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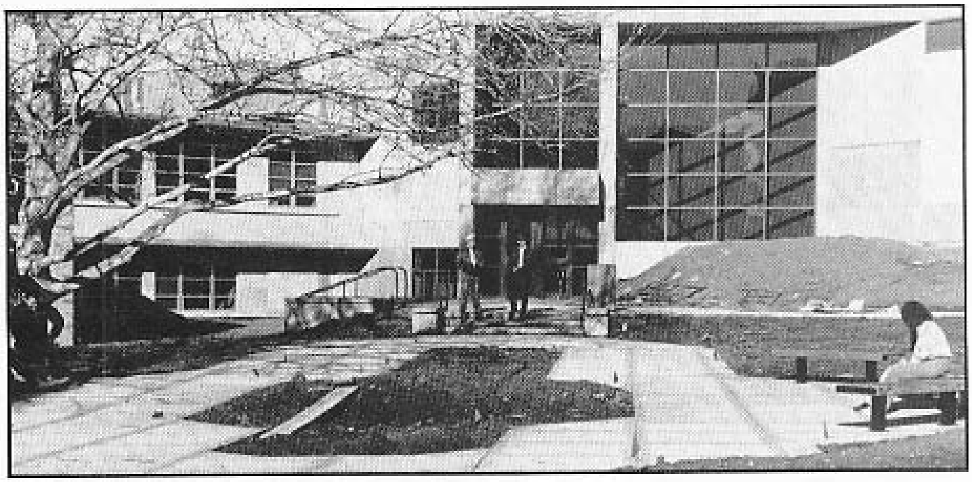
SEVENTY-FIFTH ANNUAL

CATTLEMEN'S DAY

March 1988



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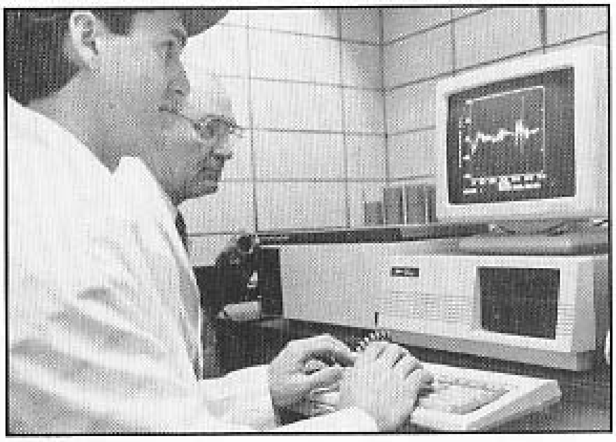

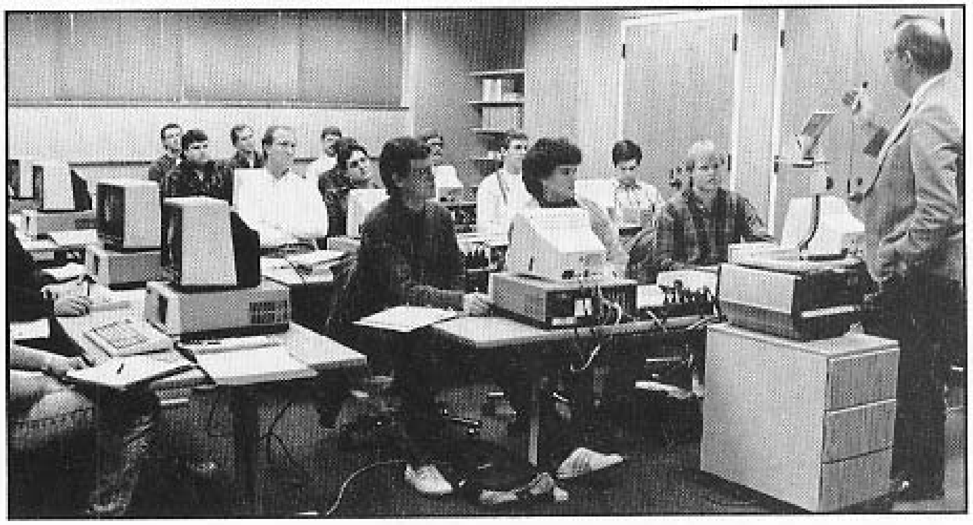

Agricultural
Experiment Station
Walter R. Woods,
Director

KANSAS STATE UNIVERSITY
MANHATTAN

COVER STORY -- WEBER HALL 1988

Weber Hall is new again! With 23,000 square feet of new space and 30,700 square feet of renovated space, Weber Hall is ready to start a new life. Originally called the Animal Industries building when it was first occupied in 1957, it was later officially named Weber Hall in honor of A. D. "Dad" Weber, former Animal Husbandry Department Head and Dean of Agriculture. In 1957, the Department had 18 faculty members, 89 undergraduates, and 11 graduate students. Less than 1000 square feet of the original building was research laboratories. By 1977, it became obvious that something had to be done. There were 403 undergraduates, and 63 graduate students. Two ladies' lounges had been converted to offices. Research equipment was operating in the halls. The meats laboratory was completely out of date and in danger of being shut down by the USDA.

Leaders of the livestock and meat industry met and agreed on the need to upgrade the facility. Largely due to the efforts of those industry leaders, the 1985 Legislature appropriated $7.2 million to add new space and renovate existing space. At the same time, the Livestock and Meat Industry Council agreed to raise $500,000 for moveable equipment.

Meats research facilities were expanded and upgraded. The kill floor was completely remodeled and re-equipped. New freezer and cooler space was added. A new facility was added for research on value-added meats products. A test kitchen and taste panel area were provided. Research laboratories were also added for monogastric nutrition, and physiology. Cattle holding and working facilities are also built in, facilitating physiology research.

Teaching facilities were developed with an eye toward providing the best possible learning environment. Classrooms are all carpeted and have comfortable seating. Television monitors have been wired into one of the classrooms. "Government Grey" is notably absent from the color scheme. The new student Commons area makes a major contribution to the new learning environment.

At the top of the front cover is the new east entrance to Weber Hall. It's on the southeast corner of the new addition. A bit of Weber Hall's old east wall can be seen on the left. The photo on the left depicts research activity in the new physiology laboratory. The photo on the right is the Department's new Near Infrared Reflectance Spectrometer, a device for forage nutrient analysis. The bottom shows Weber Hall's new computer laboratory. Numerous Animal Sciences classes are incorporating microcomputer decision-making tools. The laboratory is available for general use by our students whenever classes are not being held.

We'd like to express our appreciation to Joan Istas for the cover photographs, to Fred Anderson for cover layout, and to Eileen Schofield for editing help.

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Contribution No. 88-363-S from the Kansas Agricultural Experiment Station

An Analysis of Weaning Weight Records In Kansas Cowherds From 1968 to 1985

R.C. Perry, D.D. Simms,
L.R. Corah and D.J. Patterson

Summary

A data set of 33,208 individual weaning records (1968-1985) from producers within Kansas was analyzed to determine factors influencing weaning weight. In determining the effect of calving sequence (21 day periods), only data from larger cowherds with records from at least 5 years were included (n = 18,400).

On the average, for every 21 days later a calf is born, there is a 22.8 lb decline in weaning weight. During the 17-year period that these records encompassed, there has been an average annual weaning weight increase of 4.6 lbs. This study suggests that factors influencing weaning weight in Kansas are age at weaning, month of birth, herd size, sex of calf and age of dam.

Introduction

The total pounds of calf produced by a cowherd is a major determinant of profitability of a cow-calf enterprise. Numerous research trials have shown that many factors influence weaning weights. Our objectives were twofold: 1) to determine the influence of various factors on weaning weights in Kansas and 2) to develop baseline weaning weight values for use in the Beefpro computer program.

Experimental Procedures

In cooperation with county extension agricultural agents, 33,208 individual weaning weight records were collected from 94 Kansas producers. These records encompassed the years 1968 through 1985. The records included the following information: location (Northwest, Southwest, Northeast, South Central, Southeast); producer identification; year of record; dam breed; sire breed; calf number; calf sex; date of birth; birth weight; age in days at weaning; actual weaning weight; 205-day adjusted weight; weight ratio; height; frame score; dam number; and age of dam. Some of the records did not include information for birth weight, dam breed, sire breed, height, frame score, or age of dam.

Actual weaning weight (WW) was used in all analyses. In determining the effect of calving date (21 day periods), the data set was limited to the larger cowherds with records from at least 5 years (n = 18,400). The 21-day periods were determined from the first calf born in each year for each producer.

Results and Discussion

The mean WW for the years of 1968 through 1985 are shown in Figure 1.1. The fitted line indicates that WW has increased an average of 4.6 lbs per year.

The mean WW and average daily gain (ADG) for calving periods 1 through 7 are depicted in Figure 1.2. The mean WW for period 1 was 495.5 lbs, with the mean cumulative declines between period 1 and periods 2, 3, 4, 5, 6, and 7 being -25.8, -49.0, -75.0, -96.9, -112.9, and -136.8 lbs, respectively. Mean ADG's were similar across all periods; thus, the effect of calving date on WW was primarily due to age at weaning. The cumulative percents of calves born for periods 1, 2, 3, 4, 5, 6, and 7 were 27.3, 60.4, 82.3, 92.5, 96.9, 98.8, and 100, respectively.

The mean WW and ADG for the months of January through July are shown in Figure 1.3. Mean ADG was similar across months, even though mean WW was different.

Size of cowherd and location within the state affected WW. However, it should be noted that these two factors were somewhat confounded by an uneven distribution of cowherd size across the state. The mean WW and ADG by area were Northwest, 477.6, 1.87; Northeast, 471.1, 1.80; Southwest, 454.0, 1.79; and South Central 436.5 lbs and 1.61 lbs/hd/day, respectively. The mean WW and ADG for small (< 50 records/year), medium (50-100 records/year), and large (> 100 records/year) cowherds were 508.7, 2.00; 462.2, 1.79; and 457.4 lbs and 1.78 lbs/hd/day, respectively.

The effect of sex on WW and ADG is depicted in Table 1.1. Bull calves had the heaviest mean WW and the highest ADG, with steer calves intermediate, and heifer calves having the lightest WW and lowest ADG.

Table 1.1. Effect of Sex on Weaning Weight and Average Daily Gain

Calf Sex	Weaning weight	Average daily gain
Bull Calves	479.4	1.98
Steer Calves	475.5	1.85
Heifer Calves	446.8	1.72

The effect of age of dam on WW and ADG is shown in Figure 1.4. Eight-year old dams had calves with the heaviest mean WW and the highest mean ADG. Calf production of dams steadily increased from 2 to 8 years of age, then gradually decreased.

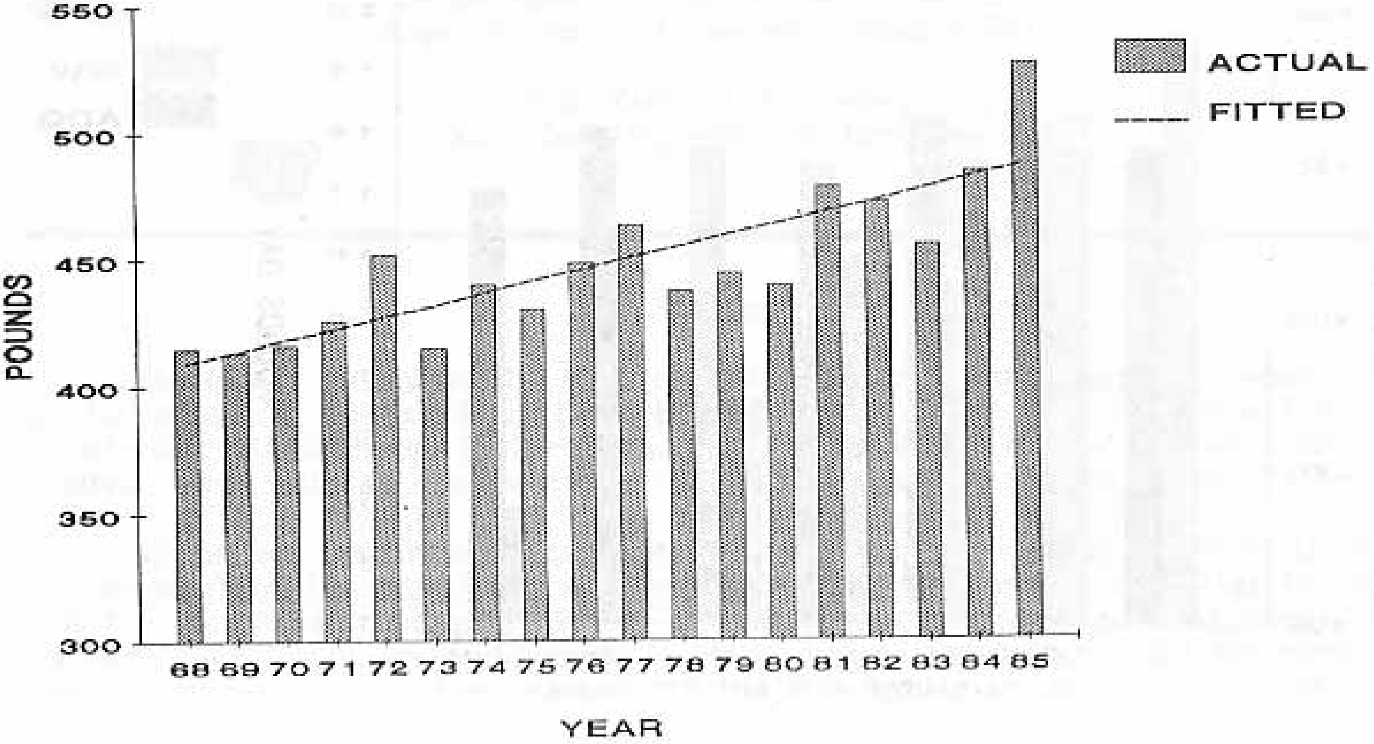
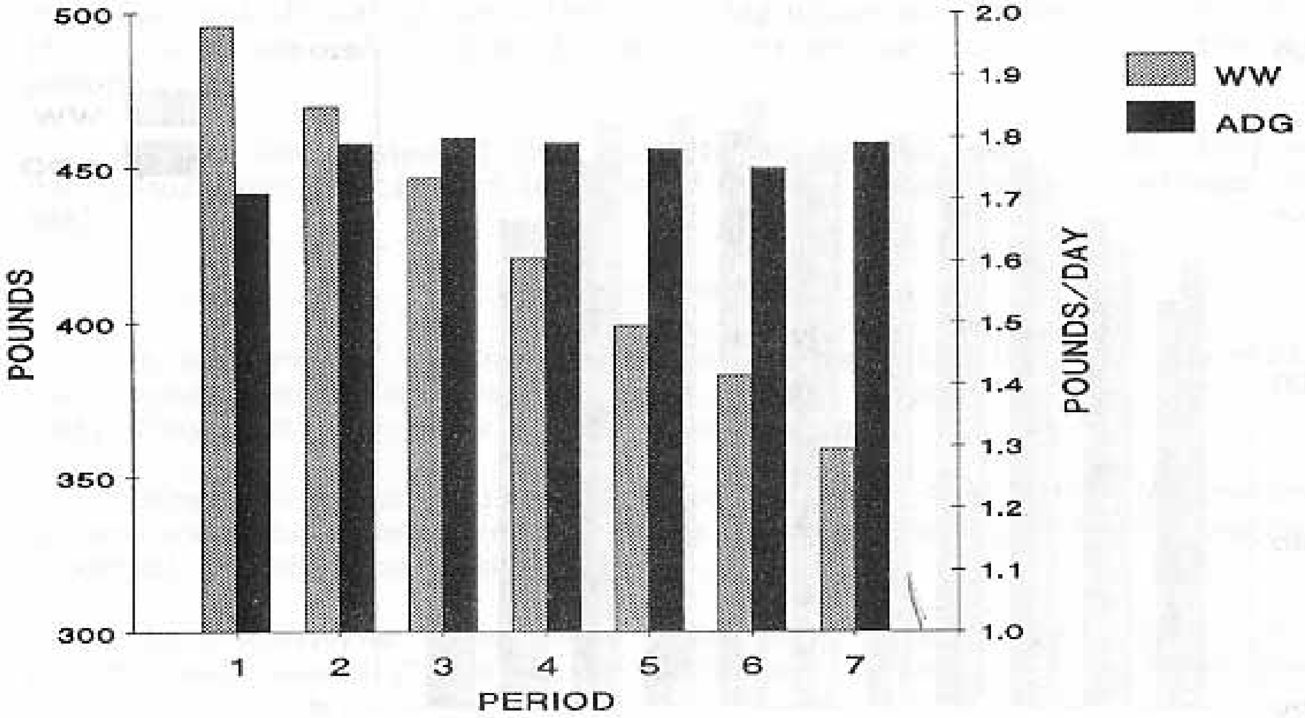


Figure 1.1. Effect of Year on Weaning Weight



* PERIOD=21 DAY CALVING INTERVALS BEGINNING WITH THE FIRST CALF BORN

Figure 1.2. Effect of Period on Weaning Weight and Average Daily Gain

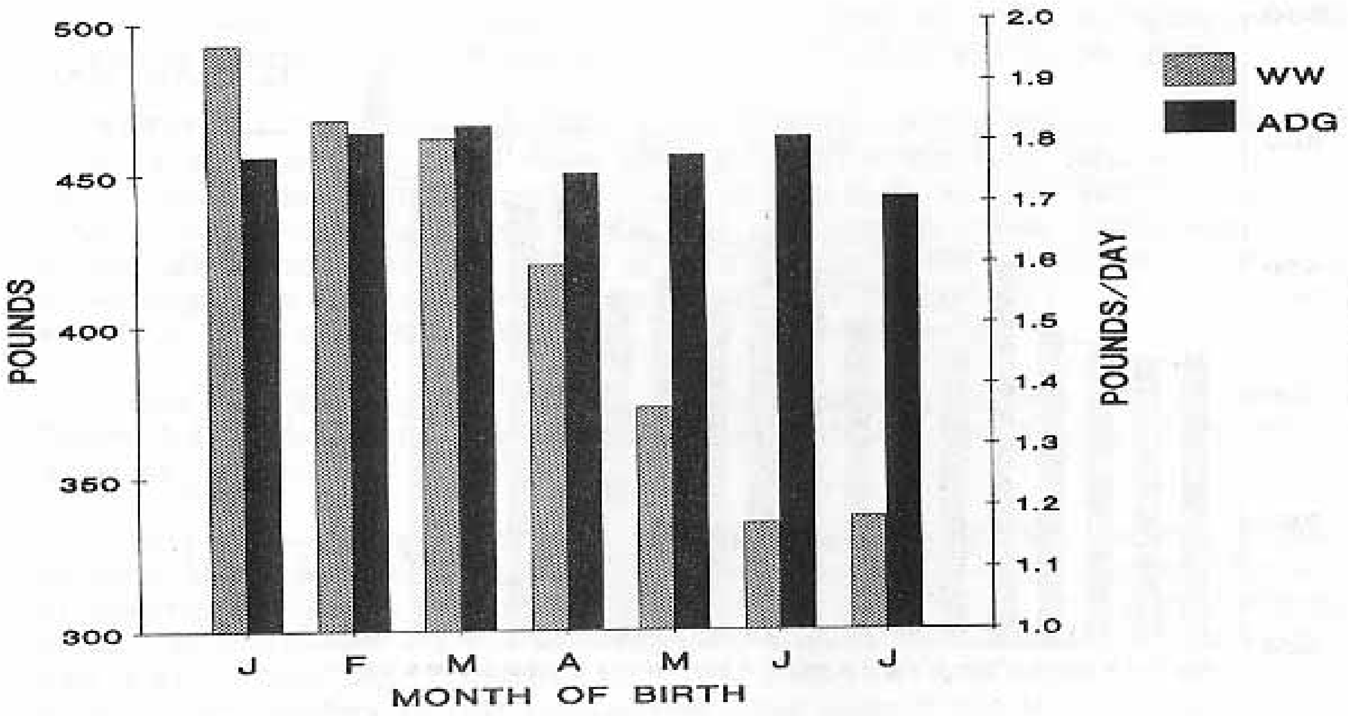


Figure 1.3. Effect of Month of Birth on Weaning Weight and Average Daily Gain

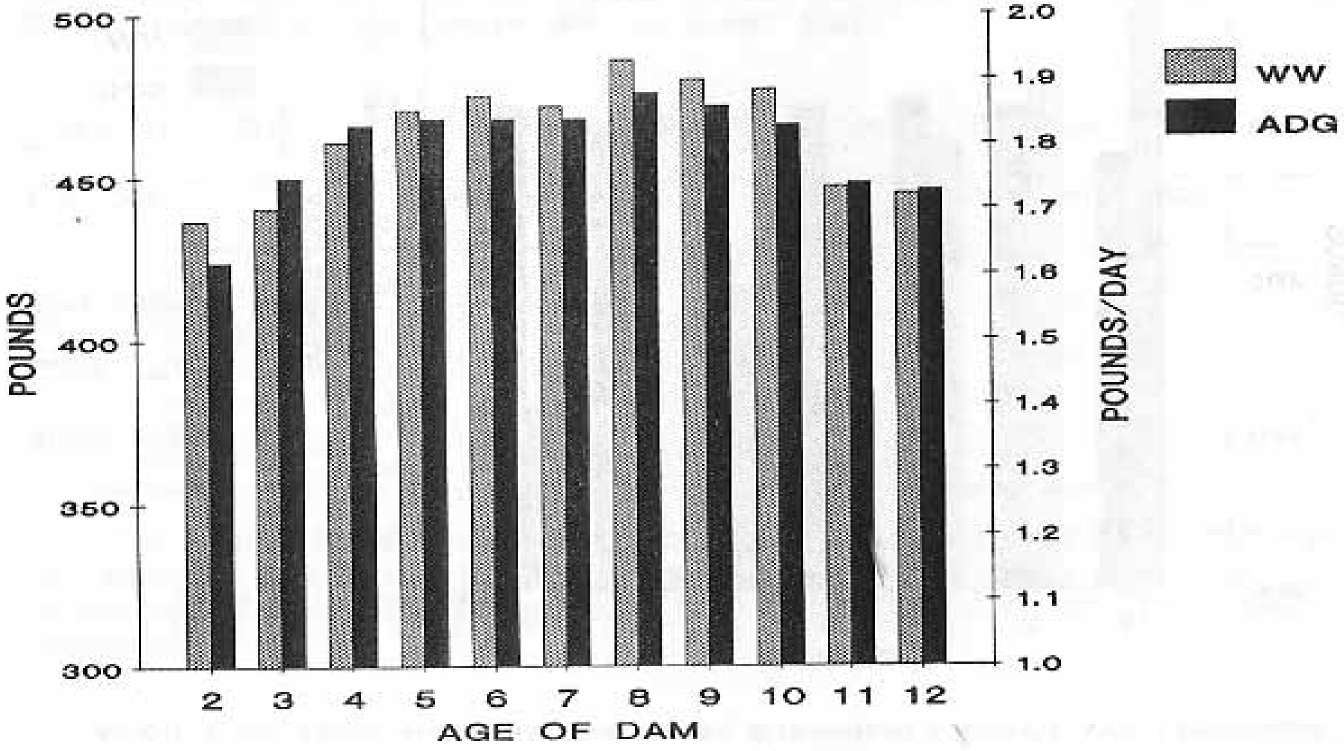


Figure 1.4. Effect of Age of Dam on Weaning Weight and Average Daily Gain

Effect of Hay Quality and Breed on the Onset of Puberty and Subsequent Reproductive Performance in Beef Heifers

R.C. Perry, L.R. Corah,
R.C. Cochran, and J.R. Brethour[1]

Summary

The effect of hay quality on the onset of puberty and subsequent reproductive performance was evaluated in 51 3/4 Hereford x 1/4 Angus (HA) heifers and 47 3/4 Hereford x 1/4 Brahman (HB) heifers. Two qualities of alfalfa hay were fed ad libitum, along with an average of 3.1 lbs/hd/day of ground sorghum grain.

HB heifers were heavier and carrying more backfat and body condition ($P<.05$) at the start of the experiment and they maintained their weight advantage through out the experiment. A higher ($P<.05$) percent of the HB heifers reached puberty by 14 and 15 months of age and became pregnant during a 45 day artificial insemination breeding period. HA heifers reached puberty at a lighter ($P<.05$) average weight.

Heifers fed high quality alfalfa hay were heavier ($P<.05$) by the start of the breeding season and were carrying more ($P<.05$) backfat and body condition. A higher percent ($P=.08$) of the heifers receiving higher quality hay reached puberty by 16 months of age and a higher ($P=.10$) percent became pregnant during the breeding period.

Heifers inseminated at their pubertal estrus had lower ($P=.04$) first service conception rates than heifers inseminated at their second or later estruses (52% vs. 88%).

Introduction

In most areas of the United States, economics dictate that producers must calve their replacement heifers first at 2 years of age. In order for heifers to calve that early, they must reach puberty by 15 months of age.

Because of increased use of larger breeds of beef cattle in crossbreeding systems and because these breeds are later maturing, age at puberty is becoming more important to today's beef cattle producer.

Our objective was to determine the influence of hay quality on growth, onset of puberty, and subsequent reproductive performance in heifers of two breed types.

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[1] Fort Hays Branch Experiment Station.

Experimental Procedures

Animals and Management. Fifty-one 3/4 Hereford X 1/4 Angus (HA) and 47 3/4 Hereford X 1/4 Brahman (HB) were allotted by breed, age, weight, and body condition to four groups within each breed type. Of the 98 heifers, all except 1 HA and 5 HB were sired by one sire. Two randomly selected groups from each breed type received high quality alfalfa hay (HQ) and the other two groups from each breed type received low quality alfalfa hay (LQ). Hay was fed ad libitum, and the heifers had access to trace minerals and salt. All heifers received an average of 3.1 lbs of ground sorghum grain /hd/day. The average nutritional characteristics of the two hays are presented in Table 2.1.

Upon delivery of hay, a core sample was taken from one out of every ten small square bales. Two core samples were taken from each large round bale. Samples from bales within a load were combined prior to analyses.

Heifers were weighed, scored for body condition, ultrasonically scanned for backfat, and measured for hip height at the beginning of the trial and prior to the start of the breeding period. Heifers were scored for body condition by two independent researchers on a scale from 1 to 9 (1 = emaciated, 9 = obese). Heifers were weighed at 28-day intervals, and a final weight was taken at the end of the trial.

Heifers were maintained in four adjacent drylot pen, with one group from each breed type in each lot. Groups were randomly assigned to lots at the start of the trial and rotated among lots every 28 days.

Puberty and Artificial Insemination. Observations for estrus were made twice daily from day 1 to 134 and three times daily from day 135 to the end of the trial. Vasectomized bulls equipped with chest harnesses filled with colored grease were used to aid in detection of estrus. Bulls were rotated biweekly among groups before day 135 and weekly after day 135.

Heifers had to meet the following criteria to be determined pubertal: (1) seen in standing estrus or marked by a bull; (2) a palpable corpus luteum present and (3) blood serum progesterone exceeding 1 ng/ml. Between day 6 to 12 after the occurrence of a visible estrus or mark, heifers were weighed and rectally palpated, and one 7-ml blood sample was taken. Those heifers showing their first visible estrus after the start of the artificial insemination (AI) period (day 135) were not palpated at this time and, thus, they only had to meet two of the three aforementioned criteria to be determined pubertal.

