[b]	54.2[a]	53.3[a]	51.5[b]
Propionic, molar %	25.1[a]	24.3[b]	22.2[a]	24.6[b]	27.3[c]
Acetic/propionic ratio	2.2[a]	2.3[b]	2.5[a]	2.3[b]	2.0[c]

[a,b,c]Means on same line without a common superscript differ significantly ($P<.05$).

[A,B]Means on same line without a common superscript differ significantly ($P<.0001$).

Effects on Carcass Traits of Beef Ration Energy Level and Length of Feeding

D. M. Allen, M. C. Hunt, C. L. Kastner, D. H. Kropf, A. R. Harrison, B. E. Brent, and J. Riley

Summary

We used 150 Angus yearling steers of similar background from the Livestock and Meat Industry Council cattle-flow project. Each was assigned to one of 12 treatments (10 per treatment) involving low-, medium-, and high-energy rations (calculated to supply 34, 45, and 58 megacalories per 100 lbs. ration for net energy of production). Times on rations were 56, 91, 119, 147, and 175 days. Ten steers were fed a submaintenance ration of prairie hay 28 days before slaughter, and 10 served as controls (slaughtered when study started).

The 14 treatments provided a wide variety of carcass and product characteristics, which will help us determine minimum feed-energy input and length of feeding needed to produce beef acceptable for display and eating. Blade tenderization was also utilized to evaluate its effect on product quality.

Slaughter and carcass weights and dressing percentages increased with ration energy and time on feed. Higher ration energy resulted in higher marbling scores and quality grades for cattle fed 91 or 119 days, but not for those fed 56 or 147 days.

Cattle on the submaintenance ration for 28 days showed a darker, firmer lean, reduced marbling and quality grade, less fat and smaller rib eye area than controls.

Fat thickness increased with longer time on feed and with higher ration energy. Rib eye area was the same for cattle on medium- and high-energy rations after 56 or 91 days and did not increase in cattle fed more than 119 days. Kidney-pelvic-heart (KPH) fat increased with longer feeding after 56 days but did not differ between medium- and high-energy rations after 119 or 147 days. Cattle on low- and medium-energy rations didn't differ from each other in yield grade after 56 or 91 days on feed, but otherwise longer feeding and higher ration energy resulted in higher yield grades.

Introduction

Fluctuations in feed grain supply, demand, and price will continue and will focus interest on alternate feeding systems and reduced feeding time.

This study was to determine the minimum feed energy input needed (in terms of both ration energy and length of feeding) to produce acceptable beef cuts, judged by display life and desirability and eating characteristics.

We also determined the effect of blade tenderization on these characteristics. This treatment might reduce ration energy inputs for acceptable beef.

Only carcass quality and yield grade characteristics are reported. Further results will be reported when available.

Experimental Procedure

We put 150 Angus yearling steers of similar background on feed after a 21-day adjustment period. Ten cattle were randomly assigned to each of 15 treatments (Table 23.2). One group was slaughtered at the start of the experiment (control) and another group (submaintenance) was fed only prairie hay 28 days, then slaughtered. Other groups were assigned to low-, medium-, and high-energy rations of approximately 35, 45, and 58 megacalories per 100 lbs. of feed calculated on the basis of net energy for production (Table 23.1). Rations were calculated to produce gains of about 0.5, 1.0, and 1.5 kg. per day (1.1, 2.2, and 3.3 lbs. per day), respectively, for low-, medium-, and high-energy rations. All cattle for a given energy level were fed in one group, and cattle were pre-assigned for slaughter after 56, 91, 119, 147 or 175 days on feed.

Cattle were withdrawn from feed 18 to 24 hours before slaughter and transported to a commercial packing plant. Carcass quality and yield grade characteristics were determined after a 24-hour chill. Round and rib wholesale cuts were transported to the Kansas State University Meat Laboratory for fabrication and sampling 7 days post slaughter.

Results and Discussion

Initial and final live weights, total gain, and average daily gains are summarized for each slaughter group in Table 23.2. The low- and medium-energy groups exceeded daily gains projected from net energy intake for each slaughter period. The high-energy group gained faster than projected the first 56 days, but slower than expected to each succeeding slaughter date.

Slaughter and hot carcass weights and dressing percentages are given in Table 23.3. Carcass weight and dressing percentages increased with time on feed, as expected, except for little increase after 147 days. Carcass weight and dressing percentage increased with higher ration energy regardless of time on feed.

Data are not included for the low-energy group fed 147 days. Six cattle died in that group; gains for the remaining 4 were very poor after 119 days on feed.

Carcass quality grade (Table 23.3) increased with time on feed and with ration energy level for cattle fed 91 or 119 days. The control group averaged midpoint Standard; the submaintenance treatment decreased in quality grade slightly. Even with the high-energy ration, cattle averaged only high Standard after 56 days, midpoint Good after 91 days on feed, high Good after 119 and 147 days, and low Choice after 175 days. Visual marbling scores closely paralleled quality grade. The results were about as expected except grades were not so high as anticipated for high-energy groups on feed longer times. We determined the effect of quality levels on tenderness, juiciness, and flavor, as judged by a taste panel, and both fresh and frozen steak display characteristics. We have not yet analyzed those data. We also studied the influence of mechanical (blade) tenderization on taste panel judgments and display characteristics.

Carcass maturity of the submaintenance group was greater than (more mature) or equal to maturity in any other treatment. The darkest lean resulted when cattle were on submaintenance rations. No consistent effects were found for rations energy level on bone, lean, or overall maturity.

Fat color, scored visually, was yellower for submaintenance cattle and cattle fed low-energy rations for 56 or 91 days than for those fed more and longer. But the degree of yellowness noted should pose no merchandising problem. Ration energy level or time on feed did not affect fat color for those on feed 119 days or longer.

Table 23.4 shows yield-grade data. Adjusted fat thickness followed expected trends with reduced fat on the submaintenance group compared to controls. Higher ration energy and longer time on feed increased fat as expected.

Rib eye area was reduced by the submaintenance ration. The low-energy ration, even after 56 days, produced rib eye area similar to that by controls. After 56 or 91 days, rib eye area was the same for cattle on medium- or high-energy rations but less for those on low energy. Rib eye area did not increase after 119 days regardless of energy level, which confirms the idea of relatively early muscle growth.