Heifers were artificially inseminated for 49 days beginning on day 135. Heifers were inseminated approximately 12 h after last seen in standing estrus. All inseminations were performed by one technician using semen from one sire. Conception and pregnancy rates were determined by fetal aging via rectal palpation.

Statistical Analysis. Differences in weights, gains, condition scores, backfat measurements, and weight at puberty were analyzed using general linear models. Differences in percent reaching puberty by certain ages, pregnancy rate, and first service conception rate were analyzed using an appropriate analysis for categorical percentage data.

Results and Discussion

Mean weights, condition scores, backfat measurements, and average daily gains (ADG) are shown in Table 2.2, along with average weight at puberty for the four treatment groups.

At the start of the experiment, HB heifers were heavier, taller, and had greater backfat, and received higher body condition scores ($P<.05$).

When prebreeding measurements were taken on May 1, HB heifers were still heavier and taller ($P<.05$); however, there were no breed differences in body condition or backfat. Hay quality influenced performance, with heifers fed HQ hay heavier and fleshier based on backfat and body condition scores ($P<.05$).

In evaluating the differences in prebreeding ADG, a breed x hay interaction ($P<.05$) was found. HA heifers gained more weight on both hay qualities, however, HB heifers showed more difference in performance between the two hay qualities than HA heifers.

Final weights were taken on June 15. HB heifers and those heifers receiving HQ were heavier at this time ($P<.05$). A hay x breed interaction influenced ($P<.05$) 180 day ADG, with the HB heifers showing higher ADG than the HA heifers on HQ and HA heifers exhibiting higher ADG than the HB heifers on LQ. HA heifers reached puberty at a lighter ($P<.05$) average weight than the HB heifers.

The actual cumulative percent of heifers that reached puberty by 13, 14, 15 and 16 months of age and the percent of the total heifers treated that became pregnant during the 45 day AI breeding period are shown in Table 2.3.

A higher ($P<.05$) percent of the HB heifers were pubertal by 14 and 15 months of age than HA heifers, and a higher ($P=.10$) percent of the HB heifers became pregnant during the 45-day AI breeding period. These differences were mainly due to the HB heifers being heavier at the start of the experiment.

Hay quality influenced reproductive performance, with a higher ($P=.08$) percent of the HQ heifers reaching puberty by 16 months of age and a higher ($P=.10$) percent becoming pregnant during the AI breeding period.

Neither hay quality nor breed influenced first service conception rate (Table 2.4). However, those heifers that reached puberty during the breeding season and, therefore, were inseminated at their first (pubertal) estrus had lower ($P=.04$) first service conception rates than those heifers that reached puberty prior to the breeding season and, therefore, were inseminated at their second or later estrus. This emphasizes the importance of proper heifer development with higher quality forages, so that heifers reach puberty prior to the breeding season\and, therefore, are not bred on their first estrus.

Table 2.1. Nutrient Composition of High and Low Quality Alfalfa Hay.

Hay Quality	Dry matter %	Crude protein %	Acid detergent fiber %	Neutral detergent fiber %	Calcium %	Phosphorus %
Low	91.3	18.3	36.7	53.5	1.31	.25
High	92.4	19.5	33.0	44.2	1.43	.27

Table 2.2. Summary of Initial Weights, Hip Heights, Condition Scores, Backfat Measurements, Average Daily Gains, and Weight at Puberty.

Hay Quality	Low		High	
Breed	HA	HB	HA	HB
No. heifers	26	23	25	22
Initial Weight (lbs)[a]	435	500	436	498
Initial hip height (inches)[a]	41.5	43.7	41.5	43.6
Initial body condition[a]	5.0	5.3	4.9	5.3
Initial backfat (cm)[a]	.20	.24	.23	.25
Prebreeding weight (lbs)[ab]	661	696	678	732
Prebreeding body condition[b]	5.2	5.3	5.5	5.7
Prebreeding backfat (cm)[b]	.38	.39	.50	.50
Prebreeding hip height (inches)[a]	45.4	47.3	45.3	47.5
Prebreeding ADG (lbs/day)[1c]	1.68	1.45	1.80	1.73
Final Weight (lbs)[ab]	724	769	734	803
180 day ADG (lbs/day)[2c]	1.61	1.50	1.66	1.70
Weight at puberty[a]	717	760	741	788

[1] Prebreeding ADG = ADG from the start of the experiment to the first day of AI breeding period (135 days)

[2] 180 day ADG = ADG during the entire experiment.

[a] Significant breed effect (P<.05)

[b] Significant hay effect (P<.05)

[c] Significnat hay x breed interaction (P<.05)

Table 2.3. Cumulative Percent of Heifers Reaching Puberty by 13, 14, 15, and 16 Months of Age and Pregnancy rate[1]

Hay Quality	Breed	Age in Months 13	14	15	16	Pregnancy rate, %
		------------%------------				
LQ	HA	4	12^{a}	35^{a}	50^{a}	35^{cd}
LQ	HB	4	30	57	61	48
HQ	HA	8	12	40	68	48
HQ	HB	14	41	68	77	68

[1] Pregnancy rate = No. of heifers that became pregnant during a 45 day AI breeding period/total No. of heifers treated

[a] Significant breed effect ($P<.05$)

[b] Significant hay effect ($P=.08$)

[c] Significant breed effect ($P=.10$)

[d] Significant hay effect ($P=.10$)

Table 2.4. Differences in Conception Rate between Heifers Bred on Their First vs. Later Estrus[1]

Estrus	Conception rate, %
First	88^{a}
Later	52^{b}

[1] Later estrus = heifers inseminated for the first time on their second, third or fourth estrus.

[ab] Numbers with different superscripts differ ($P=.04$).

Evaluation of MGA[1] and Prostaglandin[5] as an Estrous Synchronization Procedure Under Field Conditions[2]

P. L. Houghton[3], L. R. Corah
and T. B. Goehring[4]

Summary

When fed MGA (0.5 mg.hd/day) for 14 days, followed by a prostaglandin injection 17 days later, a total of 736 out of 1112 heifers at 11 locations expressed signs of estrus within 5 days following the PG injection for a 66.2% response to synchronization. Response rates between locations ranged from 33 to 95% ($P<.05$). In a comparison of prostaglandin forms at 5 locations, using 789 heifers, response to synchronization was similar ($P=.66$) between Lutalyse® (62.7% response) and Bovilene® (59.6% response). First-service conception rate was compared in 411 heifers at two locations and was higher for Lutalyse (68.9%) than Bovilene (59.9%) ($P<.08$). First-service conception rate varied by technician ($P<.05$) and ranged from 48.7 to 83.6%.

Introduction

Estrous synchronization can increase profitability of beef cow herds by increasing the number of females showing heat during a short period early in the breeding season. This makes artificial insemination more practical. The availability

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[1] MGA (melengestrol acetate) is a progestational steroid that is approved for use in feedlot heifers and is marketed by the Upjohn Company. It is not currently approved for synchronization.

[2] Appreciation is expressed to Upjohn, Syntex Animal Health, Inc., Select Sires, Inc. and American Breeders Service for providing funding support of this research, and to the following for providing cattle, facilities, and assistance in data collection; Ron Britt, White City; Craig and Gary Johnson, Dwight; Jim Katopish, Randolph; Hal Kunze, Alma; Rodney Oliphant, Offerle; Dean Perkins, Barnes; Jerry Porter and Everret Benoit, Esbon; Bob Spearow, Olsburg; Ken Stielow, Paradise; Dick Walsh, Collyer, and Vance Uden, Franklin, NE.

[3] Extension Livestock Specialist, Northwest Kansas.

[4] Formerly Extension Livestock Assistant, Kansas State University.

[5] Lutalyse® is a prostaglandin developed and marketed by the Upjohn Company. Bovilene® is a prostaglandin developed and marketed by Syntex Animal Health, Inc.

of semen from bulls of superior genetic potential results in faster growing calves and higher quality replacement females. Other advantages include shorter, earlier breeding and calving seasons and older, heavier calves at weaning.

Melengestrol acetate (MGA), an orally active progestin, is inexpensive (1 to 3 cents/hd/day) and can be mixed and fed with supplemental grain. Recent research has indicated that short-term feeding of MGA followed by a single prostaglandin injection 17 days after MGA withdrawal successfully synchronizes estrus in beef heifers without lowering first-service conception rates below satisfactory levels.

Experimental Procedures

Yearling beef heifers (1112 head) at 11 locations were estrus-synchronized using a combination of MGA and a prostaglandin injection. Beginning 33 days prior to the start of the spring breeding season, heifers were fed 0.5 mg/hd/day of MGA in a ground milo supplement for 14 consecutive days. Seventeen days after the last day of MGA feeding, heifers were injected with prostaglandin (either 2 ml of Bovilene subcutaneously or 5 ml of Lutalyse intramuscularly). Twenty-four hours after the PG injection, heifers were checked for heat at least 3 times daily for the next 4 days and those detected in estrus were artificially inseminated approximately 12 hours later. Then, heifers were exposed to clean-up bulls for the remainder of the breeding season. Pregnancy and first-service conception rates were determined by fetal aging via rectal palpation at approximately 60-75 days following synchronization.

Results and Discussion

Seven hundred thirty-six of the 1112 heifers expressed estrus within 5 days following PG injection for a 66.2% response rate. Response rates ranged from 33 to 95% ($P<.05$) at various locations (Table 3.1). Low response groups (<50% expressing estrus) included 328 heifers at 2 locations and high response groups (>50% expressed estrus) included 784 heifers at 9 locations. These groups averaged 33.5 and 80.0% response to synchronization, respectively ($P<.05$). In the low response herds, there was a high incidence of prepuberal heifers, associated with age, nutrition, and breed.

In a comparison at 5 of the 11 locations (Table 3.2) response of 789 heifers to synchronization was similar ($P=.66$) between Lutalyse (62.7%) and Bovilene (59.6%). In a comparison at 2 locations (411 heifers), first-service conception rates were higher for Lutalyse (68.9%) than for Bovilene (59.9%) ($P<.08$). First-service conception rate varied by technician ($P<.05$) and ranged from 48.7 to 83.6%.

These data suggest that feeding 0.5 mg/hd/day of MGA for 14 days followed by a PG injection 17 days later is effective for synchronizing beef heifers when they are puberal and of proper breeding age.

Table 3.1. Estrus Response to Synchronization Location

Field Location %[2]	Estrus Response %[2]
A	36/ 50 = 72
B	39/117 = 33
C	15/ 22 = 68
D	71/211 = 34
E	89/117 = 76
F	26/ 45 = 58
G	265/330 = 80
H	21/ 22 = 95
I	71/ 81 = 88
J	32/ 36 = 89
K	71/ 81 = 88

[1] Data for this study were collected at locations throughout Kansas and one location in South Central Nebraska.

[2] Percent of treated females in estrus within 5 days following prostaglandin injection.

Table 3.2. Effect of Prostaglandin (PG) Treatment on Reproductive Parameters of Heifers

Treatment	Estrus Response (%)[1]	First Service[2] Conception Rate (%)
Lutalyse	248/395 = 62.8	141/205 = 68.8[a]
Bovilene	235/394 = 59.6	123/206 = 59.7[b]

[ab] Numbers within columns with different superscripts differ (P<.08).

[1] Percent of treated females in estrus within 5 days following prostaglandin injection.

[2] Percent of artificially inseminated heifers that conceived; determined by fetal aging via rectal palpation at 60 to 75 days following synchronization.

The Influence of Stage of Pregnancy on Digestion Characteristics in Beef Cows[1]

Alison Beharka, Bob Cochran,
Dave Harmon, and Tom Avery[2]

Summary

Feed intake during the final trimester of gestation did not appear to vary significantly until 2 weeks before calving, after which it decreased dramatically. Measurements during two periods in the final trimester suggested that passage rate increased and digestibility decreased, as pregnancy proceeded.

Introduction

The variation in voluntary intake by range cows can be attributed, in part, to alterations in the physiological status of the animal. While studies indicate that voluntary intake varies significantly between pregnant and lactating animals, little work has specifically concentrated on changes that occur during pregnancy. Similarly, limited information is available regarding changes in fill and passage rates with stage of pregnancy. These changes must be identified in order to efficiently manage the pregnant cow herd for optimum animal performance.

Experimental Procedure

Four ruminally cannulated Hereford x Angus cows were synchronized and hand mated to the same Angus bull. All cows were bred within a 2-week period. Three months prior to calving, the cows were moved to individual (10' x 10') pens with climate control (average daily temperature 78 F). Alfalfa cubes were offered once daily in the morning at 115% of the previous 3 day's intake. Refused feed was weighed and subsampled for future analysis.

During two periods in the final trimester (June 14-21 and July 3-10;approximately 6 and 3 weeks before average calving day, respectively), cows were further confined (4' x 10') for two 7-day digestion trials. On day 8 after each digestion trial, ruminal fill was determined immediately before feeding by emptying the rumen, then weighing and subsampling the contents. Samples were analyzed for alkaline peroxide lignin in order to describe fill and passage relative to an indigestible portion of the diet. After evacuation, the cows' reticulorumens were filled with water to determine reticuloruminal capacity.

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[1] The authors wish to thank Mr. Gary Ritter, Mr. Wayne Adolph and Mr. Lloyd Manthe for their invaluable assistance in conducting this trial.

[2] Dept. of Surgery and Medicine.

Results and Discussion

Although day-to-day fluctuations in individual animal intakes were observed, average intake appeared to remain relatively constant throughout most of the final trimester of gestation. However, approximately 2 weeks prior to calving, intake decreased dramatically, with the lowest point typically occurring the day before calving (Figure 4.1). Similarly, ruminal dry matter fill, alkaline peroxide lignin fill, and reticuloruminal capacity (Table 4.1) did not differ over the course of the two trials. Although daily observations of these characteristics are not available during the final 2 weeks before calving, it seems likely that both fill and capacity were altered during this period, thus, contributing to the dramatic decline in intake.

Although intake, fill, and capacity appeared to remain constant during the two measurement periods, dry matter digestibility decreased ($P<.05$) and rate of passage increased ($P<.05$). Because rate of passage and digestibility are competing forces, the decline in digestibility seems to be explained by the increased passage rate. It appears that the cows were able to partially address their increasing nutrient requirements during late pregnancy by increasing overall throughput of digesta. However, as their fetuses continued to grow and change position in preparation for parturition, ability to compensate appeared to be exceeded, thus, prompting the subsequent decline in intake.

Table 4.1. Influence of Stage of Pregnancy on Dry Matter Intake, Digestibility, Fill, Passage, and Capacity

	weeks before calving		
Item	T1	T2	SE[a]
Dry matter intake (lb/day)	23.1	22.1	1.80
Dry matter digestibility (%)b	50.4	42.0	.97
Rumen dry matter fill (lbs)	17.3	16.4	.84
Alkaline peroxide lignin fill (lbs)	2.3	2.0	.16
Alkaline peroxide lignin passage (%/hr)[b]	2.9	3.8	.32
Reticulo-ruminal capacity (liters)	120.7	125.0	.64

[a] SE= standard error, (n=4).

[b] Row means with different superscripts differ ($P<.05$).

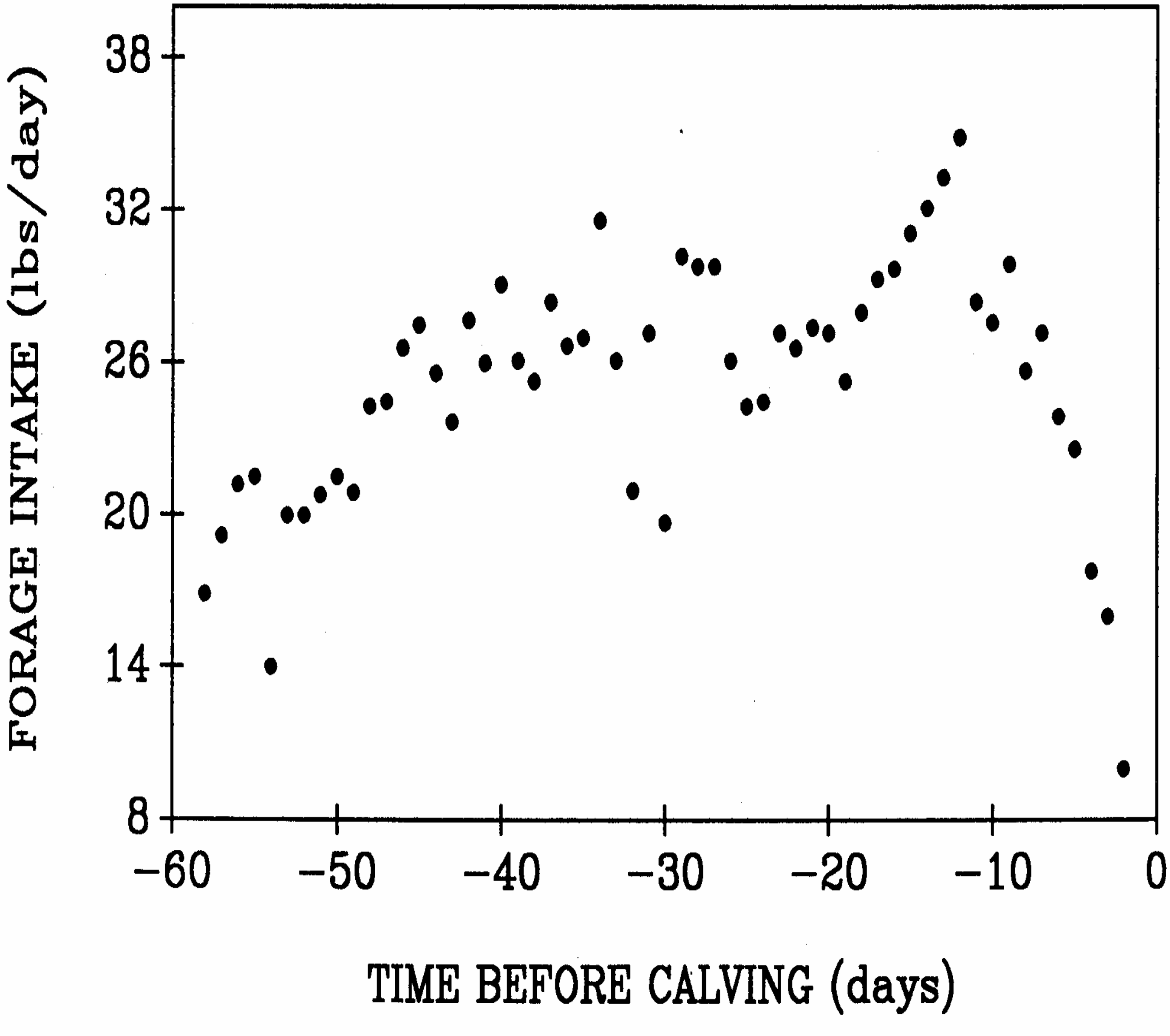

Figure 4.1. Influence of Stage of Pregnancy on Forage Dry Matter Intake

Comparison of Feedlot Performance of Steer Calves Produced by Angus X Hereford and Brahman X Hereford Cows

John R. Brethour[1], Dave Patterson,
Ken Olson, and Larry Corah

Summary

Steer calves that were 75 percent Hereford and either 25 percent Angus (BWF) or Brahman (BRX) were compared in a feedlot study that involved either high-concentrate or high-silage finishing rations. The BRX steers gained significantly faster, but there was no concomitant response in feed efficiency. The ration energy utilization by BRX steers appeared to be less than that of BWF steers. Performance of both breeds was poorer on the high-silage ration than on the high-grain ration, and there was no breed by ration interaction. A greater proportion of BWF calves graded USDA choice, but there was little difference between breeds in average cutability grade. Rates of backfat increase were determined with ultrasound scanning and were higher when the high-grain rations were fed. No significant breed effect on fattening rate was detected. Ultrasound was effective in identifying cattle that could be fed for an additional 28 days. During that period, catttle retained for additional feeding gained an equivalent 3.89 pounds per day when gains were adjusted to a constant dressing percentage.

Introduction

At the Fort Hays Branch Experiment Station, a study is being conducted to evaluate the F1 Brahman crossbred cow for use in Kansas cowherds. This phase of the study considers the feedlot performance of the steer progeny. We conducted a feedlot trial to measure traditional performance characteristics, such as gain, feed intake, and efficiency, and carcass quality. This experiment was designed to determine if Brahman-cross steers performed better than traditional cross-bred steers on a less concentrated feedlot ration. Backfat was measured with ultrasound periodically throughout the trial to track changes in carcass composition.

Experimental Procedures

The study was conducted with 116 yearling steers born in the spring of 1986 to a cowherd that consisted of either Angus X Hereford or Brahman X Hereford F1 dams. That herd had been created by combining heifers from several locations in order to make each group representative of its breed. Cows had been mated to Hereford bulls that were related to each other, and the steers used in this test were 75 percent Hereford. The calves had been weaned in the fall of 1986 and wintered together until the feeding trial began on May 13, 1987. Calves from each breed group were assigned to either a high-grain or a high-silage finishing ration.

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[1] Fort Hays Branch Experiment Station.

The rations were comprised primarily of rolled milo and sorghum silage. The high-silage ration included 46 percent silage (dry matter basis), whereas the high-grain ration contained only 13 percent silage. Each breed X ration treatment was replicated in two pens. Because of later puberty and lower conception rates among the Brahman cows, there were 65 Angus X Hereford (BWF), but only 49 Brahman X Hereford (BRX) steers available for this test.

After 121 days on feed (September 10), the fattest steers in each pen were identified with ultrasound scanning and slaughtered. The others were fed for an additional 28 days and slaughtered on October 8.

At the start of the test, mean weight of the BRX calves was 12 pounds heavier than that of the BWF calves, despite the fact the the BRX calves averaged 21 days younger. Mean birth dates were March 7 and March 28 for the BWF and BRX calves, respectively. Where appropriate, covariance analysis was used to correct the data to a constant animal age.

Results and Discussion

The BRX steers gained 6 percent faster ($P<0.05$) than the BWF steers during the feeding trial (Table 5.1). Cattle fed the high-grain rations gained faster than those fed the high-silage rations and there was a tendency for the BRX steers to respond more to the high-grain ration. That contradicts previous results of pilot trials, in which Brahman F1 cattle performed better on higher levels of roughage. However, those pilot studies were conducted in cold weather, and there could be an environmental effect on performance of Brahmans fed different amounts of roughage.

Although average gains of the BRX steers were greater than those of BWF steers, their feed intake was also substantially higher, so there was no improvement in feed conversion ratios. In addition to calculating feed conversion from gain and intake measures, a detailed analysis of energy utilization was conducted by calculating individual animal net energy gain and reconciling that estimate with calculated net energy provided by the ration. Those calculations suggested that ration energy utilization by the BRX steers was less efficient. Feed utilization ratios were 5 percent less for BRX than for BWF steers. That reduction in energy utilization by BRX steers was especially apparent when the high-silage ration was fed. The poorer utilization of the high-silage ration by BRX cattle might have resulted from greater feed intake, since ration digestibility decreases when consumption is excessive.

More BWF steers than BRX steers graded choice. Carcass quality grade of cattle that contain Brahman heredity also has been poor in other experiments. Even though the steers were only 25 percent Brahman, the proportion graded USDA Choice was 40 percent compared to 66 percent for the BWF steers. A similar reduction in quality grade occurred when the high-silage ration replaced the high-grain ration.

On the other hand, breed effect on cutability grade was small. When the two energy levels were combined, the BWF steers were slightly fatter and 58 percent of their carcasses were yield grade 3 compared to 48 percent among the BRX carcasses. When crosses were combined, feeding a high-silage ration increased the proportion of yield grade 2 carcasses to 62 percent.

Using ultrasound technology, we were able to monitor backfat thickness on each individual animal during the course of the trial. Our other research has indicated that the accumulation of backfat best fits an exponential equation:

$$Y=Ae^{kt}$$

where Y is backfat thickness predicted at a future date, A is the backfat thickness at time of measurement, t represents the number of days after measurement e=2.7148, and k is an estimated rate coefficient. A higher rate coefficient indicates a faster fattening rate, and dividing .693 by the rate coefficient gives the number of days to double backfat thickness. Calculating a rate coefficient is a convenient way to reduce many measurements on a large number of animals to a single value for comparing treatments. The values shown in Table 5.1 were obtained on only the leaner cattle fed for the full 148 days, because there were not enough ultrasound measurements for calculations from the set slaughtered earlier. Those values indicate that cattle fed high-grain rations fattened at a faster rate, ($P<0.05$) but that there was only a small effect of steer breed on fattening rate.

Measuring backfat with ultrasound was completely successful in identifying steers that could be fed an additional 28 days without any cattle becoming too fat. Regression analysis was used to estimate dressing percentage of retained animals at the time when the first group was slaughtered. Carcass gain of retained animals was estimated as 2.47 pounds per day, equivalent to 3.89 pounds per day live gain at a constant 63.5 dressing percent. That indicates fast and efficient gains can be made by cattle that have been in the feedlot a considerable length of time, if their fattening rate is still low.

These results indicate that summer feedlot gains of BRX steers were higher than those of their BWF cohorts. However, metabolic efficiency of BRX tended to be lower. There was no advantage to feeding a ration with lower caloric density to either BRX or BWF steers. The BRX calves were less likely to deposit intramuscular fat and grade USDA Choice. Fattening rate of BRX steers was numerically, but not significantly, less than that of BWF steers.

Table 5.1. Comparison of feedlot Performance of Steer Calves Produced by Angus X Hereford and Brahman X Hereford Cows. May 13 to October 7, 1987, 148 days

Item	Angus X Hereford (BWF)		Brahman X Hereford (BRX)	
	High-grain	High-silage	High-grain	High-silage
Number of head	33	32	25	24
Average initial wt	727.6	710.2	730.6	732.1
Average final wt	1193.1	1134.1	1233.5	1165.3
Average gain	465.5	423.9	502.9	433.2
Average daily gain	3.44	3.13	3.73	3.22
Average feed intake (DM)	22.33	24.00	23.31	24.89
lb DM/ 100 lb gain	649.8	765.9	624.7	772.5
Ratio of observed to predicted net energy gain	1.02	1.02	0.98	0.96
Carcass data:				
Percent USDA Choice	76%	56%	56%	25%
Percent USDA Select	24%	44%	44%	75%
Percent yield grade #2	27%	56%	36%	67%
Percent yield grade #3	73%	44%	64%	33%
Rate coefficient for increase in backfat (see MS)	.0096	.0083	.0099	.0088

Horn Fly and Face Fly Control with the Dustacator® Combination Mineral Feeder and Livestock Dusting Device[1,2]

Donald E. Mock[3] and Robert R. Schalles

Summary

Dustacators (combination mineral feeders and livestock dusting devices) were used for four beef herds at Kansas State University in 1985. Loose mineral was supplied in all four Dustacator tubs, which were adjusted to low settings. Permethrin dust had no apparent effect on horn flies. Co-Ral® from two sources and Rabon® provided approximately 65% horn fly reduction during the 53-day test period.

The 1986 experiment compared the effects of Dustacator mineral tub height adjustments and loose vs. block mineral. Co-Ral 1% dust from a single source was used in all treatments on two Simmental herds and two Polled Hereford herds. Excellent horn fly control was achieved and maintained except for a temporary increase in horn fly numbers in early September in all treatments. Face fly control was inadequate in all treatments in both years. Use of block mineral was related to reduced mineral consumption and self-application of more insecticide dust. High tub adjustment was related to greater mineral consumption but reduced self-application of insecticide. The degree of fly control was not correlated with amount of insecticide used either on a per-cow or per-herd basis. Simmentals consumed nearly twice as much mineral per head as Polled Herefords, but they used only 20% more insecticide.

Including the cost of 1% Co-Ral dust and equipment costs amortized over 5 years, Dustacators provided acceptable horn fly control and some reduction of face fly numbers for $1.62 per cow/calf pair, plus labor.

Introduction

The Dustacator Combination Mineral Feeder and Dusting Device has been in use since 1974 and has become popular among ranchers in several states. A Dustacator consists of a base, a vertical pedestal inserted upward through the center of a large rubber tub and metal tub support, and a cage to hold mineral blocks near the top of the pedestal. A circular dust bag skirts the circumference of the block cage, and the whole structure is topped with a galvanized metal rain cover. Dustacators thus force use of a self-dusting device without erecting fences around water sources or mineral stations. They are readily transportable between pastures or to different sites within a pasture and are sturdy but easily dismantled with simple tools.

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[1] Appreciation is expressed to Fred Mann of Mann Enterprises, Inc., for supplying the Dustacators and insecticides used in this study.

[2] Appreciation is expressed to A.B. Broce, Dept. of Entomology, for help in the initial phase of this study.

[3] Extension Specialist, Livestock Entomology, Department of Entomology.

This study was begun in 1985 to compare the effectiveness of various insecticidal dusts used in Dustacators. In 1986, the study was modified to determine the effects, of variables made possible by the Dustacator design, i.e., the use of loose vs. block mineral and low vs. high tub adjustment. The two hypotheses tested were 1) cattle will get more dust on themselves, especially their faces, by accessing mineral blocks in the upper cage as compared to loose mineral in the tub and 2) when using loose mineral, the cattle receive more insecticide dust if the mineral tub is higher (closer to the dust bag).

Experimental Procedures

In 1985, a Dustacator was placed in each of four Kansas State University pastures having one corner in common. Each Dustacator was placed approximately one-half mile from this common corner and well away from water sources. There were between 30 and 35 cow/calf pairs and a bull in each pasture. A herd of 32 yearling heifers in a nearby pasture served as an untreated control herd.

Insecticides (Table 6.1.) were placed in the Dustacators on June 24, 1985. Loose mineral mix was placed in tubs at their lowest position. Fly numbers on cows were estimated at weekly intervals until August 16, when the study was terminated.

Table 6.1. Insecticide Dusts Used in Dustacators®, 1985.

Insecticide	Trade Name	Brand	Conc
permethrin	Permectrin	Anchor	0.25%
tetrachlorvinphos	Rabon	Co-op (Farmland)	3.0 %
coumaphos	Co-Ral	Kaw Valley, Inc.	1.0 %
coumaphos	Co-Ral	Dr. Scratch Products	1.0 %

In 1986, the same pastures and Dustacator locations were used. Table 6.2 provides a description of the test herds and the treatments imposed on them. Upward height adjustment of the tubs was limited by the need to provide space for cows' heads between the tub and the block cage above it.

The cattle were placed in their pastures on May 22, 1986. The Dustacators were set up the following day, and all were charged with Moorman's Co-Ral 1% Dust. No untreated herd was available to use in this trial, but horn fly counts on an untreated herd a few miles away provided an estimate of horn fly numbers in the vicinity during September.

Mineral was not placed in the Dustacators until May 30. The block mineral (SE pasture) was initially placed in the lower tub until cattle became accustomed to its location; on June 18, it was placed in the upper cage for the remainder of the season. Mineral and insecticide were weighed into the Dustacators and amounts remaining at the end of fly season were weighed and subtracted to obtain actual quantities used. Fly counts were made weekly, except when rainy weather prevented access to the cattle.

Results and Discussion

Horn flies, 1985. Horn fly numbers were lower at the study site than in most years, with a maximum of only 210 per side, in mid-August, on the untreated herd. Permectrin (0.25% permethrin) dust gave no control and was dropped from the trial after 37 days. Rabon (3% tetrachlorvinphos) dust and the two brands of Co-Ral (1% coumaphos) were equally effective, all providing about 65% reduction in horn fly numbers.

Face flies, 1985. Early in the season, it appeared that the Co-Ral formulations were providing better face fly control than either Permectrin or Rabon. However, when face flies became more abundant after mid-July, Co-Ral appeared to have little or no effect. Under our conditions, none of the insecticidal dusts provided adequate control of face flies. By August 9, up to 30 face flies were noted on some calves. Eye problems typical of pinkeye were becoming numerous. The test was terminated so that effective face fly control could be instituted.

Horn flies, 1986. Pretreatment horn fly counts on May 19 averaged 54 per cow side. On May 30, when mineral was placed in the Dustacators, there was a mean of 56 per cow side. Excellent horn fly control was achieved on all four herds within 2 weeks (treatment groups averaged 11 or less per side). Good control was maintained for 8 weeks. Horn fly numbers began increasing in mid-August and reached an experiment-wide average of 79 per cow side on September 4. Numbers declined to 33 per cow side on September 21, ranging from 28 to 41 among treatments. On September 28, there were 183 horn flies per side in the block-in-cage treatment, whereas numbers remained steady or declined in the other treatments (Figure 6.1).

No untreated cattle were monitored regularly, but on September 4 and 21, when horn fly numbers were relatively high on our test herds, there were about twice as many horn flies per animal on an untreated herd 8 miles away. From a number of years of observation in these same pastures and in others nearby, we believe that these treatments provided greater than 75% season-long reduction in horn fly numbers.

Face flies, 1986. The first face fly on cattle in this trial was observed on June 12. Numbers did not reach one per cow face until mid-July. The highest populations occurred from August 20 to September 4, after which they declined sharply. The herd with the block-in-cage treatment had six face flies per face on July 21 -- 4 weeks earlier than the next herd to reach that level of infestation. Several cases of pinkeye were treated in each pasture during early September.

Simmentals consumed more mineral than Polled Herefords. Cattle using the low Dustacator tub received more insecticide dust and better horn fly control than those using the high tub, even though they consumed less mineral. Less mineral was consumed from blocks than from the loose form, but cattle received more insecticide dust (Table 6.2).

The hypothesis that cattle receive more insecticide dust from a Dustacator when block mineral is used in the upper cage was supported by this limited test.

However, the same test failed to substantiate that this procedure results in better control of horn flies and face flies.

Overall, 146 adult cattle consumed 1,448 lbs of mineral (9.9 lbs per animal) during the grazing period. They also utilized 150 lbs of 1% coumaphos (Co-Ral) dust (1.03 lbs per animal). The insecticide cost 50.7 cents per lb, or 52.2 cents per cow. Amortizing the cost of the four Dustacators over a 5-year period, the equipment cost was about $160 for the 146 cattle, or $1.10 each. The total cost of acceptable horn fly control and some reduction of face fly numbers was $1.62 per cow, plus labor.

The Dustacator also has been tested by university entomologists in Virginia and Nebraska, using insecticidal dusts known to be effective against horn flies. In 1982, 1983, and 1984 horn fly control with Dustacators in Virginia varied from poor to excellent; face fly control ranged from very poor to good. In Nebraska, 1984, with 1% Co-Ral Dust and both loose mineral in the tub and salt blocks in the cage, control of both species was termed "excellent."

In 1987, two herds of cattle were observed in Jewell County, Kansas, under treatment with 1% Co-Ral in Dustacators. Horn fly control was excellent on a herd of 120 2-year-old Angus cows with calves. Face fly control was poor in both herds.

Table 6.2. Season-long Average Numbers of Horn Flies per Side, Face Flies per Face and Usage of Mineral and Insecticide Dust (1986)

	Pasture			
Item	NE	SE	NW	SW
Breed	P. Hereford	P. Hereford	Simmental	Simmental
No. of Cows & Yearlings	40	40	32	30
No. of Calves	27	23	18	18
Mineral form	loose	block	loose	loose
Min. placement	tub	top cage	tub	tub
Min. tub height	high	---	high	low
No. horn flies	25.60	29.18	24.63	19.81
No. face flies	1.33 ± 0.23	1.81 ± 0.22	0.67 ± 0.22	1.30 ± 0.21
Lbs. mineral/cow	8.64	5.82	16.80	11.05
Lbs. dust/cow	0.86	1.09	0.92	1.43

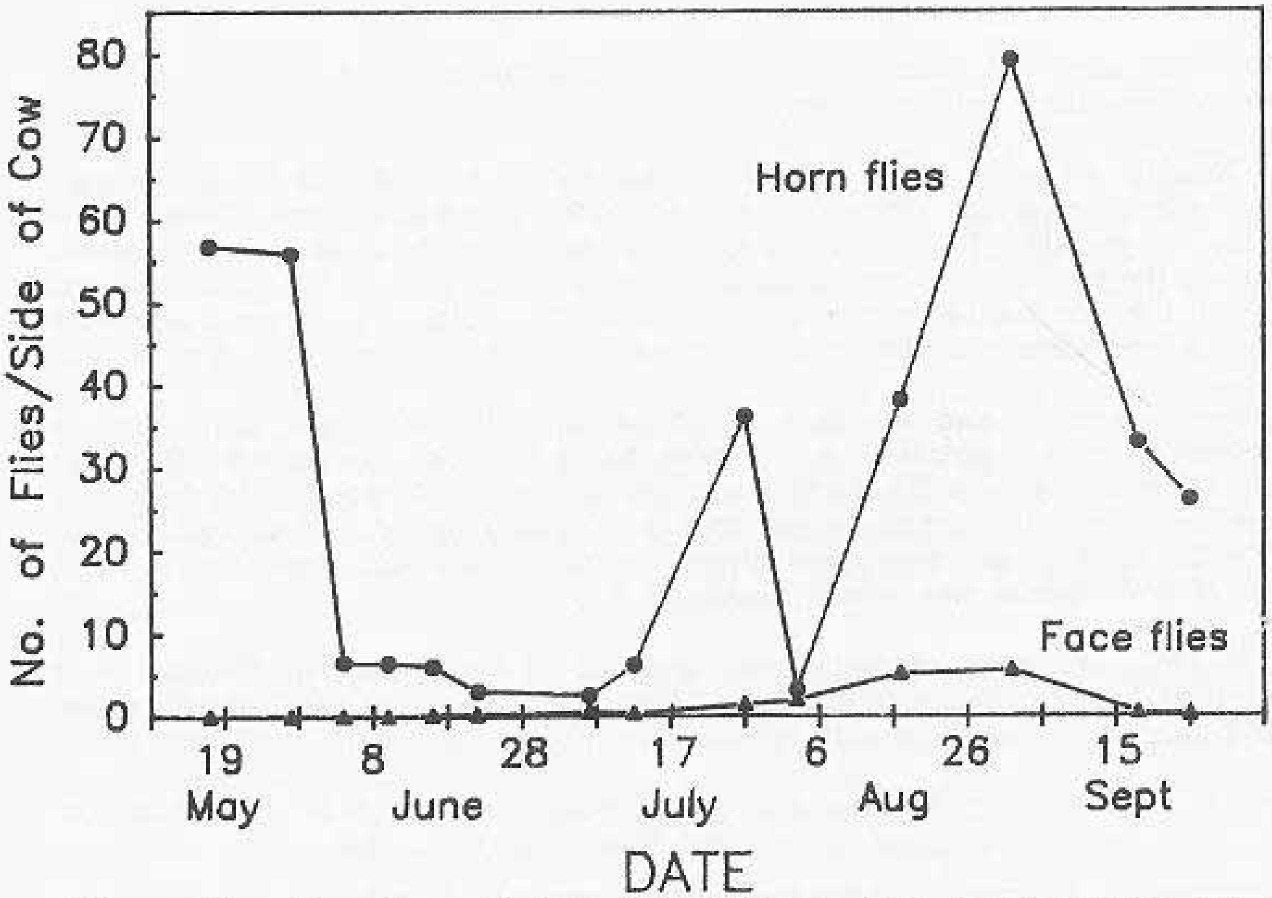
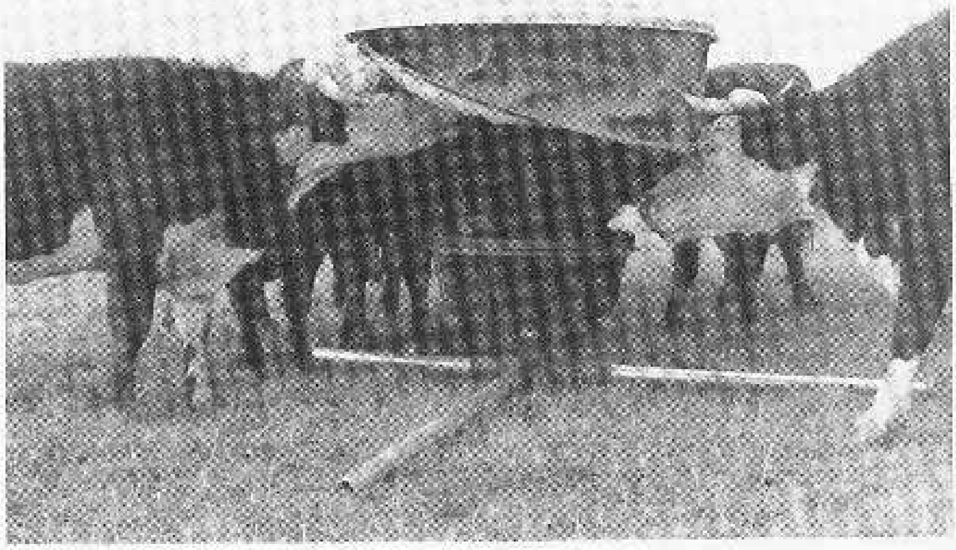


Figure 6.1. Horn Fly and Face Fly Incidence When Loose Mineral was Fed in Dusticators



As cattle consume mineral supplement from the feeder, insecticide from the dust bag is applied.

Influence of Supplemental Protein Concentration on the Performance of Beef Cows Grazing Dormant Bluestem Range[1]

Tim DelCurto, Bob Cochran, and Larry Corah

Summary

Three milo/soybean meal mixtures representing three supplemental crude protein concentrations (13, 26, and 39%) were evaluated in terms of pregnant beef cow performance. Cow weight and body condition changes responded in a linear fashion to increasing protein. Cattle fed the high protein (39% Crude Protein) supplement lost the least weight and body condition, whereas cattle supplemented with the low protein treatment lost the most. Although there was little difference between treatment groups in terms of reproductive efficiency and subsequent calf performance, moderate (26% Crude Protein) and high protein supplements appear to offer the most benefit in maintaining cow weight and body condition during the critical winter months up to calving.

Introduction

Narrow profit margins for cow-calf producers necessitate optimizing both animal performance and utilization of native forage. Digestion and metabolism studies from Kansas State University have shown that protein supplements offer the most potential in terms of increasing dry matter intake of the native range forage. In contrast, energy or grain-based supplements have been shown to exert a negative influence on utilization of dormant bluestem range. Our objective was to find the protein concentration in winter supplements that optimizes cow performance, thus, making the best utilization of the native range resource.

Experimental Procedures

Ninety-nine Angus X Hereford cows were randomly assigned to one of three treatments: 1) low protein supplement, 13% crude protein (CP); 2) moderate protein, 26% CP; 3) high protein, 39% CP. Supplements, consisting of various levels of soybean meal and milo, were fed daily at .5% of body weight (5 lbs/hd/day). Because soybean meal and milo are nearly identical in energy content, supplemental energy was similar for all three treatments.

The trial began on Nov. 15, 1986, and the supplements were fed until the cows calved (average calving date: Mar. 8, 1987). After calving, all cows received 10 pounds of supplemental alfalfa per day until spring pastures became adequate. Cow weights and body condition scores were taken every 28 days and within 48 hours after calving.

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[1] Appreciation is expressed to Gary Ritter, Wayne Adolph, and Tami DelCurto for their expert assistance during data collection.

Subsequent measurements were taken just prior to breeding (May 8) and on August 8. Before each weigh day, cows were gathered in the late afternoon, each fed 10 pounds of prairie hay and then withheld from additional feed or water overnight.

Results and Discussion

Cows supplemented with moderate or high protein gained weight with only a slight decline of body condition up to day 84 (Table 7.1). In contrast, cows fed low protein, or predominantly milo supplement, lost weight as well as a large degree of body condition during the first 84 days. Between day 84 and calving (approximately 30 days), cows responded in a linear fashion to supplemental treatments. All cows lost weight during this period, with weight loss greatest in the low protein group, intermediate in the moderate group and lowest in the high protein group. Calf birth weights increased in a linear fashion with increasing protein supplements.

Previous research at Kansas State University has shown that utilization of dormant bluestem range forage is optimized by using moderate to high levels of CP. The results from our trial support those findings in terms of cow weight and body condition changes. No differences were detected in cow reproductive efficiency or subsequent calf performance. However, winter weather conditions during this trial were relatively mild. Under more severe environmental conditions, reproductive efficiency might be depressed with low protein supplements.

Table 7.1. Influence of Supplemental Protein Concentration on Performance of Cows Grazing Dormant Bluestem Range Forage

Item		Low Protein	Moderate Protein	High Protein	SE[a]
Initial:	weight, lbs	1000	1005	999	16.8
	C-score[b]	5.64	5.67	5.69	.12
Day 84:	weight gain[cd]	-24.4	25.6	37.5	4.37
	C-score change[c]	-.74	-.40	-.20	.08
at calving:	weight gain[c]	-192.2	-123.7	97.1	8.98
	C-score change[c]	-1.84	-1.45	-.75	.11
at breeding:	weight gain[c]	-179.7	-156.9	-122.7	8.81
	C-score change[c]	-1.10	-.90	-.40	.09
Day 260:	weight gain[c]	8.3	21.0	43.8	9.55
	C-score change[c]	.32	.53	.69	.09
calf birth weight[c]		76.9	78.2	81.8	1.99
calf average daily gain (lb)		2.07	2.09	2.05	.05

[a] SE = Standard Error (n = 33 through day 84).

[b] condition score: 1 = extremely thin, 9 = extremely fat.

[c] linear response to increasing protein level ($P<.05$).

[d] quadratic response to increasing protein level ($P<.05$).

Morning Versus Evening Supplementation for Heifers Grazing Winter Range[1]

Eric Vanzant, Bob Cochran,
Larry Corah, and Keith Zoellner

Summary

Supplementing developing heifers in the morning was compared with supplementation at sundown. No difference was evident among treatments in average daily gain, distance traveled, or time spent grazing.

Introduction

Previous research from Montana reported increased average daily gain in steers when time of supplementation was shifted from morning to a time when grazing was normally minimal (in their situation, mid-afternoon). Steers in the Montana study were grazing good quality Russian Wildrye grass in the early autumn, were supplemented with cracked corn, and showed the greatest amount of grazing activity in the early morning and late afternoon/early evening. Grazing activity in the winter would be expected to be more uniformly distributed throughout the day, with reduced activity in the evening. Previous research from Montana also suggested that altering supplementation patterns was more likely to affect forage utilization when feeding energy supplements than when feeding protein supplements. Therefore, this study was designed to evaluate the effect of altering the time at which a moderate crude protein (CP) supplement was offered to heifers grazing winter, bluestem range.

Experimental Procedures

Forty-four crossbred heifers of primarily Angus x Hereford breeding (average weight = 476 lbs) were randomly assigned to four bluestem pastures. Pasture groups were then randomly assigned to receive one of two treatments: 1) AM supplementation -- supplement fed daily at approximately 8:30 AM and 2) PM supplementation-- supplement fed daily at sundown. Heifers were rotated among pastures every 14 days. Supplement offered was a soybean meal/milo mix formulated to contain approximately 20% crude protein. Six pounds of supplement per head was offered on a daily basis. Heifers were weighed and condition scored after an overnight shrink at trial initiation (November 17, 1987) and termination (March 3, 1987). Condition score was determined by palpation over the ribs and withers and represented rankings from four independent observers (1 = extremely thin to 9 = extremely fat). Six heifers were randomly chosen within each of the four pasture groups for measurement of grazing behavior. Heifers were fitted with pedometers and vibracorders for measuring daily distance traveled and daily grazing time, respectively. Grazing behavior measurements were recorded from February 17 through March 3, 1987.

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[1] Appreciation is expressed to Mr. Gary Ritter and Mr. Wayne Adolph for their expert assistance during the data collection.

Results and Discussion

Altering time of supplementation appeared to have little effect on performance or grazing behavior (Table 8.1). Grazing time averaged 9.4 hours per day, and heifers traveled an average distance of 2.4 miles per day. Lack of response to varying the time of supplementation may be due to the level of CP in the supplement. Research indicated that, unlike "protein" supplements, varying the frequency with which an "energy" supplement was fed exerted a significant impact on winter forage utilization. Our 20% CP supplement may have acted more as a protein supplement than an energy supplement. Thus, the potential for disrupting normal forage utilization may have been minimized.

Daily gain averaged .53 lb/day, whereas condition score, a measure of body fatness, declined by .34 units. The observed increase in weight with concurrent decrease in body fatness is probably explained by priority for skeletal and muscle development, rather than fattening, under such a restrictive nutritional environment.

Table 8.1. Influence of Time of Supplementation on Grazing Behavior, Weight Gain, and Change in Body Condition of Heifers

	Time of Supplementation	
Item	AM	PM
Grazing Time (hours/day)	9.2	9.5
Distance Traveled (miles/day)	2.3	2.5
Average Daily Gain (lb/day)	.5	.5
Condition Score Change[a]	-.35	-.32

[a] Condition Score, 1=extremely thin, 9=extremely fat.

Influence of Supplemental Protein Versus Energy Level on Intake, Fill, Passage, Digestibility, and Fermentation Characteristics of Beef Steers Consuming Dormant Bluestem Range Forage

Tim DelCurto, Bob Cochran, Tom Avery,[1]
and Alison Beharka

Summary

Two trials were conducted to evaluate effects of protein versus energy level in milo/soybean meal supplements on intake and utilization of dormant, bluestem forage. Forage dry matter intake and utilization of dormant bluestem forage appears to increase at higher levels of supplemental protein. Increased supplemental energy may be associated with depressed intake and utilization, particularly when supplements are low in protein.

Introduction

Previous research at Kansas State University suggests that winter supplementation with moderate to high crude protein (CP) supplements is preferable because of their ability to stimulate forage intake and utilization. Supplements low in CP (e.g., cereal grains) tended to promote lower levels of forage intake and significantly depressed fiber digestibility. However, low CP supplements are frequently much cheaper. The question exists whether feeding increased quantities of low CP supplements (i.e., increasing the level of energy offered) would sufficiently offset some of their negative impacts on forage utilization. Therefore, our study was designed to evaluate how varying the levels of protein and energy in winter supplements would affect the intake and utilization of dormant, bluestem range.

Experimental Procedures

In two trials, 16 ruminally cannulated steers were randomly assigned within weight group (avg. = 732 and 884 lb. for trials 1 and 2, respectively) to each of four treatments. Treatments consisted of supplementing steers with soybean meal (SBM)/milo mixtures that were combinations of various protein and energy levels (Figure 9.1). Crude protein (CP) concentrations in supplements and the level at which they were fed were: 1) 22% CP fed at .3% of body weight (SW); 2) 11% CP fed at .6% BW; 3) 44% CP fed at .3% BW; and 4) 22% CP fed at .6% BW. Protein concentration was altered by varying the quantities of SBM and milo. Because SBM and milo are nearly equivalent in energy value, level of supplemental energy provided was varied by feeding different quantities of supplement. Dormant prairie hay was provided at 130% of the previous 5-day average intake.

Trial 1 was a 28-day digestion study with 14-day adaptation, 7-day intake, and 7-day fecal collection periods.

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[1] Department of Surgery and Medicine.

		Metabolizable Energy (ME) Level in Supplements	
		LOW	HIGH
Crude Protein (CP) Level in Supplements	LOW	.3 g CP/lb BW 4.2 Kcal ME/lb BW	.3g CP/lb BW 8.4 Kcal ME/lb BW
	HIGH	.6 g CP/lb BW 4.2 Kcal ME/lb BW	.6 g CP/lb BW 8.4 Kcal ME/lb BW

Figure 9.1. Treatment Arrangement

Rumen fill values were obtained by complete ruminal evacuations, and subsamples of solid digesta were collected. The alkaline peroxide lignin component of the subsamples was used to describe fill and passage of an indigestible component of the diet. On day 28, CoEDTA was given intraruminally, and rumen samples collected at 0, 3, 6, 9, 12, and 24 hours after feeding to measure liquid volume and passage.

Trial 2 was a 26-day study consisting of 18-day adaption, 5-day intake, and 2-day ruminal sampling periods. Procedures were similar to those of trial 1, except fecal collections were not made. On day 26, CoEDTA was given intraruminally, and rumen samples were taken at 0, 3, 6, 9, 12 and 24 hours after feeding to measure liquid volume, and passage.

Results and Discussion

In trial 1, influence of protein level on forage dry matter intake (DMI) depended on the corresponding energy level (Table 9.1). Increased supplemental energy at the low protein level depressed forage DMI. Influence of protein level on total diet dry matter digestibility (DMD) was also dependent on the corresponding energy level. Increased supplemental energy at the low protein level had a positive influence on total diet DMD. Increased DMD in this case may be explained by the reduction in forage DMI and the increased consumption of the highly digestible supplement. However, forage fiber digestibility (e.g., acid detergent fiber) was increased only by increasing supplemental protein levels. Increased supplemental energy at the low level of protein depressed forage fiber digestibility. In trial 2, forage DMI increased in response to high supplemental protein levels but tended to decrease with increased energy levels (Table 9.2). Liquid volume and flow increased with higher protein levels.

Results from both trials indicated providing supplemental protein to cattle grazing dormant winter rangelands increases forage intake. Increasing the level of supplemental energy at low levels of crude protein appears to decrease intake and forage digestibility. At higher levels of supplemental protein, this effect is not as dramatic.

Table 9.1. Influence of Supplemental Protein versus Energy Level on the Intake, Digestibility, Fill, and Passage for Cattle Consuming Dormant Bluestem Range-Forage (Trial 1)

Energy Level[1]	.3 g CP/lb BW		.6 g CP/lb BW		SE[2]
	4.2	8.4	4.2	8.4	
Forage DMI[2], % BW	1.21	.82	1.07	1.15	.05
Supplement DMI, % BW	.30	.60	.30	.60	---
TOTAL DMI, % BW	1.51	1.42	1.37	1.75	.06
TOTAL DMD, %[b c]	39.1	46.1	45.9	47.5	3.5
ADF Digestibility, %[b]	31.9	24.3	36.1	34.8	10.6
Dry Matter Fill, lb	9.8	9.7	9.9	9.4	2.9
APL Fill, lb	.6	.6	.6	.6	.7
APL Passage, %/hr	4.0	4.9	4.2	5.4	.7
Liquid Volume, 1	43.3	36.8	43.6	48.8	16.2
Dilution Rate, %/hr	5.9	5.5	4.8	5.6	.3
Liquid Flow, l/hr	2.5	2.0	2.1	2.7	.2

[1] Energy Level = kcal ME/lb BW

[2] SE = Standard Error

[3] Dry matter intake

[4] Alkaline peroxide lignin

[a] response due to protein*energy interaction (P<.10)

[b] response due to protein level (P<.10)

[c] response due to energy level (P<.10)

Table 9.2. Influence of Supplemental Protein versus Energy Level on the Intake, Fill, Liquid Volume, and Passage for Cattle Consuming Dormant Bluestem Range Forage (Trial 2)

Energy Level	.3 g CP/lb BW		.6 g CP/lb BW		SE
	4.2	8.4	4.2	8.4	
Forage DMI[1], % BW[a]	1.30	1.17	1.71	1.49	.31
Supplement DMI, % BW	.30	.60	.30	.60	---
Total DMI, % BW[a]	1.60	1.77	2.01	2.09	.34
Dry Matter Fill, lb[a]	23.3	23.2	26.6	26.5	3.5
Liquid Volume, 1	62.7	63.1	76.4	69.0	4.1
Dilution Rate, %/hr	5.3	5.6	5.4	5.6	.1
Liquid Flow, l/hr[a]	3.3	3.6	4.1	3.8	.1

[1] Dry matter intake.