Kidney-pelvic-heart (KPH) fat percentage was less for submaintenance cattle and for all cattle fed 56 days than for controls. It increased with time on feed, but did not differ between cattle on medium- or high-energy feed 119 or 147 days.

Because of reduced rib eye area, carcass yield grade increased slightly (lower cutability) for the submaintenance group. Grades of all cattle fed 56 days were similar to the controls' grade. Yield grade of cattle on low- or medium-energy rations did not differ after 56 or 91 days; otherwise, longer time on feed and higher energy rations produced higher yield grades.

Table 23.1. Components of rations (% on as-fed basis) used to study energy levels and length of time on feed.

Ingredient	Energy level[a] Low	Medium	High
Corn	17.9	27.1	38.6
Wheat	17.9	27.1	38.6
Sorghum silage	16.8	16.5	16.3
Prairie hay	42.9	24.2	0
Supplement[b]	4.6	5.0	6.4

[a]Calculated to contain 35, 45, and 58 megacal/100 lbs. on NEp basis.

[b]Included soybean meal, ground limestone, dicalcium phosphate, salt, trace minerals, and vitamins.

Table 23.2. Weight gains by finishing steers on indicated ration energy levels for times shown.

Energy supplied	Days fed	No. steers	Pounds: Initial wt.	Final wt.	Gain	ADG
Submaint.	28	10	641.0	634.0	(-7.0)	(-.25)
Low	56	10	626.7	735.0	108.3	1.93
Medium	56	10	621.2	781.2	160.0	2.86
High	56	10	604.4	804.6	200.2	3.58
Low	91	10	619.3	777.0	157.7	1.73
Medium	91	10	627.6	860.8	233.2	2.56
High	91	10	626.0	883.8	257.8	2.83
Low	119	10	623.5	832.2	208.7	1.75
Medium	119	10	634.2	930.6	296.4	2.49
High	119	10	613.6	968.8	355.2	2.98
Medium	147	10	618.9	1004.2	385.3	2.62
High	147	10	625.2	1058.6	433.4	2.95
High	178	10	616.8	1095.6	478.8	2.74

Table 23.3. Live and carcass weights as influenced by ration energy level and length of feeding.[1]

Energy supplied	Days	No. of steers	Slaughter wt., lbs.[2]	Hot carcass wt., lbs.	Hot dressing[2] %
Control		10	636 ± 49	355 ± 26	55.7
Submaint.	28	10	634 ± 37	336 ± 26	53.0
Low	56	10	735 ± 52	385 ± 31	52.4
Medium	56	10	781 ± 42	413 ± 22	52.9
High	56	10	805 ± 48	439 ± 31	54.6
Low	91	10	777 ± 66	425 ± 38	54.7
Medium	91	10	861 ± 64	472 ± 43	54.8
High	91	10	884 ± 73	512 ± 55	58.0
Low	119	10	820 ± 57	453 ± 44	55.2
Medium	119	10	931 ± 69	538 ± 48	57.8
High	119	9	965 ± 77	569 ± 47	59.0
Medium	147	10	1004 ± 95	597 ± 56	59.4
High	147	10	1059 ± 59	642 ± 39	60.6
High	175	10	1095 ± 68	676 ± 53	61.7

[1]Mean ± standard deviation.

[2]Slaughter weight is directly from feedlot (no pencil shrink). Dressing % calculated from slaughter weight.

Table 23.4. How ration energy levels and time on feed affected yield grade factors.

Energy supplied	Days	n	Adjusted fat, in.	Rib eye area, in.[1]	% KPH fat	Yield grade
Control		10	.10 ± .03	9.47 ± .78	1.45 ± .16	1.43 ± .25
Submaint.	28	10	.03 ± .03	7.80 ± .78	1.00 ± .33	1.61 ± .22
Low	56	10	.06 ± .04	9.48 ± 1.00	.60 ± .21	1.17 ± .29
Medium	56	10	.08 ± .03	9.94 ± 1.21	.75 ± .35	1.24 ± .39
High	56	10	.10 ± .03	9.87 ± .64	.75 ± .26	1.39 ± .20
Low	91	10	.14 ± .06	9.22 ± .58	1.60 ± .32	1.87 ± .31
Medium	91	10	.16 ± .04	10.07 ± .87	1.95 ± .28	1.91 ± .28
High	91	10	.30 ± .12	10.37 ± 1.34	2.60 ± .46	2.39 ± .53
Low	119	10	.13 ± .05	9.81 ± .91	1.25 ± .26	1.67 ± .32
Medium	119	10	.23 ± .05	10.88 ± 1.07	1.85 ± .47	2.01 ± .34
High	119	9	.30 ± .09	11.53 ± 1.60	1.94 ± .39	2.13 ± .57
Medium	147	10	.32 ± .07	10.87 ± .88	2.65 ± .63	2.65 ± .50
High	147	10	.46 ± .09	11.15 ± .58	2.90 ± .46	3.19 ± .31
High	175	10	.57 ± .03	11.76 ± 1.20	3.40 ± .74	3.48 ± .69

[1] Mean ± standard deviation.

Table 23.5. How ration energy levels and time on feed affected carcass quality characteristics.[1]

Energy supplied	Days	No. of steers	Maturity, %[2]			Fat color	Marbling quantity[4]	Quality grade[5]
			Bone	Lean	Overall			
Control		10	20 ± 0	56 ± 14	38 ± 7	1.7 ± .26	115 ± 40	58 ± 20
Submaint.	28	10	33 ± 7	74 ± 16	54 ± 9	2.2 ± .42	77 ± 48	38 ± 24
Low	56	10	28 ± 8	55 ± 18	42 ± 13	2.4 ± .52	105 ± 93	58 ± 68
Medium	56	10	27 ± 7	51 ± 12	36 ± 6	2.0 ± .32	135 ± 65	68 ± 34
High	56	10	29 ± 7	44 ± 12	36 ± 6	2.0 ± 0	151 ± 72	78 ± 39
Low	91	10	55 ± 5	56 ± 13	56 ± 7	2.4 ± .44	127 ± 43	64 ± 21
Medium	91	10	57 ± 7	55 ± 14	55 ± 8	2.0 ± 0	178 ± 111	100 ± 72
High	91	10	59 ± 10	52 ± 12	57 ± 12	2.2 ± .26	266 ± 86	172 ± 78
Low	119	10	39 ± 6	50 ± 12	44 ± 6	1.3 ± .26	156 ± 75	88 ± 57
Medium	119	10	35 ± 7	38 ± 13	36 ± 7	1.2 ± .26	229 ± 45	133 ± 38
High	119	9	43 ± 5	46 ± 13	44 ± 7	1.1 ± .22	305 ± 85	183 ± 55
Medium	147	10	50 ± 8	59 ± 23	54 ± 13	1.2 ± .35	291 ± 66	184 ± 38
High	147	10	53 ± 7	57 ± 24	55 ± 14	1.1 ± .21	308 ± 50	191 ± 33
High	175	10	55 ± 8	51 ± 6	53 ± 6	1.0 ± .16	358 ± 131	210 ± 57

[1] Mean ± standard deviation.
[2] Maturity as % in A maturity (higher no. = more mature).
[3] Fat color: 1 = very white, 2 = white, 3 = slightly yellow, 4 = yellow, 5 = very yellow.
[4] Marbling quantity scored as % within marbling degree (1 to 100 = prac. devoid, 101 to 200 = traces, 201 to 300 = slight, 301 to 400 = small, 401 to 500 = modest, etc.).
[5] Quality grade: 0 to 100 = Standard, 101 to 200 = Good, 201 to 300 = Choice, 301 to 400 = Prime.

Carcass Characteristics, Palatability, and Shelf Life of Beef Finished on Selected Feeding Regimes

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This report terminates a 3-year study and includes data from this past year. Previous results were reported in the 1976 and '77 Cattlemen's Day Reports (Allen et al., 1976 and Allen et al., 1977).

Summary

Cattle were finished on four feeding regimes: grass-fed, short- and long-fed (80% concentrate and 20% forage for 49 and 98 days, respectively), and forage-fed (60% forage and 40% concentrate for 98 days).

Quality grade averaged U.S. Good for the grass and short feds and U.S. Choice for the long- and forage-fed groups.

The taste panel tended to favor cattle fed longer; however, Warner-Bratzler shear force and consumer panel responses did not differ among treatments.

Steers finished for 98 days had the lowest percentage total collagen (connective tissue) and the greatest percentage of collagen in the salt soluble (most tender) state.

Grass feds had the lowest fat rancidity, as indicated by the lowest TBA (thiobarbituric acid) number, and highest percentage total poly-unsaturated fatty acids (expressed as percentage of fatty acids in the fat).

Muscle samples from the various feeding treatments were vacuum aged (21 days at 0-1°C) and then displayed (2-3 days at 3°C) without adversely affecting color stability.

Vacuum aging improved taste panel responses, but flavor of vacuum-aged cuts decreased after 5 days' display. Vacuum aging also decreased the slightly yellow fat color observed in steaks from grass-fed cattle before vacuum aging. The slightly yellow fat color should not affect marketability.

Carcass half conditioning at 13°C until 8 hr. postmortem did not consistently improve tenderness when compared with conventional chilling at 3°C until 48 hr. postmortem.

All bacterial numbers after carcass conditioning and vacuum aging were acceptable.

Introduction

Fluctuating feed prices have generated considerable interest in feeding practices for beef that differ from traditional finishing programs.

Changes in feeding practices raise questions about acceptability of the end product, and its response to current processing practices.

Alternative feeding regimes were evaluated for carcass traits and palatability, and shelf life characteristics of the product subjected to current processing practices.

Experimental Procedure

Thirty-eight calves from the Meat Animal Research Center, Clay Center, Nebraska, were castrated at birth and remained on bromegrass and bluestem pasture with their dams until they were weaned at six months of age. For the next 75 days, they received a growing ration (65% corn silage, 15% alfalfa haylage, and 20% cracked corn) and then Ralgro (36 mg. zeranol) was implanted. All steers received a wintering ration (48% corn silage, 50% alfalfa haylage, and 2% soybean meal) for the next 134 days before being grazed on bromegrass and bluestem for 133 days.

Ten steers (grass-fed) were slaughtered at the end of the grazing period. The remaining 28 steers were randomly assigned to either a short-, long-, or forage-fed finishing program in drylot. The short- (10 steers) and long-fed (8 steers) groups were fed 75% cracked corn, 5% soybean meal, and 20% alfalfa haylage for 49 and 98 days, respectively. The forage-fed group (10 steers) was fed 36% cracked corn, 4% soybean meal, 20% alfalfa haylage, and 40% corn silage for 98 days. Steers were slaughtered at approximately 18-23 months.

Approximately 1 hr. postmortem the right half of each carcass was chilled conventionally at 3°C until 48 hr. Left halves were conditioned at 13°C until 8 hr., then chilled at 3°C until carcass fabrication at 48 hr. postmortem.

Longissimus (loin eye), semitendinosus (eye of round), semimembranosus (top round), and biceps femoris (bottom round) muscles were removed from each carcass half at 48 hr. postmortem. Each muscle was sampled before and after vacuum storage at 0-1°C for 21 days and evaluated before, during, and after 5 days' display in polyvinylchloride film at 3°C under 100 foot candles of General Electric Deluxe Warm White Light. Inside chuck and gluteus medius (top sirloin) samples were used in some comparisons.

Results and Discussion

Carcass and Eating Quality Characteristics

Longer feeding increased carcass weight, fat thickness, rib eye area, internal fat, and numerical yield grade and reduced cooler shrinkage. Higher marbling scores, quality grade, and whiter external fat resulted from increased feeding. Lean texture tended to be finer in longer fed cattle. Bone maturity increased slightly over the 98-day feeding period but remained well within the A maturity range. Quality grade averaged Good for the grass and short feds and Choice for the long- and forage-fed groups.