[a] response due to protein level (P<.10).

Influence of Supplemental Grain Type on Forage Utilization by Beef Steers Consuming Early Summer Bluestem[1]

E.S. Vanzant, R.C. Cochran,
A.A. Beharka, and T.B. Avery[2]

Summary

Supplementation of early summer bluestem with low levels of corn, wheat, or sorghum grain had no effect on forage intake, forage digestibility, or total dry matter digestibility in beef steers, compared with a regimen of no supplementation. Increased total dry matter intakes for the supplemented steers reflected supplement consumption.

Introduction

Intensive-early stocking has become an important and common practice among Flint Hills producers. Previous research at the Fort Hays Branch Station has shown that low levels of grain supplementation to cattle under intensive-early stocking programs may produce efficient gains. Additionally, research at Manhattan has shown that steers may be supplemented with up to 4 pounds of sorghum grain per day with only minimal effects on forage utilization. Other research, however, indicates that more rapidly fermentable grains such as corn and wheat have a greater potential for disrupting forage utilization. The purpose of this study was to determine the effects of supplemental corn, wheat, and sorghum grain on the utilization of early summer bluestem by beef cattle.

Experimental Procedures

Sixteen ruminally cannulated steers (avg. wt., 795 lbs.) of primarily Hereford x Angus breeding were randomly assigned to one of four treatments: 1) Control (no supplement), 2) corn, 3) wheat, or 4) sorghum grain supplements. All supplements were fed at 0.36% of body weight on an as fed basis. Soybean meal was added to the milo and corn supplements to equalize their crude protein contents with that of the wheat supplement. Animals were housed in individual pens. Fresh bluestem range grass, cut and chopped daily, was fed at 15% over each animal's previous 7-days average intake from June 11 to July 9, 1987. Forage and grain offered and forage refusals were weighed and sampled daily, analyzed for dry matter, and stored for future analyses. The trial consisted of a 14-day adaptation period, a 7-day intake measurement period, and a 7-day total fecal collection period.

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[1] The authors express their sincere appreciation to Mr. Wayne Adolph and Mr. Gary Ritter for their invaluable assistance in conducting this trial.

[2] Dept. of Surgery and Medicine.

Results and Discussion

There was no difference (P>.10) in forage dry matter intake between the control treatment and any of the supplemented treatments (Table 10.1). Therefore, the trend toward increased total dry matter (DM) intakes for the supplemented groups are simply a result of the increased DM fed in the form of a supplement. There were no differences (P>.10) in either total DM digestibility or acid detergent fiber digestibility. These results indicate that low levels of corn and wheat, as well as sorghum grain, may be used as supplements for stocker cattle grazing early summer bluestem range without adversely affecting forage utilization. Additional research is needed to determine the efficiency with which supplemental energy is converted to tissue gain in steers grazing early summer bluestem.

Table 10.1. Influence of Supplemental Grain Type on Dry Matter (DM) Intake and Digestibility in Beef Steers Consuming Early Summer Bluestem

	Supplement				
Item	None	Corn	Wheat	Sorghum Grain	SE[a]
Forage DM intake (lb/d)	19.0	19.5	19.2	19.9	.73
Total DM intake (lb/d)	19.0	22.3[b]	22.0[b]	22.7[b]	.74
Forage DM intake (% body wt.)	2.5	2.5	2.4	2.5	.18
Grain DM intake (% body wt.)	--	0.35	0.34	0.35	--
Total DM intake (% body wt.)	2.5	2.8[b]	2.7[c]	2.8[b]	.18
Total DM digestibility (%)	51.4	54.8	56.0	52.1	2.73
Acid Detergent Fiber Digestibility (%)	41.1	43.8	40.5	39.6	4.00

[a] SE = standard error (n=4)

[b] Row means differ from control ($P \leq .10$)

[c] Row mean tends to differ from control (P<.15)

Influence of Sustained Rumensin Release on Steer Performance and Forage Utilization[1]

Bob Cochran, Eric Vanzant,
Jack Riley, and Tom Avery[2]

Summary

Steers managed within an intensive-early stocking program and receiving Rumensin® via a slow-release bolus tended to have higher average daily gains than steers not receiving Rumensin. However, forage organic matter intake, fill, digestibility, and diet selection showed little response to Rumensin administration.

Introduction

Ionophores such as Rumensin play an important role in today's cattle industry because of their ability to enhance gain and efficiency. Administration of Rumensin to grazing cattle has previously been limited to situations in which supplementation systems were feasible. Recently, a Rumensin-containing, slow release, intraruminal bolus has been developed. This device allows cattle to be bolused at the beginning of a grazing period and then slowly releases the ionophore over an extended period. Although some data are available regarding the response of cattle that have received the Rumensin bolus, no information is available on how this bolus affects forage utilization. Therefore, our objective was to compare gains and forage utilization under intensive-early stocking in cattle receiving a Rumensin bolus.

Experimental Procedures

Performance Trial. Two hundred forty-four crossbred steers were randomly assigned to each of six pastures grazed at three stocking rates (two pastures per stocking rate; 1.25, 1.50 and 1.75 acres/steer). Steers grazed the pastures from May 1, 1987 through July 15, 1987. Weights taken after an overnight stand without feed or water were recorded at trial initiation and termination. At trial initiation, all steers were implanted with Compudose. Steers assigned to the Rumensin treatment received a Rumensin bolus at the same time.

Forage Utilization Trial. Eight ruminally and esophageally fistulated heifers were randomly assigned to two treatments: 1) Rumensin bolus or 2) Control -- no bolus. Boluses were given 21 days before intake and digestibility measurements started.

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[1] Appreciation is expressed to Mr. Gary Ritter and Mr. Wayne Adolph for their expert assistance during the data collection, and to Elanco Products Co., Division of Eli Lilly Co., for financial and product support for this trial.

[2] Department of Surgery and Medicine.

All heifers grazed a single pasture throughout the trial. Forage utilization was monitored during a 3-day esophageal collection period, a 7-day fecal collection period, and a l-day ruminal evacuation period. Dates of the sample collection period were June 5 to June 17, 1987.

Results and Discussion

Average daily gains of steers were not influenced (P>.10) by the stocking rates. Steers that received a Rumensin bolus tended (P=.09) to gain more than control steers. (Table 11.1). However, bolusing cattle with the Rumensin device had little effect on forage utilization. Forage organic matter digestibility, forage acid detergent fiber digestibility, forage organic matter intake, forage organic matter fill, and quality of diet selected were all unaffected (P>.10) by the slow-release Rumensin bolus.

Table 11.1. Influence of Rumensin Boluses on Gains, Forage Utilization, and Quality of Diet Selected

Item	Control	Rumensin	Standard Error
Steer Gains (lbs/day)	2.4	2.5	0.03
Forage Organic Matter Intake (% body wt)	2.9	3.0	0.5
Forage Organic Matter Fill (lbs)	5.5	6.0	0.5
Forage Organic Matter Digestibility (%)	68.7	71.4	1.8
Forage Fiber (ADF)[1] Digestibility (%)	67.4	67.7	1.0
Fiber (ADF) in Grazed Forage (%)	56.2	53.0	2.2
Crude Protein in Grazed Forage (36)	13.7	14.2	0.2

[1] Acid-detergent fiber.

Stocking Rate Effects on Intensive-Early Stocked Bluestem Range

Clenton E. Owensby[1], Robert Cochran,
and Ed F. Smith

Summary

Based on a six-year study, stocking at 2.5X and 3.0X normal season-long rates for the first half of the growing season with no grazing during the latter half results in individual steer gains that are equal to those under the 2.0X rate. The gain per acre was greatly increased at the higher stocking rates. Grass remaining in early October was 20 percent lower on pastures stocked at the 2.5X and 3.0X rates than at the 2.0X rate. However, there was no trend toward further reductions over the study period. Botanical composition did not change greatly as a result of the different stocking rates. Apparently, Flint Hills bluestem range can be intensive-early stocked at rates higher than the traditional 2.0X rate.

Introduction

The high-quality forage period for warm-season perennial grasslands is relatively short. Grazing at other times results in livestock gains that are sub-optimal. Forage quality does not meet optimal growth requirements. The goal of any rangeland-based program for growing livestock should be maximum efficiency in converting forage to animal product. Earlier work showed an increased conversion efficiency with intensive-early stocking of Kansas Flint Hills range; that is, stocking density was twice normal for the first half of the growing season. Slightly more than 1000 lb per acre of herbage remained when livestock were removed in mid-July. Lack of grazing from mid-July until frost allowed for adequate storage of reserve carbohydrates. Since there was substantial herbage remaining when livestock were removed, the next study was to determine if higher stocking rates could be attained.

We studied the effects of stocking densities on Kansas Flint Hills bluestem range at 2, 2.5, and 3 times the normal season-long rate from May 1 to mid-July on botanical composition, herbage yield, reserve carbohydrates, and animal gains.

Materials and Methods

Study Area. The study area was six 60-acre late-spring burned pastures in the northern Kansas Flint Hills near Manhattan, KS on the Kansas State University Experimental Range Unit. Big bluestem (*Andropogon gerardii* Vitman.) and indiangrass (*Sorghastrum nutans* Nash) were the dominants. Little bluestem (*A. scoparius* Michx.) and sideoats grama [*Bouteloua curtipendula* (Michx.) Torr.] were sub-dominants. Numerous grass, forb, and woody species constituted the remainder. Soils were transitional from udic ustolls to udolls. The principal range sites in the study area were loamy upland, breaks, and clay upland.

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[1] Department of Agronomy.

Cattle. Each year on May 1 from 1982 through 1987, the pastures were stocked with yearling steers weighing 500 to 575 lb. Stocking rates of 1.75 (2X), 1.50 (2.5X), and 1.25 (3X) acres per steer were applied in duplicate on the six study pastures. Steers were individually identified and weighed on April 30 and July 16 each year. Steers were confined without feed and water from the afternoon of the day prior to weighing until they were weighed the following morning.

Herbage Production. Herbage remaining following grazing was clipped to ground and level between July 16 and 20 each year on 10, 4.36 ft^2-plots in both loamy upland and breaks range sites. Regrowth was clipped using the same procedure in early October. Herbage was separated into grasses and forb-brush components, dried to moisture-free, and weighed.

Botanical Census. Botanical composition and basal cover were estimated using the modified step-point method. Pastures were sampled annually during the first half of June. Within each pasture, 1,500 points were read along a predetermined grid. Each point was recorded as to range site. Pretreatment botanical composition and basal cover were determined in 1981 and analysis of variance was conducted on the change from pretreatment levels.

Results and Discussion

Precipitation. Growing season precipitation during the initial year of the study was above normal (Figure 12.1), but precipitation during the latter half of the growing season during 1983 and 1984 was well below normal. In remaining years (1985-87), precipitation was normal, to above normal, with only July, 1987 lacking in adequate moisture for growth.

Grass Production: Mid July. Grass production (lb/acre) remaining (GR) at the time of livestock removal varied among years (Figure 12.2). During most years, GR was greater for the 2X rate on both major range sites than for the 2.5X and 3X rates. In two of the six years, GR was greater on the 2.5X rate pastures than on the 3X, but was similar during the other four years. In 1985, there appeared to be no difference in GR among pastures stocked at different rates. During the latter half of the 1983 and 1984 growing seasons there was essentially no regrowth on any treatment pasture because of insufficient precipitation. This probably accounted for the reduced herbage production during early season 1985. Even though there was substantial yearly variation in GR at livestock removal, there appeared to be no downward trend at any stocking rate indicating that sustained herbage production was possible at any of the rates tested.

Grass Production: October. GR on both major range sites in early October was greater on pastures with the 2.0X stocking rate (1904 lb/acre) than on pastures stocked at the 2.5X (1465 lb/acre) and the 3.0X rate (1537 lb/acre) which were essentially equal in GR. GR in early October varied over years in response to variable climate, but there was no downward trend under any stocking rate (Figure 12.2). It appears that the amount of grass remaining in October under each stocking rate can be sustained over a long period.

Forb Production. Forb production (lb/acre) remaining (FR) in July and October following grazing was similar under all stocking rates except in 1982 and 1985. In those years, FR was higher on pastures stocked at the 3.0X rate (Figure 12.3).

Botanical Census. There was little change in botanical composition among pastures stocked at different rates. On the loamy upland site, indiangrass percent composition at the end of the study was substantially lower under the 2.5X and 3.0X stocking rates compared to 1982 levels (Figure 12.4). On the breaks site, indiangrass percent composition was reduced from initial levels only on pastures stocked at the 2.5X rate (Figure 12.5). Kentucky bluegrass (Poa pratensis L.) percent composition in 1987 was higher on the loamy upland range site under the 3.0X stocking rate than at the beginning of the study (Figure 12.4). The increased relative amount of Kentucky bluegrass on pastures stocked at the 3.0X rate compared to lower rates likely resulted from lower fire intensity because of reduced amounts and continuity of the fuel. Big bluestem percent composition on the breaks site increased compared to initial levels on pastures stocked at the 2.0X stocking rate but did not change greatly under the higher stocking rates (Figure 12.5).

Previous research has shown that big bluestem is favored by intensive-early stocking at the 2.0X rate compared to season-long stocking. The changes in botanical composition at the different stocking rates were relatively minor, particularly for the 2.0X and 2.5X rates. At the 3.0X rate, the reduction in percent composition of indiangrass and the increase in Kentucky bluegrass, though relatively small, indicate potential long-term undesirable changes.

Steer Gains. Even though they varied among years, steer gains on pastures stocked at different rates were the same for any given year (Table 12.1). Differences in steer gains among years were likely due to changes in type of cattle utilized in the study. In 1982 and 1983, steers were purchased through local sale barns and largely represented average frame, British crossbred cattle. From 1984 through 1987, steers were from a single source, possessed larger frame size, and were British X Zebu crosses.

From an individual steer gain standpoint, stocking at any of the rates tested will give equal performance; however, the gain per acre will be substantially increased at higher stocking rates. Compared to traditional season-long stocking with per acre gains of 68 lb on unburned pastures and 78 lb on burned, there is a substantial increase in gain per acre under intensive-early stocking without increased production costs.

Table 12.1. Influence of Stocking Rate on Steer Gains on Kansas Flint Hills Bluestem Pastures Intensive-early Stocked from 1 May to 15 July, 1982-1987. Stocking Rates were 1.75 acres/steer (2.0X), 1.50 acres/steer (2.5X), and 1.25 acres/steer (3.0X)

	Gains (lb/steer)			Gains (lb/acre)		
Year	2.0X	2.5X	3.0X	2.0X	2.5X	3.0X
1982	139	128	137	79	85	110
1983	133	122	137	76	81	110
1984	166	166	168	119	123	134
1985	208	184	175	119	123	156
1986	185	190	195	106	127	156
1987	178	182	187	101	121	145
Average	168	162	166	96	108	133

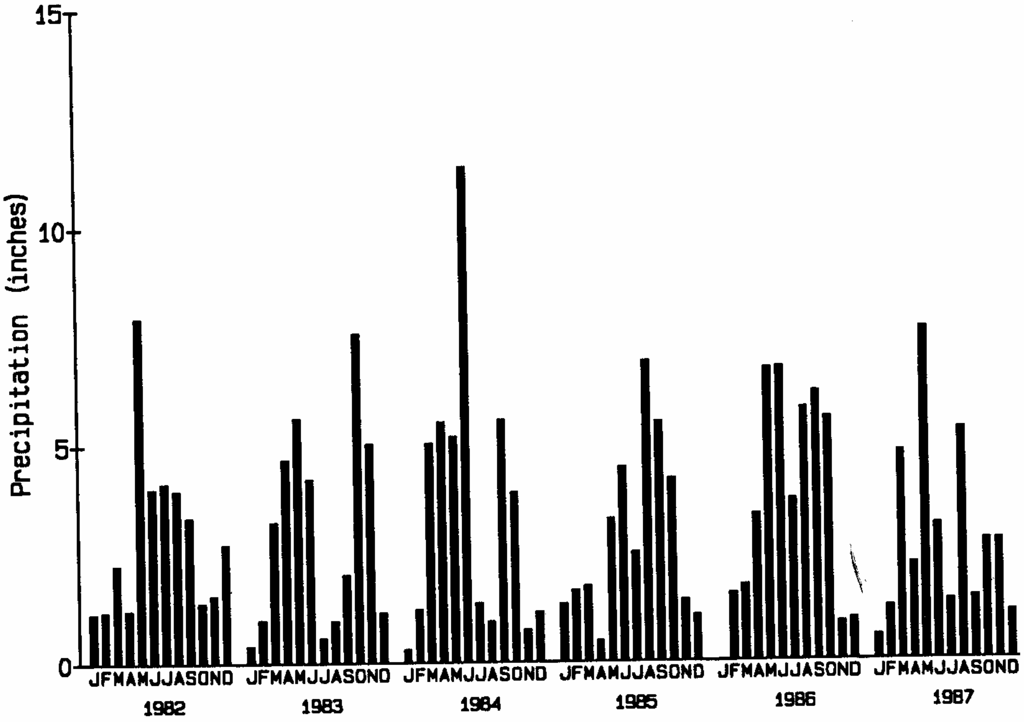

Figure 12.1. Monthly precipitation for Manhattan, KS from 1982-1987.

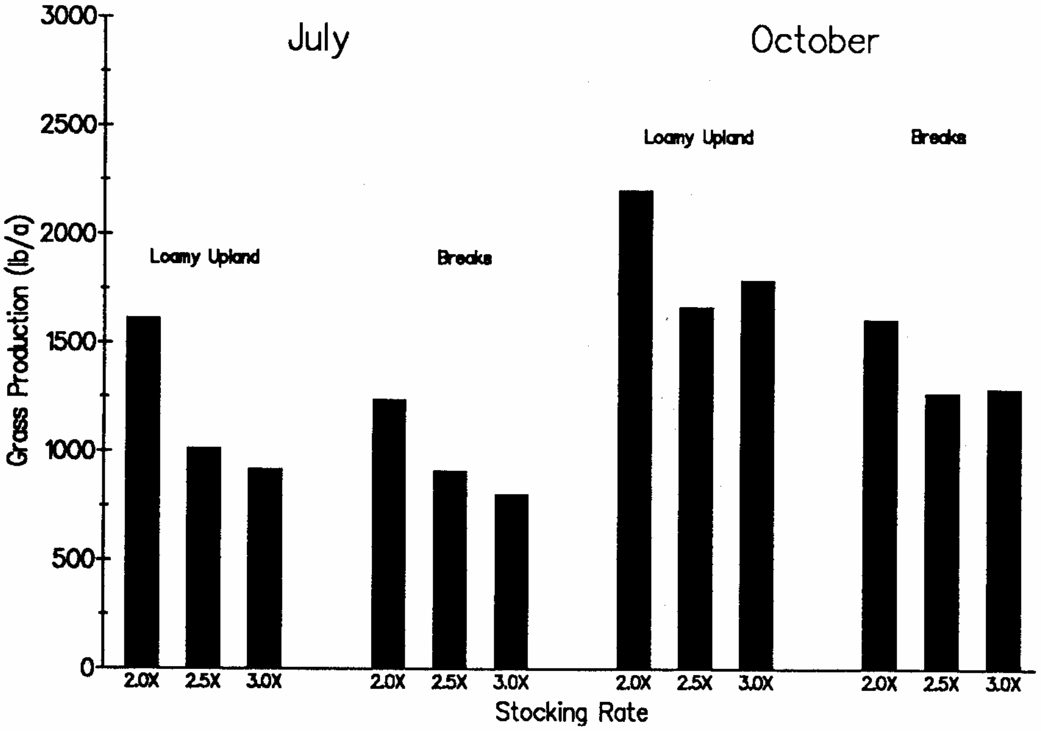

Figure 12.2. Grass production remaining (lb/a) for pastures stocked at 2, 2.5, and 3 times normal season-long stocking rates. Harvest dates were in mid July and early October. 1982-1987 average.

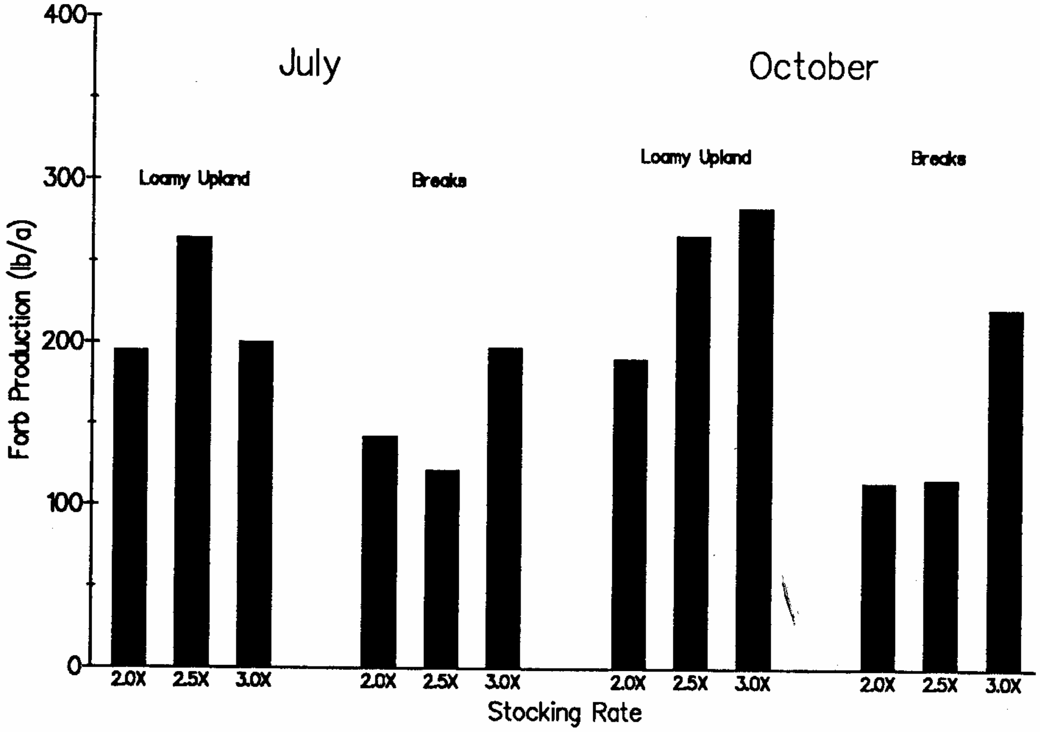

Figure 12.3. Forb production remaining (lb/a) for pastures stocked at 2, 2.5, and 3 times normal season-long stocking rates. Harvest dates were in mid July and early October. 1982-1987 average.

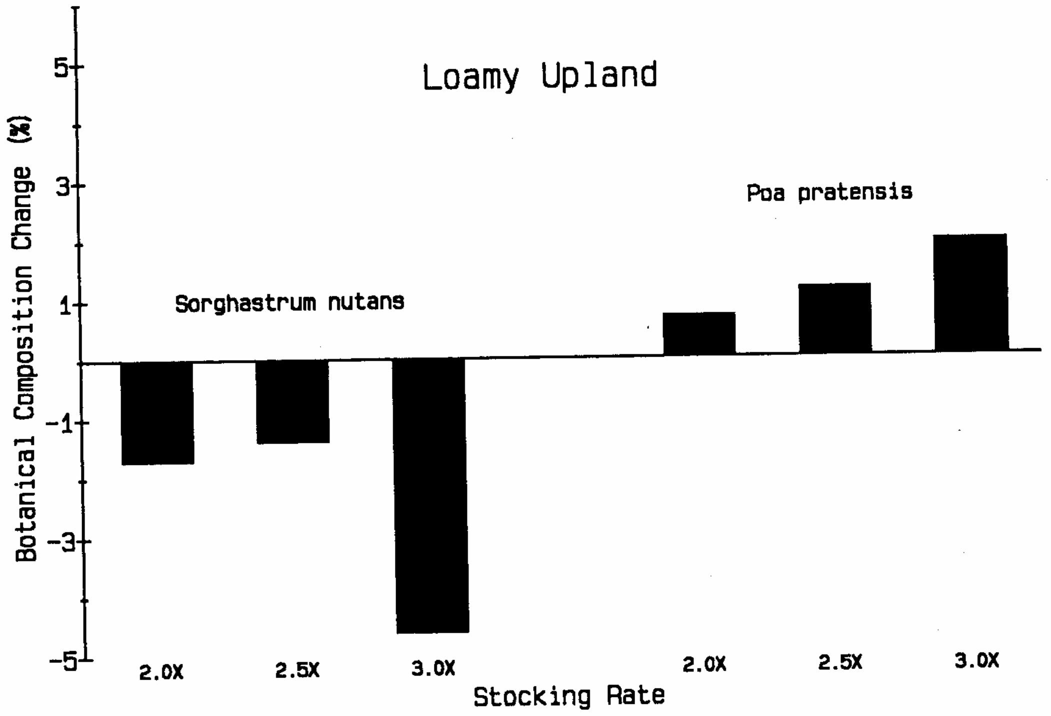

Figure 12.4. Changes in botanical composition from 1982 to 1987 under different intensives-early stocking rates for the indicated species on loamy upland range sites.

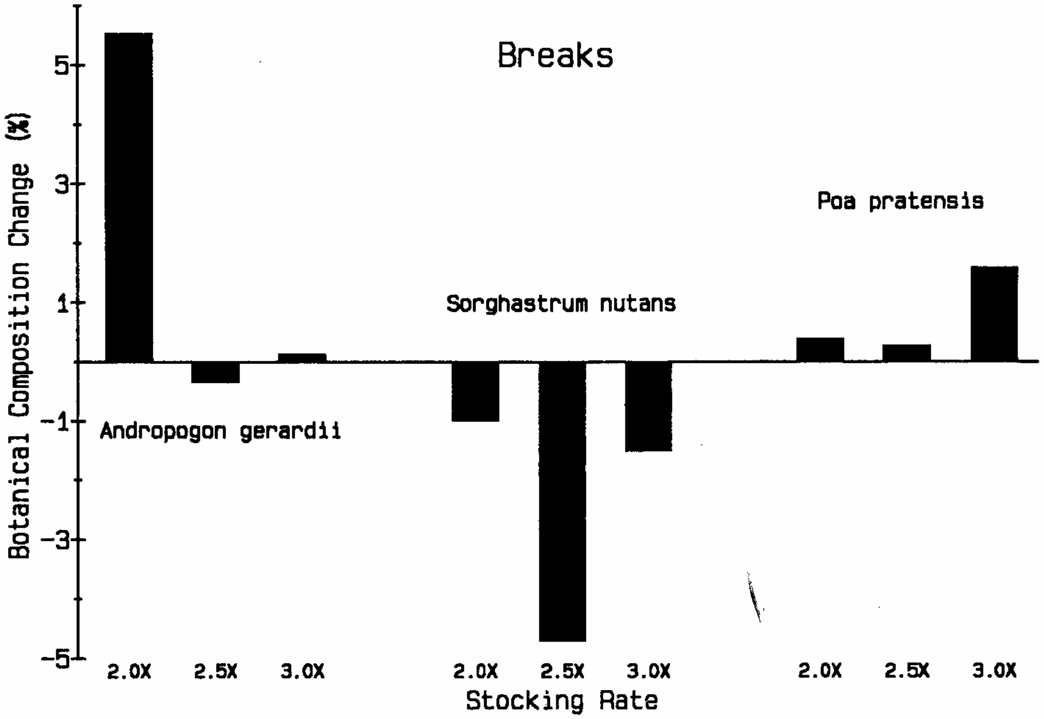

Figure 12.5. Changes in botanical composition from 1982 to 1987 under different intensives-early stocking rates for the indicated species on breaks range sites.

Performance of Stocker Heifers and Steers Grazing High Endophyte Fescue and Offered Oxytetracycline in a Mineral Mixture[1]

Ken Coffey and Frank Brazle[2]

Summary

Two experiments were conducted to evaluate the performance of stocker calves grazing high-endophyte fescue (68 to 70%) and offered oxytetracycline in a free-choice mineral supplement. In Experiment 1, 24 yearling crossbred heifers were utilized in a 112-day grazing study beginning on June 18. Performance of both control calves and those receiving oxytetracycline was extremely poor, making data interpretation difficult. Average oxytetracycline consumption was 327 mg per head, daily. Approximately 82% of the total grazing time occurred during the daylight hours (6am - 10pm) for both treatment groups. Heifers offered the medicated mineral mix grazed 20 minutes more than heifers offered the control mineral mix. Hair scores and rectal temperatures were unaffected by oxytetracycline supplementation.

In Experiment 2, fifty-three crossbred steers were utilized in an 83-day grazing study beginning on September 15. Steers were randomly divided into groups of 25 and 28. One group received a control mineral mixture, whereas the other received a similar mineral mix containing oxytetracycline, 250 mg per ounce. Steers fed oxytetracycline gained faster ($P<.05$) and tended to have lower ($P=.12$) rectal temperatures. Therefore, response of cattle to consumption of oxytetracycline from a mineral mixture may be variable. Heifers grazing endophyte infected tall fescue (Experiment 1) may not have gained sufficiently to support treatment differences. However, when cattle were gaining weight (Experiment 2), treatment differences were observed.

Introduction

Tall fescue is the predominant cool-season forage in southeastern Kansas. It is characterized by high forage production and animal carrying capacity, but is often associated with poor animal performance, particularly during the summer months. Cattle grazing endophyte infected tall fescue often display a number of symptoms indicating a generally unhealthy status. Because antibiotics have been used to help improve performance of both grazing and feedlot cattle, the purpose of this study was to determine if free-choice consumption of oxytetracycline from a mineral mixture would improve performance by cattle grazing endophyte-infected tall fescue.

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[1] Oxytetracycline and partial financial support were provided by Pfizer, Inc. Lee's Summit, MO 64063.

[2] Southeast Kansas Branch Station and Southeast Kansas Area Livestock Extension Specialist, respectively.

Experimental Procedures

Experiment 1. Twenty-four yearling Limousin crossbred heifers were randomly allotted by weight to one of four pasture replicates of six head each. Each replicate then was randomly assigned to one of two salt mixtures, which were provided ad libitum. Two replicates received a control salt mixture, whereas two replicates received a similar salt mixture containing oxytetracycline (Table 13.1) at a level of 250 mg/oz. The salt mixtures were provided free-choice from covered "weather vane" mineral feeders. The cattle were placed on one of four 7.5 acre fescue pastures (70% endophyte infestation) for a 112-day grazing study beginning on June 18. Hair scores and rectal temperatures were measured at the beginning and end of the 112-day grazing study. Hair score was estimated on a scale of 1 to 10; 1 is a smooth short hair coat with no long hair and a 10 is a rough long hair coat with dead hair on at least 75% of the body.

Three heifers from each group of six were randomly selected for grazing behavior observations. Those heifers were fitted with grazing clocks, which recorded when and for how long the heifers grazed during a 7-day period. Grazing behavior was measured from July 16 to 23 and from August 18 to 25 on the same heifers.

Experiment 2. Fifty-three crossbred steers (512 lb) were randomly allotted to two groups and placed on separate endophyte-infected (68%) tall fescue pastures on Sept. 15. One group received a control mineral mix and one group received the same mineral mix with oxytetracycline used in Experiment 1, offered in "weather vane" mineral feeders. Body temperatures, hair scores, and weights were measured at the initiation and termination of the 83-day, fall grazing study.

Results and Discussion

Experiment 1. Mineral consumption (Table 13.2) tended to be greater (P>.10) when oxytetracycline was added to the mixture. Actual consumption of osytetracycline was 327 mg/head/day, which was somewhat below the anticipated level of consumption, 400 mg/head/day.

Heifer performance was unaffected by oxytetracycline supplementation (Table 13.3). Heifers receiving no oxytetracycline in the mineral mixture actually gained .15 lb/day more (P>.10) than those receiving oxytetracycline. However, these differences are trivial considering the low total gain for the study. At gains of this magnitude, differences are more likely due to animal variability. Although not statistically different (P>.10), heifers offered oxytetracycline in the mineral mix tended to graze more, particularly during the daylight hours (Figure 13.1). Approximately 40% of the total daylight grazing time occurred between 6 and 10 pm for both groups (Figure 13.2). Proportions of the daylight grazing time occurring at the other 4-hour increments were similar between treatments.

Although final rectal temperatures were similar between treatments, heifers consuming oxytetracycline tended to have a greater reduction in temperature between the initial and final temperatures. Unfortunately, heifers allotted to the oxytetracycline treatment groups had higher initial hair scores (P<.01). Final hair scores were similar (P>.10) resulting in a tendency for a lower magnitude of increase from heifers offered oxytetracycline.

Experiment 2. Mineral consumption tended to be greater (P>.10) when oxytetracycline was not included (Table 13.5). Average oxytetracycline consumption was 600 mg/head/d. Steers consuming the medicated mineral mixture gained 26.5% faster (P<.05) and their rectal temperatures tended to be lower (P=.12) than those of steers consuming nonmedicated mineral (Table 13.6). Hair scores were not affected by the adding oxytetracycline to the mineral mix.

Conclusions

Oxytetracycline had little effect on the heifers grazing tall fescue in Experiment 1. That might be attributed to the generally poor performance of all heifers. One possible solution would to have been to start the study earlier in the grazing season to take advantage of the spring growth of fescue. Another solution might have been to hand feed the oxytetracycline in a carrier of ground corn or grain sorghum. During the fall grazing experiment (Experiment 2), gains were adequate and treatment differences were apparent. Therefore, oxytetracycline supplementation in a free-choice mineral mixture may offset some of the performance reduction observed by cattle grazing endophyte-infected tall fescue. However, a response should be expected only in cattle that are in a weight gaining status.

Table 13.1. Composition of Mineral Mixtures Offered to Cattle Grazing Tall Fescue Pastures in Experiments 1 and 2

Ingredient	Control	Medicated
	--------- %	---------
Trace mineralized salt	33	30
White salt	29	27
Dicalcium phosphate	27	25
Soybean meal	11	10
Terramycin 50	0	8

Table 13.2. Mineral Consumption by Heifers Grazing Tall Fescue Pastures, Experiment 1

Item	Control	Medicated
Mineral consumption, Oz./head/day	.8	1.3
Oxytetracycline consumption, mg/head/day	0	327

Table 13.3. Performance of Heifers Grazing Tall Fescue Pastures and Offered Oxytetracycline in a Mineral Mix , Experiment 1[a]

Item	Control	Medicated
Initial wt., lb	729	730
Final wt., lb	750	734
Total gain, lb	21	4
Daily gain, lb	.19	.04

[a]No statistically significant (P<.10) differences observed.

Table 13.4. Temperatures and Hair Scores Heifers Grazing Tall Fescue Pastures and Offered Oxytetracycline in a Mineral Mix, Experiment 1

Item	Control	Medicated
Initial temp., F	102.6	103.1
Final temp., F	102.5	102.7
Temp. difference, F	-.1	-.4
Initial hair score	3.2[a]	3.9[b]
Final hair score	5.8	5.8
Hair score difference	2.6	1.9

[a,b]Means within a row with unlike superscripts differ (P<.01).

Table 13.5. Mineral Consumption by Steers Grazing Tall Fescue Pastures, Experiment 2

Item	Control	Medicated
Mineral consumption, oz/head/d	3.1	2.4
Oxytetracycline consumption mg/head/day	0	600

Table 13.6. Performance of Steers Grazing Tall Fescue and Offered Oxytetracycline in a Mineral Mixture, Experiment 2

Item	Control	Medicated
No. of steers	25	28
Initial weight, lb.	518	508
Final weight, lb.	599	611
Total gain, lb.	81	103
Daily gain, lb.	.98[b]	1.24[a]
Final hair score	5.7	5.7
Rectal temperature, F	103.3	103.1

[a,b]Means within a row with unlike superscripts differ (P<.05).

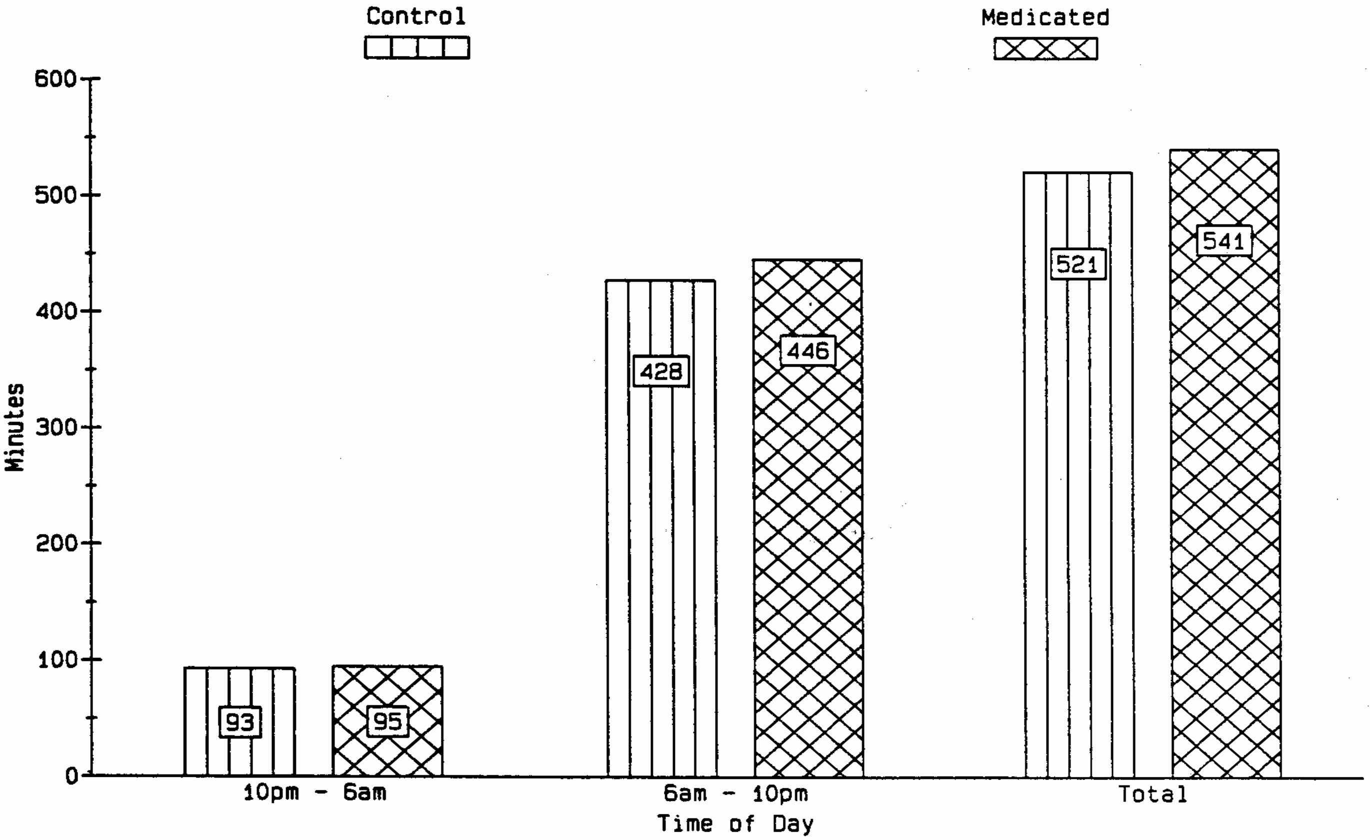

Figure 13.1. Grazing Time During Daylight and Night

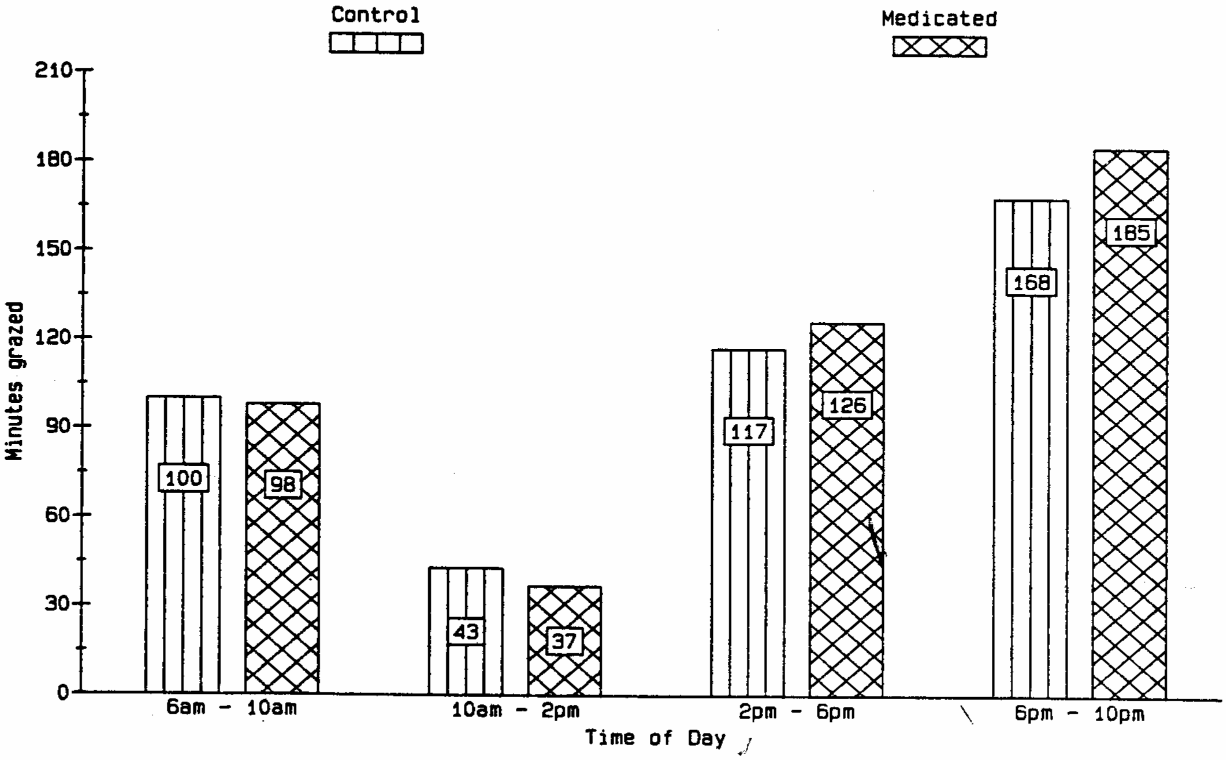

Figure 13.2. Grazing Time During Daylight Hours

Effect of Medicated Mineral Mixtures and a Pinkeye Vaccine on the Gain and Health of Steers Grazing Native Grass Pastures[1]

Frank Brazle[2]

Summary

Feeding supplements containing an antibiotic or ionophore improved stocker gains by .06 to .26 lb per head daily. A combination of Bovatec and Aureomycin in the mineral mixture improved ($P<.08$) steer gains over feeding Aureomycin alone. Mineral intake was higher than expected for the steers grazing burned, double-stocked, native grass pastures in 1987. Vaccinating steers with Piliguard at turn-out had no effect on pinkeye incidence and reduced stocker gains slightly.

Introduction

Bovatec® and Aureomycin® have been shown to improve gains of grazing cattle when added to grain-mineral mixtures. Rumensin® blocks have also been shown to increase stocker performance. The objective of this study was to compare Bovatec, Aureomycin, and a combination of Bovatec and Aureomycin in a mineral mixture on stocker performance. Bovatec and Aureomycin are not cleared at present for combination use. In addition, a pinkeye vaccine (Piliguard®) was evaluated.

Experimental Procedures

On April 23, 271 mixed-breed steers averaging 622 lbs. were weighed and randomly allotted to the following pasture supplementation: (1) salt and dicalcium phosphate; (2) salt, dicalcium phosphate, dried molasses, and Bovatec; (3) salt, dicalcium phosphate, dried molasses, and Aureomycin; (4) salt, dicalcium phosphate, dried molasses, and Aureomycin plus Bovatec; and (5) a commercial Rumensin block. The steers were intensive-early grazed (double-stocked) on burned native grass pastures until July 13 and were rotated among pastures to minimize pasture effects. They were observed weekly for incidences of watery eyes and footrot. Stocking rate was 2.37 acres per steer. Half of the steers within each pasture treatment were injected with a pinkeye vaccine (Piliguard) at the start of the trial. Steers were dusted weekly for fly control. Compositions of mineral mixtures are in Table 14.1.

Results and Discussion

Free choice supplement consumption was about 40% higher than expected for mineral mixtures and blocks. Steers eating the Bovatec plus Aureomycin mixture showed highest gains (Table 14.2). These gains, however, were not significantly

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[1] Appreciation is expressed to American Cyanamid Co., Princeton, NJ for funding support; to Tom Moxly for providing cattle and facilities; and to Chris Baker, Morris County Extension Agricultural Agent, for assistance in data collection.

[2] Extension Livestock Specialist, Southeast Kansas.

higher than those of steers consuming the Bovatec mineral mixture or the commercial Rumensin block. Stockers consuming the Aureomycin mineral mixture showed intermediate gains, and steers on the salt plus dicalcium phosphate treatment had the lowest gains.

Steers consuming the Bovatec mineral mixture and the Rumensin block had the highest percentage of eye problems, while those fed the Bovatec plus Aureomycin mineral and the salt plus dicalcium phosphate mixture had the lowest incidences (Table 14.2).

The highest percentage of footrot occurred in steers fed the Aureomycin mineral, whereas the lowest occurred in those the fed Bovatec plus Aureomycin mineral and the salt plus dicalcium phosphate mixture. Most of the footrot and eye problems occurred in the first 20 days of the grazing period. Both of these problems may have been caused by an interaction between weather and pasture conditions. Since these conditions would have changed by the time the cattle were first rotated among pastures, it is likely that the health responses were confounded with pasture allotment. Other research has consistently shown a reduction in eye problems and footrot when an antibiotic was fed.

Table 14.3 shows the results of using the pinkeye vaccine. There was no difference in the incidence of pinkeye between the control and vaccinated steers. However, the control steers gained .10 lb per day more (P<.07) than the pinkeye-vaccinated steers. The steers were vaccinated on the day they went to grass. If the cattle had been vaccinated several days or weeks before turn-out, it is possible that a better outcome would have resulted.

Table 14.1. Composition of Mineral Mixtures (Per Ton) Used in Grazing Trial

Ingredient	Control Salt Dical Phosphate	Bovatec	Aureomycin	Bovatec plus Aureomycin
Dried molasses, lb	---	800	200	800
Dicalcium Phosphate, lb	500	160	300	160
Salt, lb	1480	993.5	1320	914.5
Mineral Oil, lb	20	20	20	20
Aureomycin (50 g/lb), lb	---	---	---	---
Bovatec (68 g/lb), lb	---	26.5	---	26.5

Table 14.2. Effect of Grazing Supplements on Stocker Performance

Item	Bovatec	Aureomycin	Bovatec + Aureomycin	Rumensin Block	Salt + Dical
No. Steers	59	59	59	47	47
Daily Gain, lb	2.54^{ab}	2.46^{bc}	2.66^{a}	2.51^{ab}	2.40^{c}
Daily Intake:					
Supplement, lb	.28	.14	.27	.35	.14
Ionophore Intake, mg	252	---	243	140	---
% Eye Problems	7.3^{a}	3.3^{ab}	1.0^{b}	10.1^{a}	1.1^{b}
% Footrot	2.9^{a}	4.6^{b}	1.0^{a}	1.7^{a}	1.2^{a}

^{ab}Means in same row not sharing the same superscript differ (P<.08).

Table 14.3. The Effects of Pinkeye Vaccine on Grazing Steer Performance

Item	Pinkeye Vaccine	Control
No. Steers	134	130
Daily Gain, lb	2.46^{a}	2.56^{b}
Steers with Pinkeye, %	7.5	7.7

^{ab}Means in same row with different superscripts are different (P<.07).

Effect of Ralgro® on Performance of Steers Grazing High and Low Endophyte Fungus-Infested Tall Fescue Pastures[1]

F.K. Brazle[2]

Summary

Steers were either not implanted or implanted with 36 or 72 mg of Ralgro, then allowed to graze on both high and low endophyte fungus tall fescue pastures. Ralgro had a greater effect on improving gains of steers grazing high endophyte fungus pastures than on those grazing lowly infected fescue pastures.

Introduction

Tall fescue pastures infested with high levels of the endophytic fungus (Acremonium coenophialum) have resulted in poor gains by grazing animals. Ralgro has been shown to increase blood prolactin levels, whereas the endophyte fungus reduces blood prolactin levels in grazing animals. Research with cow-calf pairs grazing tall fescue pastures has shown a 52 lb increase in calf weaning weight due to Ralgro implants, or about twice the response typically obtained with calves grazing native grass. The objective of this study was to determine if Ralgro has a greater effect on gains of cattle grazing high endophyte- or low endophyte-infected fescue pastures.

Experimental Procedures

In trial 1, 150 mixed breed steers, averaging 541 lbs, were allotted on August 18 to either a high (70%) endophyte fungus, tall fescue pasture or a low (30%) endophyte-infected pasture. Within each pasture, 75 steers were randomly allotted to Control (no implant), 36 mg Ralgro, or 72 mg Ralgro treatments. The steers were weighed and their hair coats were scored at the start, after 30 days on trial, and at the end of the grazing period on November 17. The steers were bled for serum prolactin analysis and body temperatures were recorded at the start and at 30 days.

In trial 2, 150 mixed breed steers, averaging 614 lbs, were allotted to either a high (93%) or a low (9%) endophyte fungus-infected pasture on September 17. Within each pasture, 75 steers were randomly allotted to either Control, 36 mg Ralgro, or 72

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[1] Sincere appreciation is expressed to IMC Pitman-Moore, Terre Haute, IN for providing funding for this study. Appreciation is also expressed to Bill George and sons, David Meyer, and Irisk and Doll for supplying cattle and facilities, and to Ted Wary and Glenn Newcomer, Cherokee and Bourbon County Extension Agricultural Agents, for assistance in data collection.

[2] Extension Livestock Specialist, Southeast Kansas.

mg Ralgro treatments. The steers were weighed and hair was scored at the start, after 33 days, and again at the end of the grazing period on December 9. The steers were bled for prolactin analysis at the start and after 33 days on trial.

Results and Discussion

The results of Trials 1 and 2 are shown in Table 15.1. When the results of the two trials were combined, daily stocker gains on the low endophyte fungus, fescue pastures were 1.29, 1.43, and 1.48 lbs for the Control, 36 mg Ralgro, and 72 mg Ralgro, respectively. This represents a 10% improvement ($P<.05$) in gain with 36 mg Ralgro and a 17% increase ($P<.05$) with 72 mg of Ralgro over the Controls. Daily gains of steers grazing the high endophyte fungus pastures were .95, 1.29, 1.38 lbs for the Control, 36 mg Ralgro, and 72 mg Ralgro, respectively. This was a 37% improvement ($P<.001$) for 36 mg Ralgro steers and a 47% boost ($P<.001$) for the 72 mg Ralgro-implanted cattle. Body temperatures were higher ($P<.001$) at 33 days for steers grazing the high endophyte pasture in trial 2 compared to cattle on the low endophyte pasture. Prolactin levels at 30 and 33 days were higher ($P<.001$) in steers grazing the low endophyte pastures. Ralgro had little effect on serum prolactin levels. In trial 2, hair scores at 33 days were higher (rougher) for steers grazing the high endophyte pasture. This research suggests that Ralgro reduces the detrimental effects on steer gains from grazing tall fescue pastures with high levels of endophyte fungus.

* * *

"Fescue foot," "summer syndrome," and "fescue toxicity are all names for a condition frequently seen in cattle grazing tall fescue. Symptoms include erratic performance, lameness, rough hair coats, and reduced tolerance to heat. The problem is a toxic endophyte fungus, so named because it grows within the fescue plant. The fungus is concentrated in the plant stalk and seed head, so the symptoms are most prevalent when cattle are grazing mature fescue. The fungus is transmitted only through the seed, so fungus-free stands can be established by planting certified endophyte fungus-free seed.

* * *

Table 15.1. Effect of Ralgro on Performance of Steers Grazing Low or High Endophyte-Infected Fescue Pastures

Trial 1	Low - 30% Endophyte Fungus			High - 70% Endophyte Fungus		
Item	Control	36 mg Ralgro	72 mg Ralgro	Control	36 mg Ralgro	72 mg Ralgro
Daily Gain:						
First 30 Days	1.81^{a}	1.74^{b}	1.78^{b}	1.45^{a}	1.56^{a}	1.49^{a}
Overall, 90 Days	1.33^{b}	1.52^{bc}	1.62^{c}	1.02^{a}	1.35^{b}	1.41^{b}
Rectal Temp., F						
Day 30	104.3	103.9	103.8	104.8	104.3	104.6
Hair Score[1]:						
Day 30	4.9	4.8	4.9	5.3	4.8	5.4
Day 90	5.8	5.3	5.5	5.8	5.3	5.4
Serum Prolactin, ng/ml						
Day 30	125.9^{a}	51.9^{b}	54.6^{ab}	24.6^{ab}	15.0^{b}	4.37^{b}

Trial 2	Low - 9% Endophyte Fescue			High - 93% Endophyte Fescue		
Item	Control	36 mg Ralgro	72 mg Ralgro	Control	36 mg Ralgro	72 mg Ralgro
Daily Gain:						
First 33 Days	1.23^{a}	1.46^{a}	1.12^{a}	$.36^{c}$	$.70^{b}$	$.75^{b}$
Overall, 83 Days	1.24^{a}	1.33^{a}	1.34^{a}	$.87^{b}$	1.23^{a}	1.34^{a}
Rectal, Temp., F						
Day 33	103.3^{a}	103.1^{a}	103.1^{a}	104.5^{b}	104.3^{b}	104.3^{b}
Hair Score[1]:						
Day 33	5.2^{a}	5.0^{a}	5.3^{a}	6.0^{b}	5.9^{b}	5.6^{b}
Day 83	5.9	5.4	5.7	5.8	5.7	5.7
Serum Prolactin, ng/ml						
Day 33	139.9^{ab}	227.1^{a}	97.0^{ab}	10.0^{c}	13.2^{c}	8.9^{c}

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[1] Higher scores indicate rougher hair coats.