All taste panel responses (tenderness, flavor of lean and fat, and juiciness) to longissimus samples favored cattle fed longer. Grass-fed cattle, however, were rated slightly juicy and desirable. Generally, feeding regime did not affect tenderness measurements of the longissimus, semitendinosus, and semimembranosus steaks; however, some differences in Warner-Bratzler shear force were noted in the biceps femoris comparisons. A 61-member consumer panel did not prefer gluteus medius samples from any one feeding regime over another.

Connective tissue was studied to determine its effect on tenderness. Longissimus steaks from steers finished on a high plane of nutrition for 98 days had the lowest proportion of total collagen (connective tissue), highest yield of salt soluble collagen, and most-preferred taste panel ratings. A higher nutritional plane will improve taste panel ratings perhaps by decreasing total collagen percentage in the longissimus muscle, by increasing the percentage of collagen in the salt soluble state, or both.

Total cooking and drip losses were generally lowest in steaks from grass-fed cattle. Drip loss from the longissimus muscle increased with increasing time on feed, possibly due to the increased fat content in longer-fed cattle.

Vacuum aging improved taste panel tenderness, juiciness, flavor scores, and objective tenderness measurements. Vacuum aging, however, decreased taste panel flavor scores of steaks displayed 5 days; whereas, tenderness increased during display.

Conditioning carcass halves at 13°C as opposed to chilling counterparts at 3°C failed to consistently improve tenderness evaluated by Warner-Bratzler shear force and taste panel. Conditioning only improved taste panel tenderness evaluated for grass-fed steaks. This was true even though all halves had less than 1.27 cm. fat over the 12th rib; pH values greater than 6 prior to cold application; and, in grass-fed halves chilled at 3°C, deep tissue (internal round) that chilled at 1.3°C per hour for the first 6 hr. postmortem. All these factors met or approximated conditions (previously established by other workers) that could encourage cold shortening, which can decrease tenderness.

Shelf Life Characteristics

TBA (thiobarbituric acid) number (fat rancidity measure) for samples from carcass halves conditioned at 13°C did not differ from counterparts chilled at 3°C.

At all sampling periods, grass-fed longissimus samples had the lowest TBA numbers. Vacuum packaging and display increased TBA number in longissimus and subcutaneous fat samples. TBA number did not differ between feeding regimes for subcutaneous fat samples or between subcutaneous layers, regardless of feeding regime. All TBA numbers were low, and normally less than those reported by other workers as being detectable by taste panels. Grass feds had the highest mean total polyunsaturated fatty acid composition (expressed as percentage of fatty acids in fat) even though nutritional regimes did not differ for percentage saturated and unsaturated fatty acid composition.

For steaks displayed continously (24 hr. a day), longissimus steaks from grass- and short-fed cattle approached visual rejection by the fifth day. Semitendinosus steaks from all feeding regimes retained an acceptable visual score throughout display, but biceps femoris and semimembranosus steaks from grass-, short-, and long-fed cattle approached or surpassed visual rejection by the third day.

All test steaks from carcasses in this study were vacuum aged for 21 days and then displayed for 48 to 72 hr. without adversely affecting color stability. Vacuum aging decreased the slightly yellow fat color observed in steaks from grass-fed cattle evaluated before vacuum aging. The slightly yellow fat color should not affect marketability.

Carcass halves chilled at 3°C had lower total psychrotrophic and mesophilic bacterial numbers than did corresponding halves conditioned at 13°C. Total aerobic and anaerobic bacterial numbers tended to remain constant or decrease slightly during vacuum storage. Vacuum-stored cuts from carcasses of grass-fed steers had significantly higher aerobic and anaerobic numbers than those of other feeding regimes. All carcass and resultant cut bacterial numbers were acceptable, before and after carcass conditioning, vacuum aging, or both.

Predicting Cattle Performance from Mathematical Models

B. E. Brent, Allan Chestnut, and Phil George

Summary

Tables based on a mathematical model are presented that allow cost of gains by steers at various weights to be calculated. An example illustrates how to use the tables to help with economic decisions.

Introduction

Daily gain and feed efficiency are generally calculated for feedlot cattle at the end of the feeding period, but that gives no information on how performance changed during the feeding period. We used a mathematical model to compute gain, feed efficiency, and intake on a set of Hereford steers after each 25 pounds gained during the feeding period. Using the figures, a feeder can estimate cost of each additional unit of gain and when to sell cattle for maximum profit or minimum loss.

Experimental Procedure

Twenty Hereford steers averaging 623 lbs. were individually fed the 10 rations in Table 24.1. Feed consumption and weekly weights were used to derive mathematical models of the steers' performance. The mathematical models were translated to tables of feed intake (Table 24.2), gain (Table 24.3), and feed efficiency (Table 24.4).

Calculating costs:

The cost of each pound of gain is composed of direct feed costs and such fixed costs as interest and yardage. Thus, if an animal were fed a long period on a low-cost ration, total cost per pound of gain might be higher, because of fixed costs, than if the animal gained faster on a more expensive ration.

Ration 8 (see Table 24.1) was composed of 20.2% silage, 68.10% corn, and 11.7% supplement, all on a dry-matter basis. Assuming silage costs $25 per ton and contains 40% dry matter, cost per pound of dry matter is 3.13¢/lb. If corn costs $2.27 per bu. and is 90% dry matter, it costs 4.50¢/lb. of dry matter. If the supplement costs $200 per ton and is 90% dry matter, it costs 11.1¢/lb. of dry matter. Thus, the ration costs 5.0¢ per lb. of dry matter.

Table 24.4 shows that on ration 8, an 800-lb. steer requires 5.7 lbs. of dry matter per lb. of gain. Thus, the feed cost per pound of gain is 28.5¢. No interest costs were added to the feed.

If the steer were purchased at 700 lbs. for 45¢ per lb. with money borrowed at 9.5%, the steer uses 8.31¢ per day in interest. Assuming yardage costs of 5¢ per head per day, daily fixed costs are 13.31¢ daily. In Table 24.3, the 800-lb. steer on ration 8 is predicted to gain 3.34 lbs. per day, so fixed costs are 3.99¢ per lb. of gain. Feed cost of gain was 28.50¢ per lb., so total cost of gain is 32.49¢ per lb., but only for an 800-lb. steer. For an 1100-lb. steer, 5¢/lb. ration x 7.7 lbs. feed per lb. gain, and 13.31¢/day fixed costs ÷ 2.46 lbs. gain per day gives 43.91¢/lb. total costs of gain.

Table 24.5. shows incremental total costs of gain at various body weights for a steer fed from 650 lb. to 1200 lb. on ration 8 (20% corn silage, a fairly typical feedlot ration). Ingredient costs in footnote 1 Cost of gain is economical early in the feeding period but quite expensive at heavy weights.

You could use the gain and feed efficiency tables to construct similar tables for other combinations of corn and corn silage.

As cow slaughter decreases and percentage of beef consumed as hamburger increases, demand for good-grade beef should increase. Information contained in Tables 24.4 and 24.5 should aid in deciding when feeding cattle to the Good grade instead of Choice is financially feasible.

The model was developed using Hereford steers, fed neither DES nor Rumensin. We shall develop models for heifers and larger-framed cattle. Adjustments can be made to the basic formula to account for feed additives.

Table 24.1. Ration fed steers to develop a mathematical model of feedlot performance.

Ration no.	%, dry matter basis			NEm	NEp
	Corn silage	Cracked corn	Supplement[1]	Therms/100 lbs.	
1	90.40	0.00	9.60	71.76	45.8
2	80.40	9.70	9.90	74.92	48.0
3	70.40	19.40	10.20	78.10	50.1
4	60.40	29.10	10.50	81.26	52.3
5	50.40	38.80	10.80	84.43	54.3
6	40.30	48.60	11.10	87.60	56.6
7	30.20	58.40	11.40	90.77	58.8
8	20.20	68.10	11.70	93.93	63.1
9	10.10	77.90	12.00	97.10	63.1
10	0.00	87.60	12.40	98.36	65.3

[1] Supplement composition was varied to assure adequate protein. Ingredients included soybean meal, ground limestone, dicalcium phosphate, salt, trace minerals, and vitamins.

Table 24.2. Daily dry matter intake (lbs.) computed from a steer performance model.

Steer weight (lbs.)	Ration number (see Table)									
	1	2	3	4	5	6	7	8	9	10
650	15.6	16.3	17.2	18.4	19.3	20.0	19.6	18.8	17.4	14.5
675	15.9	16.3	17.5	18.5	19.3	19.9	19.6	18.9	17.4	14.6
700	16.0	16.5	17.3	18.3	19.3	19.9	19.6	18.9	17.3	14.6
725	16.0	16.6	17.5	18.4	19.4	19.8	19.5	18.8	17.5	14.4
750	16.1	16.8	17.3	18.4	19.3	19.7	19.5	18.8	17.4	14.4
775	16.4	16.7	17.6	18.2	19.2	19.9	19.7	19.1	17.4	14.4
800	16.5	16.8	17.3	18.3	19.0	19.7	19.5	19.0	17.4	14.4
825	16.7	16.9	17.5	18.5	19.1	19.8	19.4	16.9	17.3	14.8
850	16.9	17.0	17.6	18.6	19.0	19.7	19.6	18.8	17.2	14.8
875	16.9	17.0	17.4	18.3	19.1	19.5	19.5	19.0	17.4	14.8
900	16.9	17.2	17.7	18.5	19.3	19.7	19.6	18.8	17.6	14.7
925	17.4	17.3	17.7	18.6	19.1	19.7	19.7	18.7	17.7	14.7
950	17.4	17.4	17.7	18.5	19.0	19.8	19.8	18.9	17.9	14.9
975	17.5	17.3	17.8	18.6	19.0	19.7	19.6	19.0	18.0	15.1
1000	17.7	17.4	17.8	18.5	18.9	19.7	19.7	18.7	18.2	14.9
1025	18.0	17.6	17.8	18.4	19.1	19.4	19.5	18.8	18.0	15.0
1050	18.0	17.7	17.8	18.4	19.1	19.3	19.3	19.1	17.6	14.9
1075	18.0	17.8	18.0	18.4	19.0	19.3	19.4	19.0	17.4	14.9
1100	18.9	18.0	18.1	18.6	19.0	19.4	19.6	18.9	17.4	15.0
1125	18.8	17.7	18.1	18.5	19.0	19.4	19.5	19.0	17.6	15.3
1150	19.1	18.0	18.2	18.5	18.8	19.5	19.6	18.7	17.5	15.3
1175	19.0	18.1	18.4	18.7	18.9	19.2	19.4	18.8	17.6	15.2
1200	19.1	18.3	18.4	18.3	19.0	19.2	19.3	18.7	17.7	15.1

Table 24.3. Daily weight gain (lbs.) at various body weights, computed from a steer performance model.

Steer weight (lbs.)	Ration number (see Table)									
	1	2	3	4	5	6	7	8	9	10
650	2.11	2.44	2.77	2.97	3.17	3.39	3.56	3.76	3.70	3.72
675	2.07	2.40	2.73	2.93	3.12	3.32	3.50	3.70	3.63	3.65
700	2.02	2.35	2.66	2.86	3.06	3.26	3.43	3.63	3.54	3.56
725	1.98	2.31	2.61	2.79	2.99	3.19	3.37	3.54	3.50	3.50
750	1.94	2.27	2.55	2.75	2.93	3.12	3.30	3.48	3.41	3.43
775	1.91	2.20	2.51	2.68	2.86	3.06	3.23	3.41	3.34	3.34
800	1.87	2.16	2.44	2.62	2.79	2.99	3.15	3.34	3.28	3.28
825	1.83	2.11	2.40	2.57	2.73	2.95	3.08	3.26	3.21	3.21
850	1.78	2.07	2.35	2.51	2.68	2.86	3.01	3.19	3.12	3.15
875	1.74	2.02	2.29	2.44	2.61	2.79	2.95	3.12	3.06	3.08
900	1.69	1.98	2.24	2.40	2.57	2.74	2.88	3.04	2.99	3.01
925	1.67	1.94	2.18	2.35	2.51	2.66	2.82	2.97	2.90	2.93
950	1.63	1.89	2.13	2.29	2.44	2.60	2.75	2.90	2.84	2.86
975	1.58	1.82	2.07	2.24	2.38	2.53	2.68	2.84	2.77	2.79
1000	1.54	1.78	2.02	2.18	2.31	2.46	2.62	2.75	2.71	2.71
1025	1.50	1.74	1.98	2.11	2.27	2.40	2.53	2.68	2.64	2.64
1050	1.45	1.69	1.91	2.07	2.20	2.33	2.44	2.62	2.55	2.57
1075	1.41	1.65	1.87	2.00	2.13	2.27	2.40	2.53	2.49	2.49
1100	1.39	1.61	1.83	1.96	2.07	2.20	2.33	2.46	2.42	2.42
1125	1.34	1.54	1.76	1.89	2.00	2.13	2.27	2.40	2.35	2.35
1150	1.30	1.50	1.72	1.83	1.94	2.07	2.20	2.31	2.27	2.29
1175	1.25	1.45	1.67	1.78	1.89	2.00	2.13	2.24	2.20	2.20
1200	1.21	1.41	1.63	1.74	1.83	1.94	2.05	2.18	2.13	2.13