[abc] Means in the same row not sharing the same superscript are significantly different (P<.001).

Influence of Ralgro® on Suckling Calf Performance on Tall Fescue Pastures with Various Levels of Endophyte Infestation[1]

Frank Brazle[2] and Jack Whittier[3]

Summary

Four hundred and ten cow-calf pairs were allotted to tall fescue pastures containing 40, 45, or 70% endophyte fungus infestation. One half of the calves in each pasture were implanted with Ralgro® initially and reimplanted about 110 days later. Calf gains on the 70% endophyte fungus pasture showed a greater ($P<.05$) response to implanting than those grazing the 40 and 45% endophyte-infested tall fescue pastures during the 165 day trial.

Introduction

Tall fescue pastures infested with high levels of endophytic fungus (*Acremonium coenophialum*) have resulted in poor gains for grazing animals. Earlier K-State research has shown more than twice the gain response to Ralgro implants in steers grazing 80% compared to 20% infested tall fescue pastures. Research with cow-calf pairs grazing tall fescue has shown a weaning weight response of 52 lbs with Ralgro implants. The objective of this study was to determine if Ralgro has a greater effect on calf performance with cow-calf pairs grazing high compared to low endophyte-infested, fescue pastures.

Experimental Procedures

Mixed-breed cows bred to Romognola bulls were randomly allotted in the winter of 1987 to either 40, 45, or 70% endophyte fungus-infested tall fescue pastures. In May, the calves within each pasture were weighed and randomly allotted by sex to either Control (no implant) or Ralgro groups. Calves in the Ralgro group were implanted with 36 mg zeranol (Ralgro) in May and again after about 110 days. At the end of the trial in October, calves were individually weighed and body condition was scored (1 to 9 scale). The pastures were tested for endophyte fungus level in the spring and again in the fall.

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[1] Sincere appreciation is expressed to IMC Pitman-Moore, Terre Haute, IN for providing funding for this study. Appreciation is also expressed to Ted Thorenson for providing cattle and facilities.

[2] Extension Livestock Specialist, Southeast Kansas.

[3] Extension Beef Specialist, University of Missouri.

Results and Discussion

Performance of the heifer calves receiving Ralgro implants was improved 15% ($P<.05$) compared to controls on the 70% endophyte fungus, tall fescue pastures, but only 5% on the 40 and 45% endophyte pastures (Table 16.1). Similarly, the Ralgro-implanted steer calves showed a 12% improvement in gain on the high endophyte pasture compared to 2.5 to 3.5% responses on the 40 and 45% endophyte-infested pastures (Table 16.2). There was a trend toward lower body condition in the nonimplanted calves on the high endophyte-infested, tall fescue pastures, but this was not statistically significant.

This research supports our earlier work that showed a higher response to Ralgro implants on high compared to low endophyte-infested, tall fescue pastures.

Table 16.1 Effect of Ralgro on Suckling Heifer Performance on Endophyte-Infested Fescue Pastures

	40% Endophyte Pasture		45% Endophyte Pasture		70% Endophyte Pasture	
Item	Control	Ralgro	Control	Ralgro	Control	Ralgro
No. Heifers	51	49	45	47	13	14
Starting Wt., lb	169^{a}	164^{a}	167^{a}	165^{a}	185^{b}	197^{b}
Daily Gain, lb	1.72^{a}	1.80^{a}	1.75^{a}	1.84^{a}	1.72^{a}	1.98^{b}
Body Condition Score at Weaning	6.07	6.00	6.13	6.12	5.77	6.14

^{abc}Means in a row not sharing a common superscript differ ($P<.05$).

Table 16.2. Effect of Ralgro on Suckling Steer Performance on Endophyte-Infested Fescue Pastures

	40% Endophyte Pasture		45% Endophyte Pasture		70% Endophyte Pasture	
Item	Control	Ralgro	Control	Ralgro	Control	Ralgro
No. Steers	39	41	42	39	16	14
Starting Wt., lb	179.6^{f}	178.8^{f}	165.4^{e}	166.7^{e}	200.3^{g}	202.3^{g}
Daily Gain, lb	1.73^{a}	1.79^{ab}	1.80^{ab}	1.84^{ab}	1.88^{b}	2.10^{c}
Body Condition Score at Weaning	5.87	6.02	5.83	5.85	5.75	5.93

^{abc}Means not sharing a common superscript differ ($P<.05$).
^{efg}Means not sharing a common superscript differ ($P<.05$).

Limit Versus Full Creep for Calves Grazing Late Summer Bluestem[1]

Bob Cochran, Gerry Kuhl, Tim DelCurto,
Larry Corah, and Eric Vanzant

Summary

Limit-feeding a soybean meal/milo creep supplement (16% crude protein, average 3.0% salt) was compared with ad libitum consumption of the same supplement without salt or with no supplementation. Little difference was evident in average daily gain of calves among treatments. However, poor supplement consumption may have affected results.

Introduction

Reduced quality of late-summer pasture and declining milk production in cows represent significant nutritional challenges to the suckling calf. Offering supplemental creep feed to calves, on an ad libitum basis, has been one approach to improving performance during this difficult period. However, the efficiency with which creep feed is converted to additional gain appears to be reduced at high levels of creep consumption. Therefore, the objective of this study was to compare ad libitum consumption of creep feed with a limit-creep system, in which salt was used to limit creep consumption.

Experimental Procedures

Ninety Angus x Hereford calves were randomly assigned to three treatments: 1) Limit-creep: salt used to limit consumption of a soybean meal/milo supplement available free-choice in a creep feeder; 2) Full-creep: the same soybean meal/milo supplement without salt, offered free-choice in a creep feeder and; 3) Control: no supplementation. The supplement was comprised of approximately 79.5% rolled milo, 19.5% soybean meal, and 1% soybean oil (to reduce dust) and contained 16% crude protein (CP). Desired level of consumption for the limit-creep group was 1.5 lb/day for each calf. Both supplemented groups were initially exposed to the basal supplement without salt for 2 to 3 days. Salt was then mixed with the supplement offered to the limit-creep group. Concentration of salt in the limit-fed supplement averaged 3% for the duration of the trial.

The three treatment groups grazed three separate bluestem pastures. Stocking rates were similar among treatment groups. Groups were rotated twice during the study, so that each group was exposed to all pastures. Calf weights were taken at trial initiation (August 12, 1987) and termination (October 12, 1987). Before each weigh day, cow/calf pairs were held overnight without feed or water (calves were allowed to suckle their dams).

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[1] Appreciation is expressed to Mr. Gary Ritter and Mr. Wayne Adolph for their expert assistance during the data collection.

Results and Discussion

Little difference was observed among treatment groups in average daily gain (Table 17.1). However, the full-creep group tended (P=.10) to have greater daily gains. Lack of substantial difference among treatments probably reflects poor consumption of creep feed by both supplemented groups. Daily supplement consumption averaged 1.5 lb/day for the full creep group and .8 lb/day for the limit-creep group (approximately .76 lb/day of basal supplement) over the duration of the trial. Creep consumption was highest during the intial 15 to 20 days of the trial but dropped dramatically thereafter. Given the initial willingness to consume supplement, palatability was not considered to be a problem. Altering placement of creep feeders was not successful in encouraging increased creep consumption.

In contrast to our expectations, the low levels of creep feed consumed in this study were not used efficiently for producing additional gain. For the full-creep treatment, consuming 1.5 lb/day of supplement only increased gains by .11 lb/day; 13 lb of supplement were required to produce an additional pound of gain. The additional .76 lb of supplement consumed by the limited group did not promote any additional gain. A possible explanation for the lack of response may lie in the low CP concentration in the supplement (16% CP). Previous research at K-State suggests that utilization of poor quality forage is optimized when supplements contain moderate (26% CP) to high (39% CP) levels of CP. Since CP would be expected to be the first limiting nutrient in late-summer bluestem, using a supplement with higher CP might have improved response to supplementation.

Table 17.1. Initial Weight, Final Weight, and Average Daily Gains of Calves on Different Creep Treatments

Item	No Supplement	Full Creep	Limited Creep
Initial Wt (lb)	393.4	391.0	382.4
Final Wt (lb)	499.1	502.9	485.6
Daily Gain (lb/day)	1.73	1.84	1.69
Supplement consumed (lb/day)	------	1.50	.76

Influence of Limited-Creep Feeding on Pre and Postweaning Performance of Spring Born Calves[1]

Patsy Houghton[2], Frank Brazle[3], Gerry Kuhl,
Bob Schalles, and Keith Zoellner

Summary

Two limited-creep feeding trials were conducted in Northwest and Southeast Kansas using spring-born, suckling calves to evaluate the effect of available forage supply on creep-fed calf performance. Energy vs. protein creep feeds were compared at each location. Creep feed intake was limited with salt to achieve an average daily intake of about 1.5 lb per head. Calves consuming the limited energy and protein creep feeds gained from 0.1 to 0.6 lb more per head daily preweaning, and required 2.3 to 7.6 lb of creep per lb of extra weaning weight. Postweaning gains of the noncreep-fed calves were .12 to .27 lb per day higher than those of creep-fed calves, suggesting some compensation by the control calves postweaning.

Introduction

Kansas producers are interested in improving the carrying capacity of pastures, increasing weaning weights, and achieving top market prices for their calves. Ad lib creep feeding historically has helped cattlemen improve carrying capacity and weaning weights, but feed conversion and economic feasibility have often been unsatisfactory. A promising approach to creep feeding, however, is limiting creep intake to 1 to 2 lbs per day with salt. Recent research has indicated that this method results in feed conversions of 4 to 6 lbs of feed per lb of extra gain. Providing calves a salt-limited creep could be especially beneficial when 1) pastures are in poor condition in late summer (starting around August 1st), 2) during droughts, and 3) in pastures with young cows (2 to 3-year olds).

Use of limited creep in suckling calves looks promising, but questions remain. One question relates to the use of high protein vs. high energy creep. Trials have yielded variable results that could depend upon available forage supply and quality. Another concern relates to the market value of creep fed and limited creep-fed calves at weaning. To demand top prices at weaning, calves must not be overly conditioned by excessive creep feed consumption. Other concerns relate to economic feasibility of creep feeding suckling calves in retained ownership programs where cow-calf producers have the opportunity to capitalize on postweaning compensatory gain.

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[1] Appreciation is expressed to Farmland Industries, Inc. Kansas City, MO for providing creep feed; to the Leland Werth family, WaKeeney, KS for providing cattle, facilities and assistance in data collection; and to J. P. Worcester, and Mick Glaze, Trego and Decatur County Extension Agricultural Agents for their help in data collection.

[2] Extension Livestock Specialist, Northwest Kansas.

[3] Extension Livestock Specialist, Southeast Kansas.

Two trials were conducted to (1) evaluate differences in pre-and postweaning performance of nursing calves on native grass pasture when offered an energy vs. protein, salt-limited creep feed and (2) evaluate the pre-and postweaning productivity of suckling calves receiving salt-limited creep feeds vs. noncreep-fed calves.

Experimental Procedures

Trial 1: One hundred forty-one exotic cross, suckling calves were randomly allotted to three treatments: (1) noncreep-fed controls, (2) energy creep feed or (3) protein creep feed. On August 17, the calves were weighed, paired with cows and moved to three native, short-grass pastures located in Northwest Kansas. Calves allotted to treatments 2 and 3 were provided creep feed in self feeders located in cattle loafing areas. Nutrient content of the creep feeds is detailed in Table 18.1. Creep intake was closely monitored, and salt was added as necessary to limit daily intake to no more than 2 lb per head. Calves were re-weighed on November 2, weaned, implanted, dehorned, and moved to a backgrounding lot. During the 71-day backgrounding period, calves received an average of 8.5 lbs of milo, 1.5 lb of a commercial 36% protein supplement, and a full-feed mixture of 2/3 sorghum silage and 1/3 cane-wheat hay. Final calf weights were obtained on January 11th.

Trial 2: One hundred forty-six Angus-Hereford crossbred, suckling calves were randomly allotted to the same treatments as used in Trial 1. On August 10, the calves were weighed, paired with cows, and moved to three native tallgrass pastures located in the Kansas Flint Hills. Calves on the creep treatments were provided creep feed in enclosed wind-vane feeders at two locations in each pasture. Nutrient content of the creep feeds was identical to that used in Trial 1. Creep feed intake was monitored throughout the 62-day trial. The cow-calf pairs were rotated among the three pastures every 21 days to minimize pasture effects. The calves were reweighed and condition-scored on October 12, weaned, and shipped to the KSU Beef Research Unit for a 65-day growing trial. During this phase, the calves were fed an average of 2.0 lb of a 36% protein supplement, 3 lb of milo, and a full-feed of grain sorghum silage. Final calf weights were obtained on December 16, after an overnight stand without feed and water.

Results And Discussion

Table 18.3 details the pre- and postweaning performance of calves from Trial 1. Calves consuming the energy creep gained .61 lb per day more than noncreep fed calves and .28 lb per day more than protein creep-fed calves (P<.01). Protein creep-fed calves gained .33 lb per day more than noncreep-fed calves (P<.01). Calves receiving the energy creep consumed an average of 1.4 lb per head daily and required 2.3 lb of creep feed per lb extra gain. Protein creep-fed calves consumed an average of 1.6 lb per head daily and required 4.8 lb of creep feed per lb extra gain. Creep feed intake by 24-day periods is outlined in Table 18.2. Neither the energy nor protein creep feeds required the addition of salt to limit intake until the second 24-day period. Both types of creep feed required 6 to 7% salt by the end of the feeding period to limit daily intake to about 1.5 lb per head.

Postweaning performance of creep-fed vs. noncreep-fed calves from Trial 1 is shown in Table 18 .3. Noncreep-fed calves gained about 0.25 lb per day more during the 71-day backgrounding phase than calves receiving either type of creep feed. Final calf weights were similar for all treatments, suggesting that noncreep fed calves produced compensatory postweaning gain.

Preweaning performance of calves from Trial 2 is detailed in Table 18.4. Although daily intake of the energy and protein creep feeds averaged only .83 and .38 lb per head, respectively, for the 73-day test, creep-fed calves still gained an average of 0.13 lbs/day more than noncreep fed calves (P<.08). This resulted in 7.6 lb and 2.7 lb of creep feed per lb of extra gain for the energy and protein creep-fed calves, respectively. Condition scores were higher (P<.08) for energy creep-fed calves than noncreep-fed calves; however, protein creep-fed calves were not different from noncreep-fed or energy creep fed calves. Postweaning gains of the noncreep-fed calves averaged .12 lb and .21 lb per head daily higher than that of the energy and protein creep-fed calves, respectively, durng the 65-day growing period.

Table 18.1. Nutrient Composition of Experimental Creep Feeds used in Trials 1 and 2 [a]

Nutrient	Energy Creep	Protein Creep
Crude Protein, %	16.0	36.0
Crude Fiber, %	11.2	11.5
TDN, %	69.5	68.6
Calcium, %	.85	.85
Phosphorus, %	.85	.85

[a] Nutrient composition expressed on an air-dry (90% dry matter) basis. Creep feeds as supplied to KSU by Farmland contained no added salt; however, salt was added as needed to limit creep feed intake to 1.5-2.0 lbs/hd/day.

Table 18.2.Limited Creep Feed Intake Over 73-Day Preweaning Period (Trial 1)

	Limited Energy Creep		Limited Protein Creep	
Period	Avg. Daily Intake, lb	% Salt	Avg. Daily Intake, lb.	% Salt
First 24 Days	.42	0	1.12	0
Second 24 Days	1.56	5	1.76	6
Third 24 Days	2.21	6	2.04	7
Overall 73 Days	1.40	--	1.60	--

Table 18.3. Effect of Limited Creep Feeding on Pre- and Postweaning Calf Performance (Trial 1)

Item	No Creep	Limit-fed Energy Creep	Limit-fed Protein Creep
Preweaning Calf Performance-73 Days on Native Grass:			
No. Calves	49	44	48
Initial Wt., lb	386	395	383
Weaning Wt., lb	505^a	557^b	525^{ab}
Total Gain, lb	118^c	162^d	142^e
Daily Gain, lb	1.62^c	2.23^d	1.95^e
Daily Creep Intake, lb.[4]	----	1.4	1.6
Creep/Extra Gain, lb.[5]	----	2.3	4.8
Postweaning Calf Performance-71-Day Backgrounding Period:			
No. Calves	41	37	42
Weaning Wt., lb	522^a	558^b	540^{ab}
Final Wt., lb	651	668	651
Total Gain, lb	129^a	110^b	112^b
Daily Gain, lb	1.82^a	1.55^b	1.59^b

[ab] Means in a row not sharing the same superscript differ ($P<.05$).
[cde] Means in a row not sharing the same superscript differ ($P<.01$).
[3] Total number of calves preweaning = 141; Total number of calves postweaning = 120.

Table 18.4. Effect of Limited Creep Feeding on Pre- and Post-weaning Calf Performance (Trial 2)

Item	No Creep	Limit-fed Energy Creep	Limit-fed Protein Creep
Preweaning Performance-73 Days on Native Grass:			
No. Calves	47	51	48
Initial Wt., lb	342	365	365
Weaning Wt., lb	450	480	482
Total Gain, lb	108^a	115^b	117^b
Daily Gain, lb	1.75^a	1.86^b	1.89^b
Condition Score[1]	6.84^a	7.04^b	6.96^{ab}
Daily Creep Intake, lb[2]	----	.83	.38
Creep/Extra Gain, lb	----	7.6	2.7
Postweaning Performance-65 Days:			
Total Gain, lb	178^b	170^{ab}	165^a
Daily Gain, lb	2.74^b	2.62^{ab}	2.53^a

[ab] Means in a row not sharing the same superscript differ ($P<.08$).
[1] Body condition scores: 1 = extremely thin, 9 = very fleshy.
[2] Average daily creep intake over entire 73-day preweaning period. Due to little or no creep feed intake for the first 30 days of the trial, dry molasses was added to the creep feed to get the calves started eating.

Effect of Limited - Creep Feeding on Performance of Spring-Born Calves[1]

Danny Simms[2] and Gerry Kuhl

Summary

Three limited-creep feeding trials were conducted with spring-born suckling calves on native grass. The 16% crude protein, high energy creep feed containing Bovatec® was fed from mid-August to weaning in mid-October. Limited-creep feeding increased ($P<.05$) calf gains .19 lb per/head/daily with an average daily consumption of 2.15 lb, giving a creep feed-to-gain conversion rate of 11.2.

Introduction

Native grass in Kansas declines in energy and crude protein during late summer and fall. Correspondingly, milk production of spring calving cows declines during the grazing season, resulting in reduced calf nutrition. Traditional creep feeding programs have not been economical because of excessive creep consumption and poor creep-to-gain conversion. Limiting creep intake by using salt as an intake inhibitor should improve creep conversion and be economical. Thus, three field trials were conducted to evaluate limited-creep feeding of spring-born calves.

Experimental Procedures

In each trial, spring-calving cows and their calves were randomly assigned to pastures and treatments: (1) Control-no creep or (2) Limited-Creep. At the start of each trial, a 16% protein, 5% salt, pelleted creep feed containing 75 mg Bovatec/lb was placed in the limited-creep pastures. When daily intake exceeded about 4 lb per head, a 10% salt pelleted creep feed replaced the 5% salt creep feed. All trials were initiated in mid-August and terminated in mid-October. Individual, non-shrunk weights were taken at initiation and termination of the trials. In all three trials, cow/calf pairs grazed native grass pastures.

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[1] Appreciation is expressed to John Schmitz, Farmland Industries, Inc., Kansas City, MO for supplying creep feed; to Bruce Hightshoe, Lawrence, KS, Dick Poovey, Paxico, KS, and Jerry Wheeler, Larkinburg, KS for supplying cattle; and facilities; and to Bill Wood and Gene Harder, Wabaunsee and Jackson County Extension Agricultural Agents for assistance with data collection.

[2] Extension Livestock Specialist, Northeast Kansas.

Results and Discussion

As shown in Table 19.1, limit-creep feeding increased ($P<.05$) average daily gains in two of the three trials and when all of the trials were combined ($P<.05$). Gain response and conversion of creep-to-extra gain were variable. The overall conversion rate of 11.2 lb of creep per pound of extra gain was much poorer than in previous studies (1987 Cattlemen's Day) of limited-creep feeding.

The poor conversion rates may be a function of the creep intake patterns exhibited during the course of these trials. That is, while the average daily feed consumption was only slightly above the goal of 2 lb per head in all three trials, the calves consumed very little of the creep feed early in the trials and consumed well over the goal late in the trials.

Based on the research conducted on limited-creep feeding to date, the following recommendations appear warranted:

1. Start calves on a very low (0 to 2%) salt level until they are readily consuming (1.5-2.0) lb/head daily) the creep feed. The initial creep ration must be very palatable to stimulate intake.

2. Monitor consumption and adjust the salt level to maintain daily intakes of 1.5 to 3.0 lb of feed per head. Maintenance of desirable intake levels will require frequent monitoring and adjustment of salt levels.

Based on these field trials, a meal form of creep feed is preferable to a pelleted form, since it is easier to adjust the salt level.

Table 19.1. Results of Limited-Creep Feeding Trials

Trial	Length of Trial (Days)	Average Daily Gain, lbs Control (n)	 Limited-Creep (n)	Average Daily Consumption, lb	Creep to Gain Conversion
1	54	1.68^{a}(72)	1.81^{b}(107)	2.08	16.0
2	71	2.12_{a}(19)	2.24_{b}(26)	2.11	8.8
3	63	2.01^{a}(20)	2.61_{b}(20)	2.54	4.2
Combined		1.81^{a}(111)	2.00^{b}(153)	2.15	11.2

n = Number of calves.

^{ab}Means in a row with different superscripts are different ($P<.05$).

Effect of Depo-MGA on the Prevention of Pregnancy in Grazing Heifers[1,2]

L.R. Corah, F.K. Brazle,[3]
G.W. Boyd[4], and T. Goehring[5]

Summary

Two field trials were conducted to evaluate various dosage levels of Depo-MGA® for preventing pregnancy in grazing heifers. Injecting Depo-formulated MGA subcutaneously in the ear at dosages of 60, 90 or 120 mg effectively prevented pregnancy for up to 135 days. There was no effect on average daily gain.

Introduction

Unwanted pregnancies in grazing heifers cause major economic losses to cattlemen. In the past, methods of preventing these pregnancies have focused predominantly on management systems, such as spaying.

Recent research has shown that melengestrol acetate (MGA) in solution, injected subcutaneously in the ear may prevent pregnancy in heifers. Our objectives were to evaluate the efficacy of Depo-MGA in 1) preventing pregnancies 2) stimulating additional weight gain in grazing heifers.

Experimental Procedures

Two field trials were conducted at cooperating ranches in Kansas. At each location, 100 crossbred heifers were allotted by weight to the following treatments: 1) control; 2) 30 mg Depo-MGA in .5 ml soultion; 3) 60 mg Depo-MGA in 1.0 ml solution; 4) 90 mg Depo-MGAin 1.5 ml solution; and 5) 120 mg Depo-MGA in 2.0 ml solution injected subcutaneously on the backside of the ear. Prior to the start of the trial, all heifers were pregnancy checked to make sure that only open heifers were used. At the start of the trial, heifers were weighed within 4 hours of removal from pasture, injected with the designated dosage of Depo-MGA, and then maintained on fall or winter pasture; winter fescue pasture at one location and intermediate native

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[1] Appreciation is expressed to the UpJohn Company for providing the Depo-MGA® and partial funding support of the research trial.

[2] Appreciation is expressed to Ron Wells at Gridley, Kansas, and Jack and Allen Grothusen at Ellsworth, Kansas, for kindly allowing the trial to be conducted at their cattle operations.

[3] Southeast Kansas Area Extension Specialist.

[4] Former Ext. Ass't at KSU - Currently at Colorado State University.

[5] Former Ext. Ass't at KSU - Currently at American Angus Assoc.

grass pasture at the other. Within one week after injection, five fertile bulls were placed with the heifers. Supplement was feed at both locations to maintain weight gain from 1/4 to 1/2 lb per head per day.

The cattle were evaluated for pregnancy via rectal palpations 60, 90, 135, 180, and 240 days postinjection to determine the length of efficacy of the various Depo-MGA dosages. At 135 days, the cattle were weighed again within 4 hours of removal from grass and all cattle confirmed pregnant were removed from the trial.

Results

All four dosages of Depo-MGA prevented pregnancy up to 90 days (Table 20.1). At 135 days, the dosages of 60, 90 and 120 mg were fairly effective in preventing pregnancies. At 180 and 240 days, only the 90 and 120 mg dosages prevented pregnancies.

There was no beneficial effect on average daily gain in either trial. This is inconsistent with previous feedlot trials conducted at Kansas State University and other locations, in which the use of Depo-MGA improved average daily gain. However, in those feedlot trials, the daily gains were in excess of 2.5 pounds, whereas in the current trials gains were only marginal; 1/2 pound per day or less. This may have negated a potential effect on weight gain. It should be noted that Depo-MGA is currently (at the date of this report) not cleared for use in the cattle industry.

Table 20.1. Effect of Depo-MGA Dosages on Weight Gain and Pregnancy Prevention

		% Pregnancy				
Dosage of MGA	ADG	60 days	90 days	135 days	180 days	240 days
Location 1						
0	.29	20	50	70	70	85
30	.23	---	5	35	60	65
60	.35	---	5	10	20	35
90	.3	---	---	---	---	10
120	.34	---	---	---	---	---
Location 2						
0	.41	35	70	85	100	100
30	.32	5	5	50	70	80
60	.49	5	5	10	50	55
90	.47	---	---	15	20	30
120	.47	---	---	10	30	30

The Effect of Physical Characteristics on the Price of Stocker and Feeder Cattle[1]

Frank Brazle[2], James Mintert[3],
Ted Schroeder[3], and Orlen Grunewald[3]

Summary

A survey of feeder cattle sales was conducted at seven Kansas cattle auctions during 1986 and 1987. A wide variety of physical characteristics was found to influence feeder cattle prices. The price impact resulting from changes in fill and condition varied seasonally. Although calves showing any signs of health problems received severe price discounts, the presence of other undesirable characteristics also resulted in discounts, but to lesser degrees.

Introduction

Feeder cattle price involves the interaction of many factors. Price differentials among lots of feeder cattle should reflect differences in supply and demand of the cattle in various weight and grade categories. As a result, the relative price premiums and discounts among lots of feeder cattle at a given location should reflect the demand for specific traits of a lot, such as sex, weight, number of head, breed, health, grade, and condition. This study's objective was to examine the effect of a wide variety of physical characteristics on Kansas feeder cattle prices.