Table 24.4. Feed efficiency (units dry feed per unit of body weight gain) computed from a steer performance model.

Steer weight (lbs.)	Ration number (see Table)									
	1	2	3	4	5	6	7	8	9	10
650	7.4	6.7	6.2	6.2	6.1	5.9	5.5	5.0	4.7	3.9
675	7.7	6.8	6.4	6.3	6.2	6.0	5.6	5.1	4.8	4.0
700	7.9	7.0	6.5	6.4	6.3	6.1	5.7	5.2	4.9	4.1
725	8.1	7.2	6.7	6.6	6.5	6.2	5.8	5.3	5.0	4.1
750	8.3	7.4	6.8	6.7	6.6	6.3	5.9	5.4	5.1	4.2
775	8.6	7.6	7.0	6.8	6.7	6.5	6.1	5.6	5.2	4.3
800	8.8	7.8	7.1	7.0	6.8	6.6	6.2	5.7	5.3	4.4
825	9.1	8.0	7.3	7.2	7.0	6.7	6.3	5.8	5.4	4.6
850	9.5	8.2	7.5	7.4	7.1	6.9	6.5	5.9	5.5	4.7
875	9.7	8.4	7.6	7.5	7.3	7.0	6.6	6.1	5.7	4.8
900	10.0	8.7	7.9	7.7	7.5	7.2	6.8	6.2	5.9	4.9
925	10.4	8.9	8.1	7.9	7.6	7.4	7.0	6.3	6.1	5.0
950	10.7	9.2	8.3	8.1	7.8	7.6	7.2	6.5	6.3	5.2
975	11.1	9.5	8.6	8.3	8.0	7.8	7.3	6.7	6.5	5.4
1000	11.6	9.8	8.8	8.5	8.2	8.0	7.5	6.8	6.7	5.5
1025	12.0	10.1	9.0	8.7	8.4	8.1	7.7	7.0	6.8	5.7
1050	12.4	10.5	9.3	8.9	8.7	8.3	7.9	7.3	6.9	5.8
1075	12.8	10.8	9.6	9.2	8.9	8.5	8.1	7.5	7.0	6.0
1100	13.6	11.2	9.9	9.5	9.2	8.8	8.4	7.7	7.2	6.2
1125	14.0	11.5	10.3	9.8	9.5	9.1	8.6	7.9	7.5	6.5
1150	14.7	12.0	10.6	10.1	9.7	9.4	8.9	8.1	7.7	6.7
1175	15.2	12.5	11.0	10.5	10.0	9.6	9.1	8.4	8.0	6.9
1200	15.8	13.0	11.3	10.8	10.4	9.9	9.4	8.6	8.3	7.1

Table 24.5. Economic data computed from steer performance model.

Animal wt., lbs.	Lbs. feed D.M. per lb. gain	Feed cost[1] per lb. gain, ¢	Lbs. gain per day	Fixed[2] cost per lb. gain, ¢	Total cost per lb. gain, ¢
650	5.0	25.00	3.76	3.43	28.43
675	5.1	25.50	3.70	3.48	28.98
700	5.2	26.00	3.63	3.55	29.55
725	5.3	26.50	3.54	3.64	30.14
750	5.4	27.00	3.48	3.70	30.70
775	5.6	28.00	3.41	3.78	31.78
800	5.7	28.50	3.34	3.86	32.36
825	5.8	29.00	3.26	3.95	32.95
850	5.9	29.50	3.19	4.04	33.54
875	6.1	30.50	3.12	4.13	34.63
900	6.2	31.00	3.04	4.24	35.24
925	6.3	31.50	2.97	4.34	35.84
950	6.5	32.50	2.90	4.44	36.94
975	6.7	33.50	2.84	4.54	38.04
1000	6.8	34.00	2.75	4.69	38.69
1025	7.0	35.00	2.68	4.81	39.81
1050	7.3	36.50	2.62	4.92	41.42
1075	7.5	37.50	2.53	5.09	42.59
1100	7.7	38.50	2.46	5.24	43.74
1125	7.9	39.50	2.40	5.37	44.87
1150	8.1	40.50	2.31	5.58	46.08
1175	8.4	42.00	2.24	5.75	47.75
1200	8.6	43.00	2.18	5.91	48.91

[1]Silage at $20 per ton, 40% dry matter. Corn at $2.27 per bu., 90% dry matter. Supplement at $200 per ton, 90% dry matter.

[2]Assume 5¢/day yardage, and 650 lb. steer purchased for $46/cwt. at 9.5% interest. 12.89¢/day fixed costs.

The Concept of Adjusting Energy Level in Maintenance Rations for Cold Weather

D. R. Ames

Nutrient requirements for domestic animals (NRC) published by the National Research Council are the best estimates available. For beef cattle, specific tables are listed for animals of different weights and for various stages of the production cycle. Although these values are useful for many situations, there are instances when they should be adjusted. One needed adjustment is energy requirement for maintenance when cattle are exposed to cold and rate of heat production must increase to compensate for increased heat loss. The two factors that determine the rate of heat loss are: (1) the difference between body temperature and environmental temperature, and (2) the amount of insulation provided by fat, hide, and hair.