Experimental Procedures

Data on prices and physical traits of stocker and feeder cattle were collected by a trained staff from seven weekly Kansas cattle auction markets. The date, location, time of sale, price, average weight per head, health, muscling, condition, fill, frame size, sex, breed, presence of horns, and lot uniformity were recorded for each lot sold. Fall data were collected from October 31, 1986 through December 13, 1986; spring data were collected from March 19, 1987 through April 15, 1987. Only data from steers, heifers, and bulls weighing between 300 and 900 lbs. were used. This included 18,534 lots of cattle consisting of 141,677 head. Fifty-eight percent were sold in the fall; 42% were sold in the spring. Fifty-six percent were steers, 3% were bulls, and 41% were heifers. The multiple regression technique used to analyze the data made it possible to independently evaluate each trait's price impact and accounted for the effect on price of interactions between traits.

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[1] We gratefully acknowledge the data collection assistance of Garth Boyd, Jeff Davidson, Al Dinkel, Terry Goering, Scott Laudert, and John Requa.

[2] Southeast Kansas Area Extension Specialist.

[3] Department of Agricultural Economics.

Results and Discussion

The price relationship between weight and sex is shown in Table 21.1. Weight had a nonlinear impact on feeder cattle price, with price declining as weight increased. The lighter the weight, the smaller the price spread between steers and bulls. The price spread for steers vs. heifers as well as for steers vs. bulls narrowed in the spring. These changes from fall to spring may have reflected the classes and weights of cattle desired for spring and summer grazing.

Lot size had a significant impact on price -- buyers preferred large lots. Figure 21.1 shows the effects of lot size on steer prices. The largest premiums were for lots of 55 to 65 head, with a premium in excess of $5/cwt. relative to single-head lots. Similar results were found for heifers. Sellers can capture a large portion of this premium by marketing cattle in groups of at least 30 head.

The visual indication of health had a profound influence on price. Cattle with mud on their hair received $1.25 to $1.80/cwt. discounts (Table 21.2). "Stale" cattle, characterized by watery eyes and runny noses, received price discounts of $4.65 to $5.35/cwt. Obviously sick cattle were discounted approximately 25% of the average price of healthy cattle.

The effects of condition (flesh) on price are reported in Table 21.3. During the spring, very thin cattle did not receive significant price discounts. However, during the fall, very thin steers were discounted approximately $5/cwt, and very thin heifers, over $6/cwt., relative to cattle in average condition. During the fall, fleshy cattle were not discounted, but they were discounted by approximately $1.00 to $1.25/cwt. in the spring. There are clear-cut financial incentives for producers to market feeder cattle in the fall in average to slightly fleshy condition, but in only average condition in the spring.

The effects of fill on price are reported in Table 21.4. Gaunt steers sold for a premium of $1.25/cwt. over average cattle in the spring, but did not earn a premium in the fall. Full cattle were discounted much more in the spring than during the fall. The seasonal effect of condition and fill may be related to the fact that more health problems normally occur in the fall than during the spring. The data suggest that buyers perceive fleshier cattle with average fill as being better able to withstand winter health problems and are willing to pay a premium for those cattle.

The effects of frame size and breed are reported in Tables 21.5 and 21.6, respectively. Table 21.5 reports the effects of frame size on the price of Hereford cattle only. Hereford steers and heifers falling into the small and the lower half of the medium frame category (Table 21.5) received significant discounts, with small frame heifers discounted $10/cwt. compared to heifers in the upper half of the medium frame category.

Breed type influenced the prices buyers were willing to offer for feeder cattle, as indicated in Table 21.6. Premiums and discounts are calculated relative to a Hereford of the same sex and frame size. Consequently, price variation attributable to differences in frame size, rather than breed type, have been accounted for and removed.

There was little difference in price for uniform vs. nonuniform cattle. Less than 6% of the cattle sold were identified as nonuniform, indicating that most of the sale barns were sorting the cattle into good, uniform groups. Steers with horns were discounted $.50/cwt., and mixed horned and nonhorned cattle were discounted $.25/cwt. This price premium for dehorned cattle may not pay for the setback in performance, if dehorning is delayed until the cattle weigh 500 to 600 lbs. Light-weight calves may be less adversely affected by dehorning and, consequently, there may be some economic advantages to removing horns from light-weight calves.

The degree of muscling also influenced price. As one might expect, lighter muscled cattle were discounted in relation to heavier muscled cattle.

Table 21.7 identifies the price impact attributable to the time during the auction when cattle were sold. The lowest prices were received during the first part of the sale. If cattle were not sold in the first quarter of the sale, time of sale did not appear to have a significant impact on price.

Conclusion

Kansas cattle producers are encouraged to review the information in this report to become more familiar with the premiums and discounts associated with various feeder cattle characteristics. Although the price changes attributable to the various characteristics will vary somewhat from sale to sale, these survey results should provide a good guideline for both buyers and sellers of feeder cattle.

Table 21.1. Effects of Sex and Weight on Price Discounts of Cattle at Auctions

Season and Category	Percent of Cattle	Weight Range (lbs)[a]					
		300-399	400-499	500-599	600-699	700-799	800-899
Spring							
Steers	58.6	Base	Base	Base	Base	Base	Base
Bulls	1.8	-1.62*	-1.41*	-1.70*	-2.48*	-3.77*	-5.55*
Heifers	39.6	-9.78*	-7.85*	-6.40*	-5.44*	-4.97*	-4.97*
Fall							
Steers	54.7	Base	Base	Base	Base	Base	Base
Bulls	3.2	-2.65*	-3.60*	-4.37*	-4.95*	-5.37*	-5.60*
Heifers	42.1	-10.24*	-8.23*	-6.71*	-5.65*	-5.08*	-4.98*

[a] Discounts are based on the midpoint of each weight category, e.g., 300-399. is calculated for cattle weighing 350 pounds.

*Indicates significantly different from zero at the .05 level.

Table 21.2. Effects of Health on Price Discounts of Cattle at Auctions

Health Status	Percent of Cattle (%)	Steers ($/cwt.)	Heifers ($/cwt.)
Healthy	76.3	Base	Base
Dead Hair or Mud	22.0	-1.22*	-1.40*
Stale	1.1	-4.65*	-5.34*
Sick	0.1	-19.32*	-20.53*
Bad Eye	0.3	-8.35*	-7.58*
Lame or Lump	0.2	-14.65*	-14.28*

*Indicates significantly different from zero at the .05 level.

Table 21.3. Effects of Condition on Price Discounts of Cattle at Auctions

Condition	Percent of Cattle (%)	Steers		Heifers	
		Spring ($/cwt.)	Fall ($/cwt.)	Spring ($/cwt.)	Fall ($/cwt.)
Very Thin	0.4	+0.61	-4.97*	-1.56	-6.20*
Thin	9.1	-0.21	-1.55*	-0.59*	-0.88*
Average	75.2	Base	Base	Base	Base
Fleshy	15.2	-1.17*	+0.36*	-1.09*	-0.67
Fat	0.1	-1.28	+0.02	0.74	-2.11*

*Indicates significantly different from zero at the .05 level.

Table 21.4. Effects of Fill on Price Discounts of Cattle at Auctions

Fill	Percent of Cattle (%)	Steers		Heifers	
		Spring ($/cwt.)	Fall ($/cwt.)	Spring ($/cwt.)	Fall ($/cwt.)
Gaunt	1.0	+1.24*	+0.15	+1.31*	-0.69*
Shrunk	12.3	+0.56*	+0.02	+1.13*	-0.01
Average	76.8	Base	Base	Base	Base
Full	9.8	-2.60*	-0.77*	-3.20*	-1.21*
Tanked	0.1	-7.54*	-7.78*	-10.59*	-7.84*

*Indicates significantly different from zero at the .05 level.

Table 21.5. Effects of Frame Size on Price Discounts of Hereford Feeder Cattle at Auctions

Frame Size	Percent of Cattle (%)	Steers ($/cwt.)	Heifers ($/cwt.)
Large	11.0	-1.11	1.35
Medium - Upper 1/2	72.3	Base	Base
Medium - Lower 1/2	15.9	-2.13*	-1.22*
Small	0.9	-7.69*	-10.04*

*Indicates significantly different from zero at the .05 level.

Table 21.6. Effects of Breed Type and Frame Size on Price Discounts of Cattle at Auctions

		STEERS Frame Size				HEIFERS Frame Size			
Breed	Percent of Cattle (%)	Large	Medium Upper 1/2	Medium Lower 1/2	Small	Large	Medium Upper 1/2	Medium Lower 1/2	Small
Hereford	8.1	Base	Base	Base	Base	Base	Base	Base	Base
Angus	7.4	-0.54	-0.73*	-1.86*	-4.62*	-2.80*	-1.10*	-2.08*	-0.48
White Face (black or red)	19.0	-0.63	+0.53*	+0.93*	-3.80*	-2.23	+0.61*	+0.10	-1.47
Other English Crosses	0.8	-6.24*	-1.77*	-1.70*	-3.56*	-1.13	-0.34	-1.84*	+0.92
Exotic Crosses	21.5	+1.29	+0.66*	-0.54	+3.27	-0.05	+0.99*	-0.74	+7.77*
Brahman less than 1/4	5.1	-0.70	-1.65*	-2.47*	-3.21	-1.83*	-0.81*	+1.77	NA
Brahman greater than 1/4	0.8	-4.15*	-6.00*	-8.28*	NA	-6.88*	-4.48*	-3.83	NA
Dairy	1.8	-6.96*	-9.04*	-12.80*	NA	-10.45*	-8.72*	-4.68*	NA
Longhorn	0.7	-5.18*	-6.93*	-2.20	NA	-7.93*	-6.11*	-4.05*	NA

*Indicates significantly different from zero at the .05 level.
NA Indicates insufficient observations available for calculation.

Table 21.7. Effects of Quarter of Sale on Price Discounts of Cattle at Auction

Quarter of Sale	Percent of Cattle (%)	Steers ($/cwt.)	Heifers ($/cwt.)
1st	8.2	Base	Base
2nd	66.1	+1.99*	1.59*
3rd	24.0	+1.17*	1.17*
4th	1.7	+1.24*	0.91*

*Indicates significantly different from zero at the .05 level.

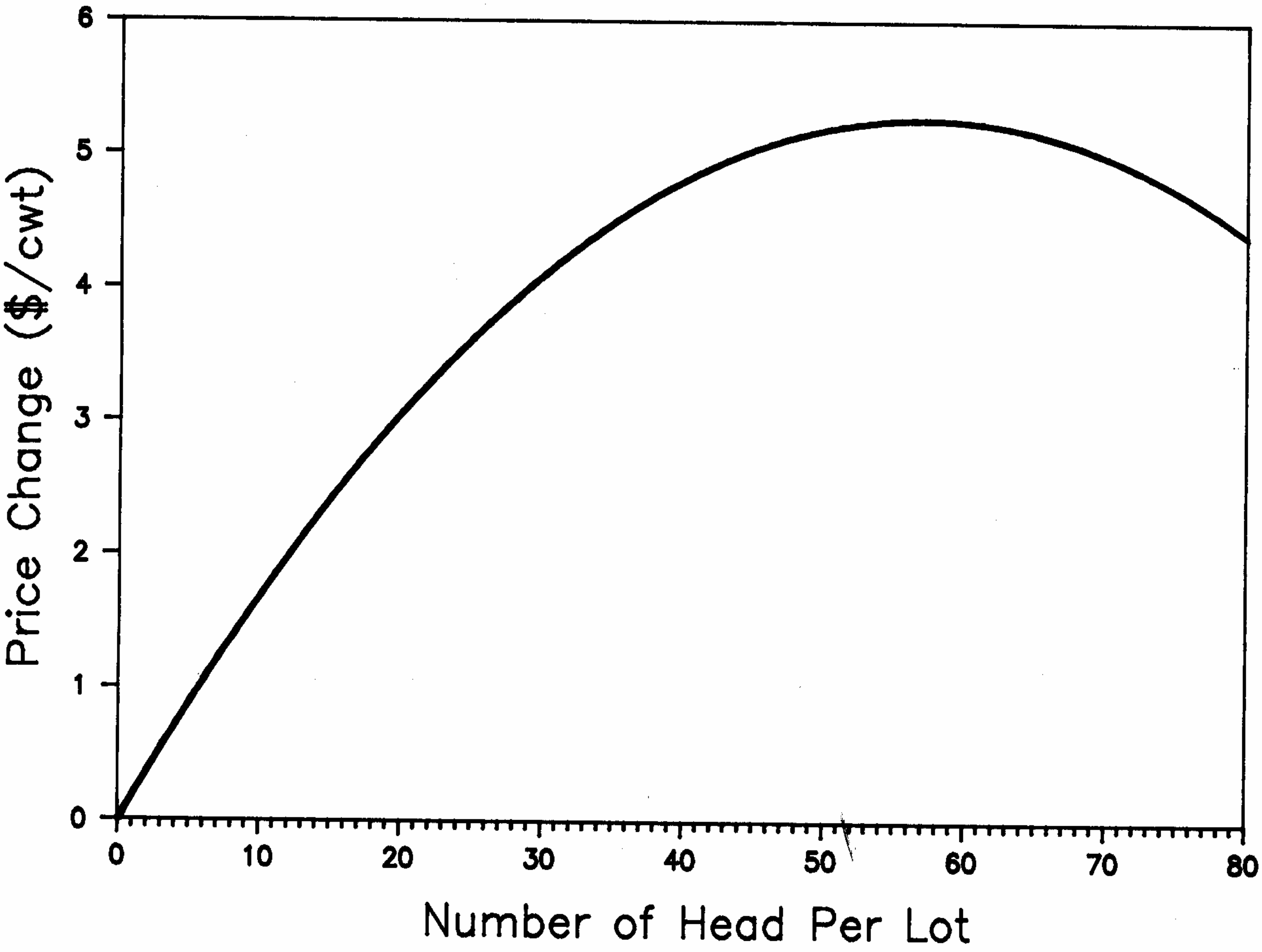

Figure 21.1. Effect of Lot Size on Steer Price

The Effect of Physical Characteristics on Cow Price Differentials in Kansas[1]

Frank Brazle[2], James Mintert[3],
Ted Schroeder[3], and Orlen Grunewald[3]

Summary

A survey of cow sales was conducted in the fall of 1986 and spring of 1987 at seven Kansas cattle auctions. Several factors significantly influenced cow prices, including health, estimated dressing percentage, lot size, breed, and time of sale. Changes in dressing percentage explained the major portion of cow price variation.

Introduction

Knowledge of the effect of physical characteristics on cow prices may influence cow-calf producers' management of cull cows. The objective of this study was to identify the physical characteristics of cows that have a significant impact on cow price and measure those price impacts.

Experimental Procedures

Seven cattle auctions in Kansas were surveyed for 6 weeks in the fall (October 31 to December 13) of 1986 and 5 weeks in the spring (March 19 to April 15) of 1987. 7,105 cows were evaluated. The auctions surveyed were in Dodge City, Fort Scott, Manhattan, Parsons, Pratt, Russell, and Salina. The cows were evaluated for health, grade, dressing percentage, weight, price, lot size, and time sold. Prices were adjusted for both the market location and sale date. The interactions among various characteristics was accounted for via interaction terms in the multiple regression analysis. This analytical approach made it possible to evaluate the economic impact of individual characteristics, independent of the cows' other attributes.

Results and Discussion

A larger percentage of cows (66%) was sold in the fall compared to the spring (34%). The average cow in the spring of 1987 sold for $9.34/cwt. more than the average cow in the fall of 1986 (Table 22.1). On average, the cows were thinner in the spring than the fall, as shown by cow grade. Cow grades of 1 and 2 are canner and cutter cows. Grade 3 are utility boning cows, and Grade 4 are utility breaker and commercial cows. The base cow was defined as healthy, grade 3, Hereford, weighing 969 lbs., with a dressing percentage of 45, and sold during the first quarter of the sale.

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[1] We gratefully acknowledge the data collection assistance of Garth Boyd, Jeff Davidson, Al Dinkel, Terry Goering, Scott Laudert, and John Requa.

[2] Southeast Kansas Area Extension Specialist.

[3] Department of Agricultural Economics.

The seasonal price impact of dressing percentage is reported in Table 22.2. Cows with dressing percentages below 45 sold in the spring received slightly larger price discounts than similar cows sold in the fall. For example, a cow having a dressing percentage of 40 was discounted $2.75/cwt., compared to the base in the spring, whereas this dressing percentage received a $2.60/cwt. discount in fall. The premiums and discounts associated with changes in dressing percentage correspond to the expected change in the cows carcass value. Interestingly, spring-sold cows received smaller premiums than fall-sold cows as their dressing percentage increased above that of the base cow. This fall price premium may be attributable to the increased availability during the fall and winter of surplus forage resources, such as corn or milo stalks, which tends to increase farmers' demand for higher quality cows.

The effects of the interaction between weight and dressing percentage on cow price are the focus of Table 22.3. At low dressing percentages (40%), cows weighing less than 950 pounds were discounted, whereas at high dressing percentages (45 and 50%), light weight cows tended to receive a premium. This transition might be explained by packers effectively discounting the very light weight carcasses expected from light weight cows with low dressing percentages. Premiums and discounts associated with weight differences within a given dressing percentage should be viewed with some caution, since none of the price changes was significantly different from zero (P>.05).

Figure 22.1 indicates that increasing lot size had a positive impact on cow price. However, the magnitude of the effect was small. Cows in groups of 12 to 14 sold for $1.30/cwt. more than single cows. Groups of 6 to 8 cows received a premium of more than $1/cwt.

Health-related influences on cow price are in Table 22.4. Cows classified as having bad eyes or exhibiting any growth or protrusion in the eye were discounted. Buyers discounted cows with enlarged briskets (indicative of hardware disease) by over $5/cwt. From a management standpoint, these results suggest that a cow showing any sign of bad eyes, etc., should be sold before her cull value decreases as a result of her physical deterioration.

The premiums attributed to the various breed classifications relative to Herefords are in Table 22.5. Over half of the cows evaluated were in lots classified as Herefords, Angus, or mixed lots of Hereford and Angus. No statistically significant premiums were identified for the Angus or mixed Hereford and Angus lots relative to the Hereford lots, although on average, both groups received a slight premium over Herefords. White-faced cows received statistically significant, but small, premiums over Herefords, whereas exotic cross cows received premiums of $1.30/cwt. to $2.00/cwt. Exotic breed cattle are often heavier muscled than English breed cattle, suggesting somewhat higher meat yields. That factor apparently was bid into the exotic cattle live price. Surprisingly, Brahman cows received a premium over Herefords, with those judged to be less than 1/4 Brahman earning a $1.16/cwt. premium and those having more than 1/4 Brahman blood receiving an average premium of $1.74/cwt. It seems likely that the premium for Brahman cattle reflects their tendency to have somewhat higher dressing percentages than similar cattle of other breeds. Dairy cattle also tend to have higher dressing percentages, which helps explain their slight premium over Hereford cows. Finally, Longhorn cross cows also received premiums over Hereford cows; an average of $2.30/cwt. Since less than 1% of the cows were identified as Longhorn crosses, their premium could be attributable to a few buyers desiring Longhorn cows for other than slaughter purposes.

Table 22.6 highlights the expected price change resulting from selling cows during different parts of the sale. There was very little difference in the sale price received for cows sold during the first, second, and third quarters of the sale, but cows sold in the fourth quarter, after 8 p.m., received a statistically significant discount of $1.48/cwt. These results suggest that the time of a cow's sale has little impact on price received, unless the cow is sold so late that many potential buyers have already left.

Conclusions

This study implies that cow-calf producers interested in improving the prices they receive for their cull cows should consider several management practices: 1) bunch cows to increase lot size, 2) sell cows before eye problems, etc., reduce their value, and 3) feed some of the lighter-weight cows to increase their weight.

Table 22.1. Averages for Selected Cow Data from Spring and Fall Auctions

Item	Spring Average	Fall Average
Price	$42.50/cwt.	$33.16/cwt.
Weight	971.11 lbs.	967.82 lbs.
Estimated Dressing percent	44.38	45.09
Grade[a]	2.31	2.57

[a] Grade is coded as very thin = 1, thin = 2, average = 3, fat = 4.

Table 22.2. Effects of Season and Dressing Percentage on Cow Price Differential at Auctions (adjusted to grade 3, 969 lbs.)

Dressing Percent	Percent of Cows	Spring ($/wt)	Fall ($/wt)
40 & under[a]	11.2	-2.75*	-2.60*
41-43[b]	7.7	-1.70*	-1.65*
44-46[b]	11.9	Base	Base
47-49[b]	7.9	1.87*	1.93*
50 & over[c]	8.9	3.20*	3.37*

[a] Price change calculated for dressing percent of 40.

[b] price change calculated for midpoint of the range, e.g., 41-43 calculated for a dressing percent of 42.

[c] Price change calculated for dressing percent of 50.

*Indicates significantly different from zero at the .05 level.

Table 22.3. Effects of Weight and Dressing Percentage on Grade 3 Cow Price Differential at Auctions

Weight	Percent of Cows	Dressing Percentage 40	Dressing Percentage 45	Dressing Percentage 50
699 & Under[a]	4.4	-0.91	1.02	NA
700 - 799[b]	11.0	-0.58	0.60	NA
800 - 899[b]	20.7	-0.28	0.26	0.79
900 - 999[b]	24.0	Base	Base	Base
1000 - 1099[b]	19.1	0.25	-0.17	-0.60
1100 - 1199[b]	11.4	NA	-0.27	-0.86
1200 & Over[c]	9.5	NA	-0.28	-1.22

[a] Price change calculated for a weight of 650.

[b] Price change calculated for the midpoint of the range, e.g., 900-999 lbs. is for a 950 lb. cow.

[c] Price change calculated for a weight of 1250.

NA indicates insufficient observations available for calculation.

Table 22.4. Effect of Health Problems on Cow Price at Auctions

Health Problem	Percent of Cows	Price Change ($/cwt.)
Bad Eyes	4.5	-8.99*
Hardware Disease	0.4	-5.33*
Knots	5.0	-3.68*

*Indicates significantly different from zero at the .05 level.

Table 22.5. Effect of Breed Type on Cow Price

Breed	Percent of Cattle	Price Change ($/wt)
Hereford	27.8	Base
Angus	19.6	0.24
Herefords and Angus mixed	7.0	0.35
White face (black or red)	18.5	0.36*
Other English cross	3.4	0.82*
Simmental, Charolais, Gelbvieh and Maine-Anjou	9.6	1.30*
Other Exotic cross	1.7	2.03*
Brahman (less than 1/4)	1.5	1.16*
Brahman (greater than 1/4)	0.3	1.74*
Dairy	5.4	0.79*
Longhorn cross	0.9	2.29*

*Indicates significantly different from zero at the .05 level.

Table 22.6. Effect of Quarter of Sale on Cow Price at Auctions

Quarter of Sale	Percent of Cattle	Price Change ($/cwt.)
1st	66.7	Base
2nd	11.5	0.02
3rd	18.9	-0.08
4th	3.0	-1.48*

*Indicates significantly different from zero at the .05 level.

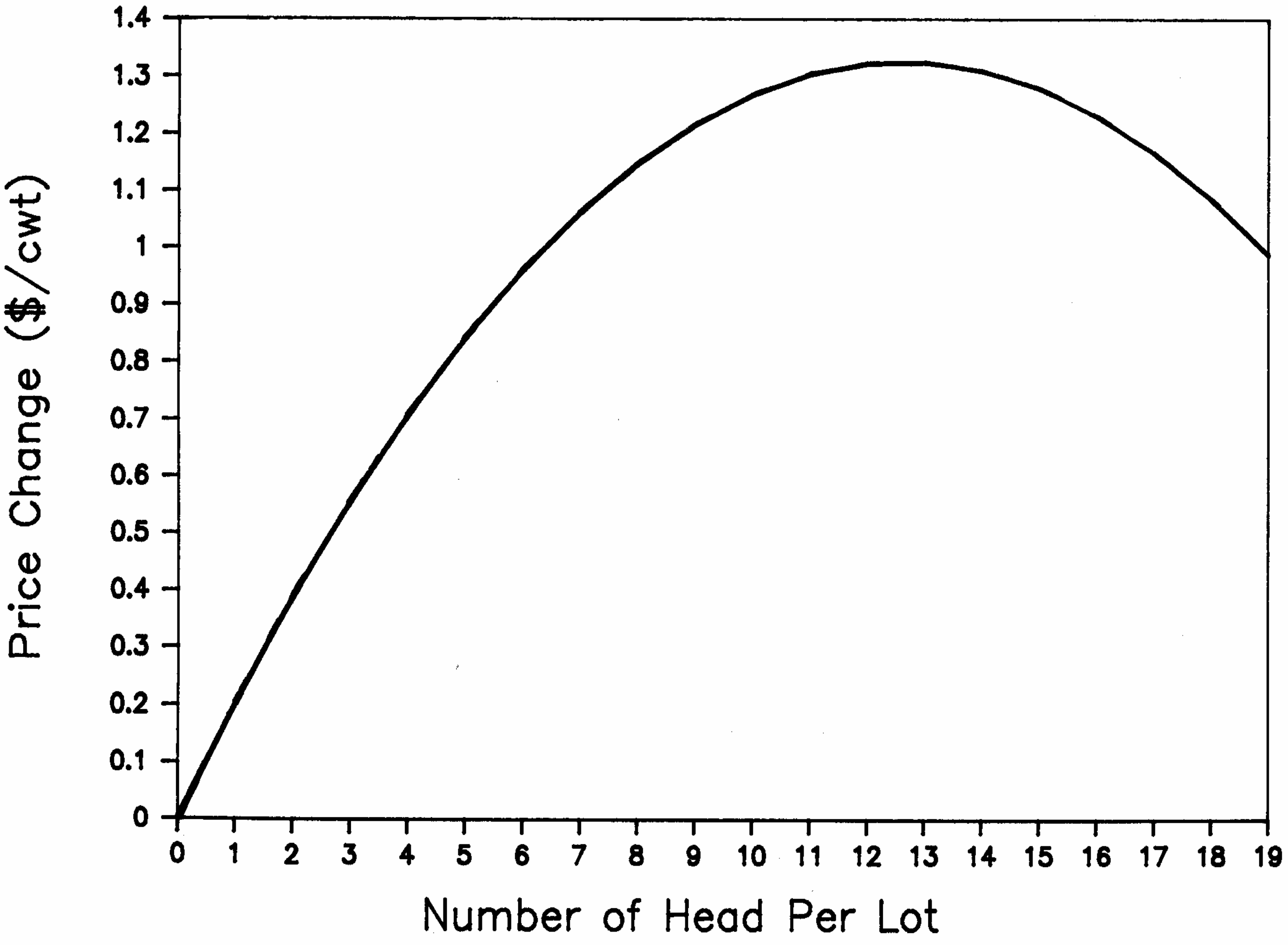

Figure 22.1. Effect of Lot Size on Cow Price

Farm, Wholesale, and Retail Beef Price Relationship[1]

Ted Schroeder[2]

Summary

Analysis of weekly retail, wholesale, and farm beef price data indicated that a time lag exists between price changes at the various market levels. Farm-level slaughter cattle price changes typically lead wholesale beef price changes by 2 to 3 weeks. Similarly, wholesale beef price changes typically lead price changes at the retail level by 3 to 4 weeks.