The temperature gradient between environmental and body temperature (factor 1) combined with the animal's insulation (factor 2) can be used to predict energy loss per unit of time, i.e. maintenance energy requirement. The relationship of these variables is:

Equation 1: $$\text{Insulation} = \frac{\text{Temperature gradient}}{\text{Rate of sensible heat loss}}$$

The slower the rate heat is lost, the lower the cost of energy for maintenance; however, there is a minimum rate of metabolic heat production which must be lost or body temperature would rise because heat production must equal heat loss. For cattle consuming a maintenance level of feed this minimum heat production is 131 $\text{Kcal}/w^{3/4}$ (Lofgreen and Garrett, 1968). Rate of sensible heat loss in equation 1 equals heat production minus evaporative heat loss. Blaxter (1967) has estimated a relatively constant rate of evaporative heat loss during cold to be 300 $\text{Kcal}/m^2/\text{da}$ for cattle. Blaxter also estimates that 80 $\text{Kcal}/m^2/\text{da}$ is used to warm feed and water. While heat of warming is sensible heat exchange it is not included in equation 1 because this particular avenue of heat flow is not a function of animal insulation, nor is it affected by environmental temperature.

Equation 1 indicates that different combinations of insulation and thermal gradient may result in the same rate of heat loss. In other words, when insulation values are high, animals can tolerate larger thermal gradients (magnitude of cold) without increasing rate of sensible heat loss. But, if insulation value is low, smaller gradients (higher environmental temperature) could result in large rates of heat loss.

The relationship of insulation, temperature gradient, and sensible heat flow establishes an animal's critical temperature. Critical temperature is the environmental temperature below which the animal must increase heat production to maintain constant body temperature, and by definition is the lower limit of the thermal neutral zone. In effect, the critical temperature and thermal neutral zone are much the same, but one may be more appropriate than the other in some situations. When adjusting energy levels in maintenance rations, the critical temperature is most appropriate because it is the temperature below which increased energy is necessary. The major animal variable that determines critical temperature is insulation, which is obvious from equation 1. Using typical insulation values one can calculate critical temperature as follows:

Example:

Insulation	$.015/\text{Kcal}/m^2/\text{da}$
Body temperature	39 C
Heat flow	$2390\ \text{Kcal}/m^2/\text{da}$

$$.015C/\text{Kcal}/m^2/\text{da} = \frac{39 - x}{2390\ \text{Kcal}/m^2/\text{da}}$$

then $x = 3$ C

This example suggests that the critical temperature is 3 C so when the environment is colder than 3 C, more energy will be needed for maintenance.

When adjusting rations for thermal environment an "effective temperature" should be used as environmental temperature. Effect temperature is defined as the heating or cooling power of the environment in terms of dry-bulb temperature. A wind-chill temperature is a good example of an effective temperature and should be used for cattle exposed to cold (see 60th Annual Cattlemen's Day Report, p. 84).

Critical temperature cannot be calculated without some error. First, the insulation value of hair and fat is not uniform over the entire surface of the animal; second, the animal's ability to shunt blood to and from specific areas of the body reduces the accuracy of estimates of insulation. Third, calculations assume that the animal is a sphere with no facing surfaces. Other methods of determining critical temperature are possible and involve measuring heat production of animals exposed to various temperatures to determine effective temperature when heat production is lowest or performance is highest. Using both calculations and deductive interpretation, table 25.1 lists the estimated critical temperature of beef cows presently being used in our research. The more insulation the lower the critical temperature (see heavy winter coat, Table 25.1). This would be expected from equation 1. The effect of wetting the haircoat by rain or high humidity results in reduced insulation. Fat is not considered here and more research is needed on its influence. Recent work has refined observed changes in haircoat insulation (Table 25.2).

Values in Table 25.1are generally higher than calculated values primarily because previous calculations assumed constant insulation over the entire body surface. A second reason for higher values is that many body surfaces face each other so heat lost is regained by the animal. This is enhanced by behavioral thermoregulation.

Table 25.2 data show that total insulation and haircoat insulation are closely related ($r = .98$), suggesting that insulatory value of the haircoat could be used to indicate total insulation. The best measurement of haircoat to predict insulation value uses hair depth and weight per unit area in this equation:

Equation 2: Total Insulation ($C/Mcal/m^2/da$) = 7.18 + 3.08 (hair depth, cm) + .017 (weight in gms/m^2)

After total insulation is estimated, increased energy loss per degree increase in temperature gradient is determined by modifying equation 1 as follows:

$$\text{Insulation} = \frac{1\ C}{\text{rate of sensible heat loss}}$$

For example, if insulation value is .015 $C/Kcal/m^2/day$ then for each 1 C of thermal gradient the increased rate of heat loss is 66.6 $Kcal/m^2/da$ as shown below:

$$.015\ C/Kcal/m^2/da = \frac{1\ C}{X}$$

$$x = 66.6\ Kcal/m^2/da$$

One remaining conversion that must be dealt with in determining rate of heat loss is converting heat production during feeding, which is described per unit of metabolic size, ($131\ Kcal/w^{3/4}/da$), to rate of heat loss per unit of surface area ($2770/Kcal/m^2/da$). Both values are a function of body weight but at slightly different powers ($w^{.75}$ vs. $w^{.66}$). Thus, body weight has a relatively small effect when converting rate of heat loss per unit of metabolic size to heat loss per unit of surface area.

Table 25.3 shows the percentage increases in NRC maintenance energy requirement at four different insulation values for animals of five different weights.

Values in table 25.3 can help cattlemen properly adjust energy in rations.

Example 1: If a 500 kg. (1100 lb.) cow has a winter coat (critical temperature 0 C) with an estimated insulation value of .020 $C/Kcal/m^2/da$, how much energy does she require if the wind-chill is -25 C?

Answer: The cow is experiencing 25 C of cold (difference between critical and effective temperatures) and according to table 25.3 needs 1.8% additional energy per degree of cold or 45% more than the NRC maintenance energy requirement.

Thus,

NRC Requirement	13,850	Kcal
Adjustment (45%)	6,232	Kcal
Adj. Requirement	20,082	Kcal

Example 2: Suppose a 400 kg. cow is wet, the dry-bulb temperature is 2 C (35 F) with a wind-chill of -5 C (23 F). What is her adjusted maintenance requirement for energy?

Answer: In this case the cow experiences 20 C cold (difference between critical temperature -15 C and effective temperature -5 C). Table 25.3 indicates a 3.7% increase per degree cold, therefore, 74% adjustment.

NRC Requirement	11,700	Kcal
Adjustment (74%)	8,660	Kcal
Adj. Requirement	20,360	Kcal

The value of the described system is to more accurately feed energy during periods of cold stress. The system is based on an assumed accuracy of existing NRC requirements at thermal neutral temperature. The system does have some shortcomings in its present form, however, the adjustments attempt to correct NRC requirement for effect cold.

Table 25.1. Estimated critical temperature - beef cows.

Coat description	Critical temperature	Expected insulation ($C/Kcal/m^2/da$)
Summer coat or wet	15 C (59 F)	.010
Fall coat	7 C (45 F)	.015
Winter coat	0 C (32 F)	.020
Heavy winter coat	-7 C (18 F)	.030

Table 25.2. Haircoat, external, and total insulation of cattle by month in Kansas.[1]

Month	Insulation ($C/Kcal/m^2/da$) Haircoat	External[2]	Total[3]
Jan.	.019	.029	.032
Feb.	.015	.023	.027
Mar.	.011	.018	.022
April	.008	.014	.018
May	.005	.011	.015
June	.003	.008	.013
July	.002	.007	.012
Aug.	.002	.006	.012
Sept.	.002	.007	.012
Oct.	.003	.009	.013
Nov.	.004	.010	.015
Dec.	.006	.013	.018

[1]Calculated on fifteenth of each month.

[2]External insulation included haircoat and air interface.

[3]Total insulation includes hide, haircoat, and air interface.

Table 25.3. Increased maintenance energy costs for cattle per degree (C) cold.

Insulation ($C/Kcal/m^2/da$)	Cow weight (kg) 200	300	400	500	600
	Percentages				
.010	4.1	3.9	3.7	3.6	3.5
.015	2.8	2.6	2.5	2.4	2.3
.020	2.1	1.9	1.9	1.8	1.8
.025	1.7	1.6	1.5	1.4	1.4
.030	1.3	1.2	1.2	1.2	1.1

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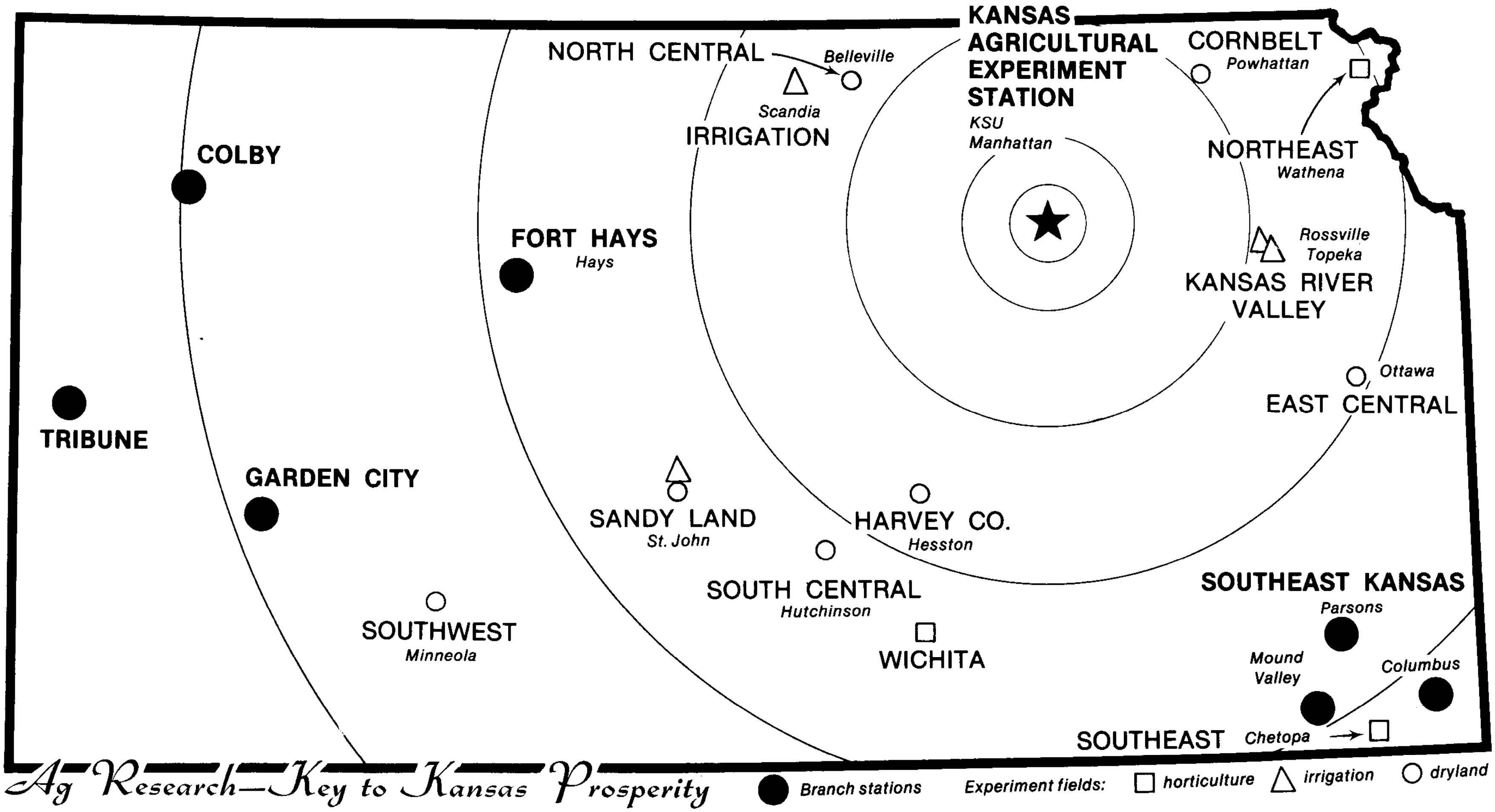

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