Introduction

The temporal relationships among live, wholesale, and retail beef prices changes are important in effectively monitoring and analyzing the conduct and performance of the meat processing and retailing industry. Knowledge of how prices at the various market levels react to one another is useful for private as well as public policy decision making.

Frequently, in the short-term, cattle prices decline during periods when retail beef prices are not declining. This leads to a short-term increase in the farm-to-retail beef price margin. Similarly, when slaughter cattle prices are increasing, retail beef prices may not be increasing simultaneously, resulting in a temporary decline in the farm-to-retail price spread. Retail beef price patterns reflect wholesale prices of previous weeks, which in turn, are responding to changes in slaughter cattle prices of earlier weeks. Thus, prices at separate market levels on a given day do not reflect the same set of market information.

The time required to move beef from feedlots to retail shelves, including transporting, processing, and packaging, is one factor contributing to the lag in price response at the different market levels. However, attempts by retailers to curtail short-term price fluctuations at the retail level may also dampen the response. Retailers typically sell meat about a week after purchase. Since virtually no aging of beef occurs after slaughter, the physical process of transporting beef from the farm to the retail shelf typically takes less than 3 weeks. If retailers are using markup pricing, they will adjust retail prices to reflect changes in what they have to pay for meat at the wholesale level.

The objective of this study was to determine the typical lead-lag relationship between retail, wholesale, and farm beef prices. Knowledge of the typical lag length of price changes across market levels provides some explanation as to why the farm-

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[1] Helpful comments on this paper from Jim Mintert are acknowledged.

[2] Department of Agricultural Economics.

to-retail beef price spread fluctuates during periods of volatile live cattle prices. In addition, knowledge of which market level's price is the leading indicator should help provide a grounds for price forecasting.

Procedure

The data analyzed in this study consisted of weekly prices for 900 to 1100 pound Dodge City slaughter steers, weekly Yellow Sheet (midwest river basis) prices for yield grade 3, 600-to 700-pound choice steer carcasses, and a composite weekly, weighted average, retail beef price. The retail prices were averages of 15 retail beef cut prices, weighted by their respective percentage volume of total retail cuts. The retail prices were an average of beef prices in nine major U.S. cities (Commodity News Services). The price data analyzed covered the January 1983 through December 1986 period.

Statistical analyses of the prices were performed to determine the approximate lead-lag relationships between the three market levels.

Results

A summary of the average retail, wholesale, and farm beef prices during the January 1983 through December 1986 period is reported in Table 23.1. The retail beef price averaged $180.09/cwt (retail weight), the wholesale price for yield grade, 3 600 to 700 pound, choice steer carcasses averaged $94.00/cwt (carcass weight), and the price for 900 to 1100 pound slaughter steers averaged $62.74/cwt (live weight). Although the retail price was the most volatile price in absolute dollars, with a standard deviation of $7.96/cwt, the retail price was the least variable when variation was expressed as a percentage of average price. For example, although the farm price standard deviation is just over half as large as the retail price standard deviation, indicating that the farm price is much less variable in absolute dollars, the retail price coefficient of variation is just over half as large as the farm price coefficient of variation. Therefore, when adjusted for the average price, the retail price is much less volatile in a relative sense than the wholesale and farm beef prices. The lower relative price variability at the retail level suggests that retailers do not change retail prices very quickly as prices at the lower market levels change. They are apparently able to exert some market power to maintain comparatively more stable retail beef prices.

A graph of the wholesale and farm prices is provided in Figure 23.1. Note that the two price series tend to follow the same general patterns. Statistical analyses, however, revealed that changes in the live slaughter steer price led changes in the wholesale carcass price by 2 to 3 weeks. That is, an increase in the price of slaughter steers this week (all else constant) generally will result in an increase in steer carcass prices over the next 2 to 3 weeks. In the short-run, no significant price influence was found from the wholesale price back to the farm price. This means that changes in the live slaughter steer price led to significant changes in carcass prices; however, carcass price changes did not systematically lead to short-run changes in farm prices.

The wholesale and retail price patterns are shown in figure 23.2. Once again, the retail and carcass prices tend to follow the same general patterns, though they do not visually match each other as closely as the farm and wholesale prices. Changes in the wholesale price typically led changes in the retail price by 3 to 4 weeks. That is, a decline in the wholesale price of beef this week (all else constant) would be expected to lead to a decline in the retail beef price over the next 3 to 4 weeks. In the short run, no significant price influence from the retail price back to the wholesale price was detected.

Implications

Cattle price changes at the farm level are reflected in the wholesale beef price after a 2 to 3 week lag, which in turn, is transmitted to the retail beef price in 3 to 4 weeks. This holds at least two significant implications for cattlemen. First, the retail beef price does not provide much information on the expected direction of future slaughter steer prices. The retail price appears to be responding to prices at the farm level of previous weeks and little new information on short-term price expectations is introduced at the retail level.

Second, short-term changes in the farm-to-retail price spread will occur simply as a result of changes in slaughter steer prices. During periods of increasing slaughter steer prices, the farm-to-retail price spread can be expected to decline, because the retail price generally does not increase as rapidly as the farm price. During periods of declining slaughter steer prices, the farm-to-retail price spread can be expected to increase as a result of the lagging response of retail prices to farm level price declines.

Table 23.1. Summary of Weekly Retail, Wholesale, and Farm Beef Prices, January 1983 through December 1986

Market Level	Average Price	Lowest Price	Highest Price	Standard Deviation	Coefficient of Variation
		----$/cwt----			
Retail[a]	$180.09	$161.40	$198.48	$7.96	4.42%
Wholesale[b]	94.00	76.00	108.50	7.19	7.65
Farm[c]	62.74	50.90	72.45	4.47	7.12

[a] Composite weighted average of 15 separate beef cut price in nine major US cities including Atlanta, Chicago, Houston, Kansas City, New York, Minneapolis, San Francisco, St. Louis, and Washington. Primary source Commodity News Service.

[b] Weekly Yellow Sheet midwest river basis price for yield grade, 3 600 to 700 pound, choice steer carcass. Source National Provisioner.

[c] Dodge City, Kansas Weekly price for 900 to 1100 pound, choice slaughter steers. Source USDA.

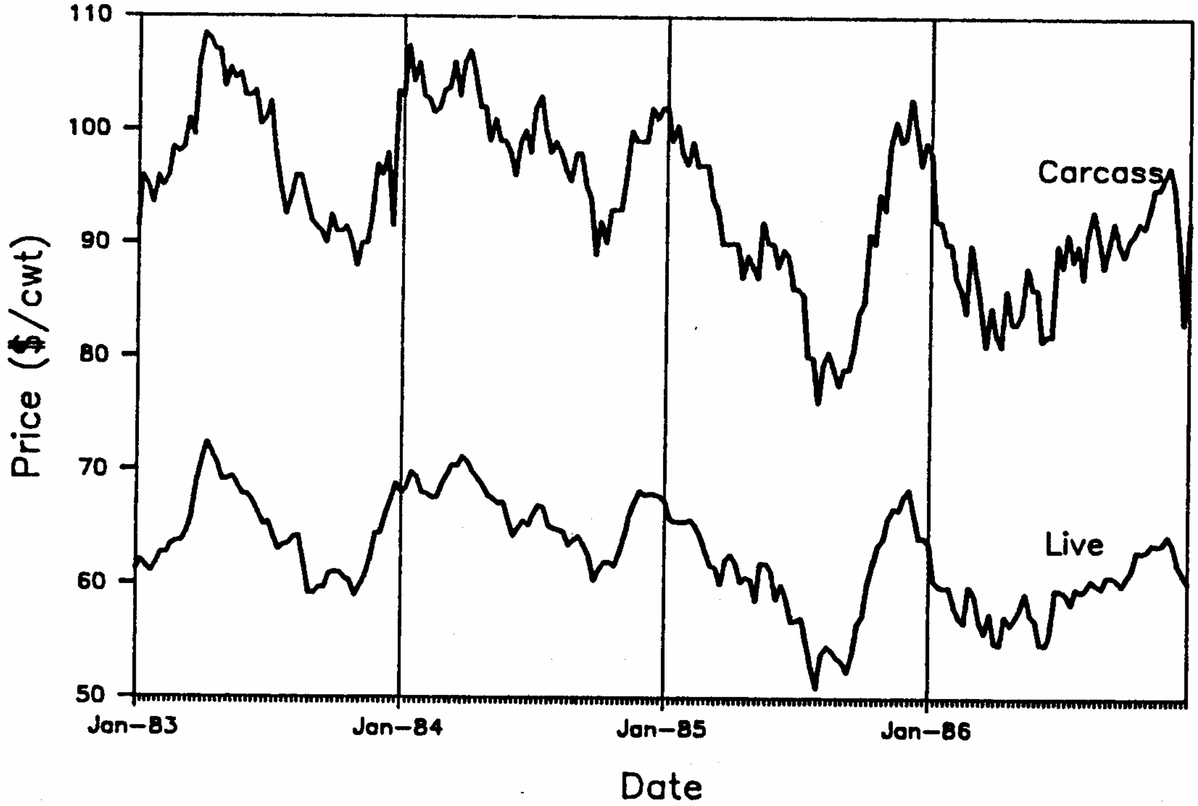

Figure 23.1. Weekly, Dodge City Slaughter Steer Price and Yellow Yield Grade 3 6/700 lb Steer Carcass Price, January, 1983 - December, 1986

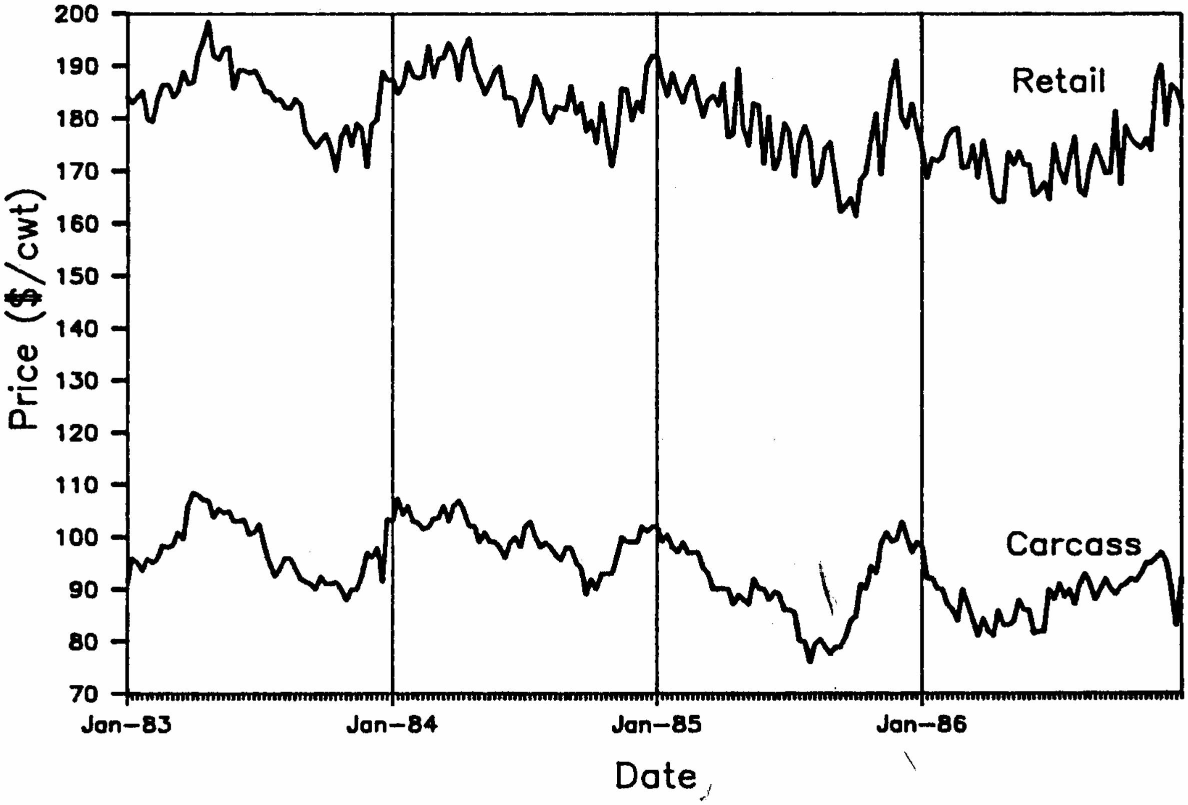

Figure 23.2. Weekly Yellow Sheet Yield Grade 3 6/700 lb Steer Carcass Price and Nine - City Average Retail Beef Price, January, 1983 - December, 1986

Effects of Sugar, Internal Cooking Temperature, and Hot-Boning on the Characteristics of Low Fat, Restructured, Value-Added Beef Roasts[1]

S.J. Goll, C.L. Kastner, M.C. Hunt, and D.H. Kropf

Summary

Low fat, restructured beef roasts were made from muscles that were conventionally or hot-boned. Differing combinations of salt, phosphate, and glucose were added. Then roasts were cooked to 145 F or 200 F. Roasts from conventionally boned muscle generally had less warmed-over flavor and higher acceptability scores than those from hot-boned muscle. Adding glucose with salt and phosphate helped suppress warmed-over flavor throughout display and did not reduce flavor acceptability or increase cooking loss. Roasts cooked to 200 F had lower warmed-over flavor scores and were more acceptable, but were less cohesive and had higher cooking losses than roasts cooked to 145 F. All roasts were acceptable, regardless of boning, ingredient, or temperature treatment.

Introduction

When "restructured" meat products are precooked, an undesirable "warmed-over" flavor may become evident and the desirable beef flavor may become less intense. "Warmed-over flavor" is due to rancidity of fats. Salt, which is used in restructuring meat, encourages both rancidity and color deterioration. Adding certain sugars and cooking at high temperatures may help prevent rancidity. The use of hot-boned meat may also help decrease rancidity, as well as increase the cohesiveness of restructured roasts. Consumer acceptability of pre-cooked, restructured, beef roasts can be increased through: 1.) improved flavor, 2.) improved color, 3.) elimination of added salt, 4.) decreased fat levels, and 5.) greater convenience. The objective of our study was to evaluate the effects of: 1.) conventional vs. hot-boning, 2.) added glucose, and 3.) internal cooking temperature on flavor and color characteristics of low fat, restructured, beef roasts.

Experimental Procedures

Meat from six Holstein steers was used to produce low fat, restructured beef roasts. Muscles were removed by either conventional or hot- boning, then were blade tenderized and ground. Meat batches (90% coarse plus 10% fine ground meat) then were subjected to four ingredient additions: 1.) 4% water, 2% NaCl, 0.5% phosphate, 2% glucose; 2.) 4% water, 2% NaCl, 0.5% phosphate; 3.) 4% water, 2% NaCl, 2% glucose; and 4.) 4% water, 0.5% phosphate, 2% glucose. The resulting restructured roasts were cooked to an internal temperature of either 145 or 200 F. Slices of the roasts were displayed (refrigerated, wrapped with plastic film, and placed under lights for 24 hours/day) for 10 days. Meat was evaluated for consumer acceptability and rated for flavor by a trained panel.

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[1] Appreciation is expressed to the Cattlemen's Beef Promotion and Research Board for support of this research.

Results and Discussion

Results of the study are shown in Table 24.1. As expected, roasts without added salt and those cooked to 200 F had less moisture, were less cohesive, and had more cooking loss than roasts with added salt and those cooked to 145 F. However, roasts cooked to 200 F received higher consumer acceptability scores, and were perceived to have less warmed-over flavor than those cooked to 145 F (Figure 24.1). Roasts from conventionally boned muscles were more acceptable than those from hot-boned muscles when cooked to a low internal temperature. Roasts with salt, phosphate, and glucose, or salt and phosphate had the highest acceptability scores, whereas roasts with phosphate and glucose had the lowest. All roasts were scored acceptable, regardless of ingredient treatment. Warmed-over flavor, pH values, and cooking yields were higher for hot-boned roasts than conventionally boned roasts when a difference existed. Roasts with salt, phosphate, and glucose maintained the lowest level of warmed-over flavor (Figure 24.1). These data show that adding glucose to a salt and phosphate mix for restructured beef roasts will help maintain low warmed-over flavor scores, without affecting acceptability or yield.

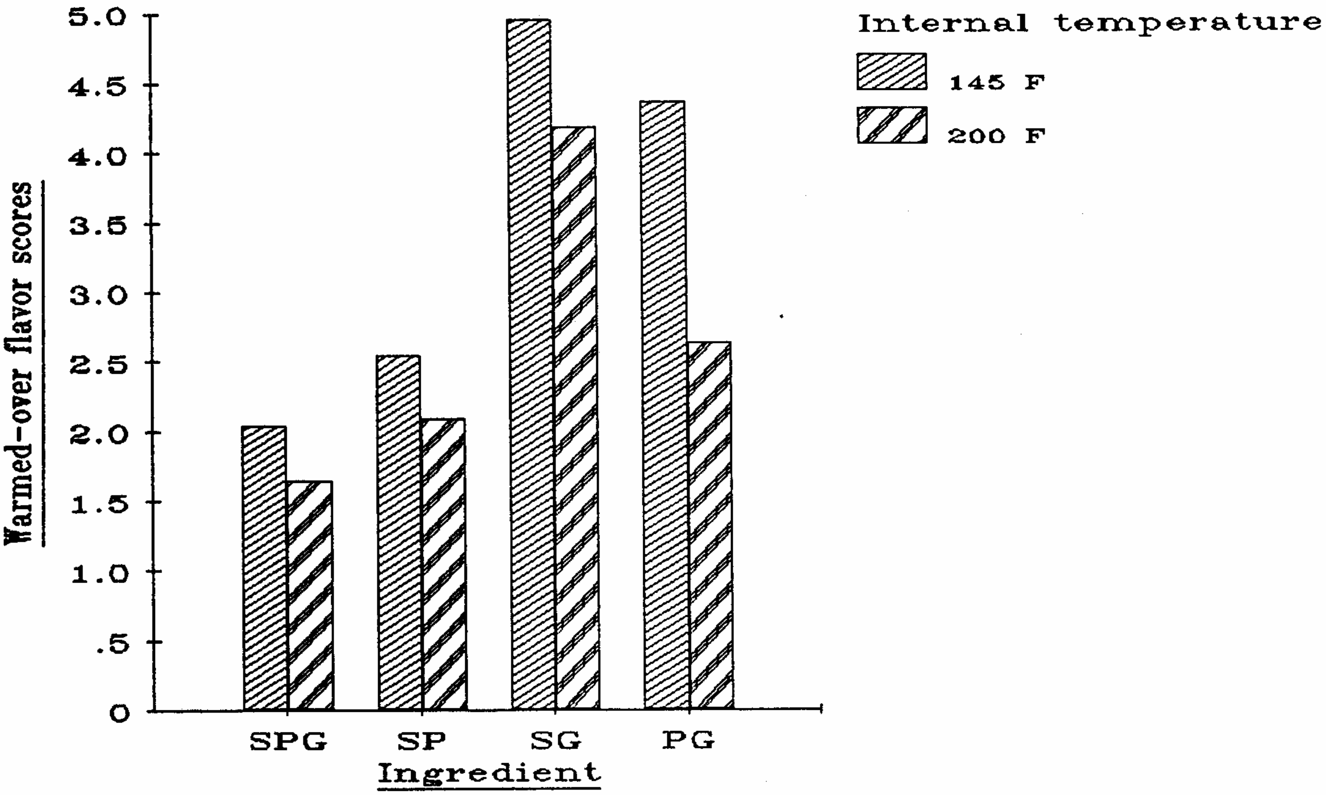
Table 24.1. Mean Values for Consumer Acceptability Scores of Restructured Beef Roasts as Affected by Ingredient and Boning x Temperature Treatments

	Acceptability	Internal	Acceptability Scores[ab]	
Ingredient	Scores[a]	Temp.	HB	CB
salt, phos. glucose	3.25^{c}	145 F	4.26^{c}	3.92^{c}
salt, phos.	3.25^{c}	200 F	3.33^{d}	3.45^{d}
salt, glucose	3.67^{d}			
phos. glucose	4.78^{e}			

[a] Consumer panel: 1=like extremely, 9=dislike extremely.

[b] HB = Hot-boned, CB = Conventionally boned.

[cde] Mean values in the same column with common superscripts are not different (P>.05).



Six-member trained panel: 1=threshold, 5=moderate −, 10=strong +.

Figure 24.1. Effects of ingredient and internal cooking temperature treatments on "warmed-over flavor" scores of restructured beef roasts. SPG = salt, phosphate and glucose; SP = salt and phosphate; SG = salt and glucose; PG = phosphate and glucose.

* * *

"Restructuring" is a process by which lower value meat raw material, which is generally merchandized in the ground form, is manufactured into "value added" products. The process consists of chopping the meat, mixing it to bring its binding proteins to the surface, blending in desired amounts of fat and added ingredients, and forming the final mixture into appropriate shapes. The product can be raw or precooked, and can be handled and distributed at either chilled or frozen temperatures. The advantage of this process is that it can produce a product that is consistent in quality, composition, size and price; a very desirable advantage for those supplying the needs of the food service industry.

* * *

Kansas Custom Cattle Feeding Practices[1]

Ted Schroeder[2] and Gerry Kuhl

Summary

A survey of Kansas custom cattle feedlots was conducted in the fall of 1987. This paper summarizes the survey and discusses some of the custom cattle feeding services and charges being offered.

Introduction

Custom cattle feedlots offer a variety of services to feeding customers. However, the types of services offered and the charges for specific services vary among feedlots. It is important that prospective cattle feeders be aware of the different types of services a particular lot offers and their associated costs. Additionally, the cattle feeder should clarify whether the feedlot or the owner assumes the responsibility for cattle performance, cost of gain, death loss, and catastrophes.

Survey Results and Discussion

A mail survey of all licensed custom cattle feedlots in Kansas was conducted to determine the typical practices and ranges of services being offered to prospective cattle feeders. In total, 66 custom cattle feedlots responded to the survey. The one time feeding capacity size distribution of the lots is reported in Table 25.1. The largest 10% of the lots accounted for 45.8% of the one time feeding capacity. Thus, a fair amount of feedlot capacity is concentrated in a few yards. Table 25.2 reports the cattle selling methods most often used by custom feeders. The vast majority of the cattle (88.4%) are sold live, FOB the feedlot, with a 4% pencil shrink.

The percentage of custom feedlots offering specific marketing and financing services is reported in Table 25.3. Almost all of the lots (83%) offer cattle forward contracting; however, only 63% offer futures market hedging and 58% offer options services. Feed and service financing is offered by almost all feedlots. However, cattle financing is offered by just over half of the lots. In addition, the required minimum owner's equity in order to qualify for cattle financing averaged about 27.5%. Very few lots offer guarantees on cost of gain or maximum death loss. Percentages of lots offering different types of feeding services are reported in Table 25.4.

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[1] Sincere appreciation is expressed to Scott Laudert and Kevin Vondenkamp for assistance in development and handling of the survey summarized here. The authors also acknowledge the helpful comments of Jim Mintert in reporting the results.

[2] Department of Agricultural Economics.

The average cattle and feed handling charges are shown in Table 25.5. Cattle processing costs average $5.31/head, and average yardage charges, for those feedlots that charge explicitly for yardage, is 6 cents/head/day. Feed markup for lots not charging explicit yardage fees is 23%, and average markup for lots that charge separately for yardage is 16%. These values are averages and do not represent the charges of any given lot. In addition, since different feedlots frequently charge different amounts for different services, a feedlot with a higher yardage fee may well have a lower feed markup, and vice versa. Similarly, feedlots offering more "free" services may charge higher fees for basic services in order to cover total service costs.

Table 25.6 summarizes the average daily gains and average feed conversions reported by the feedlots. It is important to note that these rates of gain may reflect "optimal" conditions. Extreme weather conditions or unhealthy cattle would likely result in significantly lower performance. Of more value than the absolute rate of gain values may be the differentials in performance between yearlings and calves and between heifers and steers.

The accuracy of all figures reported in this summary is dependent upon the quality of data the survey respondents had at their disposal, their interpretations of the question being asked, and our interpretations of their responses. We appreciation the cooperation of the Kansas feedyards that responded to this survey.

Table 25.1. Lot Size Distributions of Custom Feedlots Responding to Survey

	One-time Feeding Capacity, number of head			
Item	Under 10,000	10,000 to 19,999	20,000 to 29,999	30,000 and above
Number of Lots	21	25	8	6
Percent of Lots	35.0	41.7%	13.3%	10.0%
Percent of Cattle Capacity[a]	10.6%	29.2%	14.4%	45.8%

[a] Total one-time capacity represented was 1,191,600 head.

Table 25.2. Finished Cattle Selling Methods

Selling Methods	Percent of Cattle
Live, 4% pencil shrink, FOB feedlot[a]	88.4%
Packer Contract, owner pays freight	8.9
In the Beef (carcass wt alone), owner pays freight	1.7
USDA Grade and Yield, owner pays freight	1.0
Terminal or Local Auction Market	0.0[b]

[a] Average number of regular buyers bidding per feedlot was 4.7 with a range of 2 to 7 buyers.

[b] Less than .1%.

Table 25.3. Marketing and Financial Services Offered by Feedlots

Service Offered	Percent of Lots
Cattle Forward Contracting	83%
Cattle Hedging	63
Cattle Options	58
Feed Cost Forward Pricing	70
Prepayment of Feed Costs	97
Financing of:	
Feed and Services	99
Cattle[a]	57
Partner on Customer Cattle	88
Cattle Fed on Predetermined Cost of Gain Basis	9
Guaranteed Maximum Death Loss	3

[a] Average minimum owner equity required by feedlots in order to offer cattle financing was 27.5%.

Table 25.4. Percentage of Feedlots Offering Various Custom Feeding Alternatives

Feeding Services Offered	Percent of Lots
Finishing	100%
Growing/Backgrounding	68
Limit-fed Growing	39
Preconditioning	28
Wheat Grazing	39
Summer Grazing	35
Lots that will custom feed:	
Yearling Steers	100
Yearling Heifers	100
Heiferettes	95
Cull Cows	86
Young Bulls	56
Holsteins	100
High % Brahman	84
Lots that will:	
Sort Incoming Cattle into Uniform Lots	97
Top Out Finished Cattle	88
Feed Steers and Heifers in Same Pen	74

Table 25.5. Average Handling Charges of Feedlots

Activity	Average of Lots
Cattle Processing on Arrival	$5.31/hd
Cattle in Sick Pen, excluding medication	$ .095/hd/day
Cattle in Buller Pen	$0.62/hd/day
Yardage Charge[a]	$0.06/hd/day
Average Feed Markup, with separate yardage charge	16%
Average Feed Markup, with no yardage charge	23%

[a] Includes only lots that explicitly charge for yardage (88% of lots surveyed).

Table 25.6. Average Cattle Performance in Feedlots Surveyed

Cattle Type	Average Daily Gain (lb/head)	Average Feed Conversion (lbs dry matter/lb gain)
Yearling Steers	3.22	6.48
Yearling Heifers	2.91	6.75
Steer Calves	2.80	6.45
Heifer Calves	2.58	6.87

Effect of Limit-Fed, High Energy Growing Rations on the Performance of Feedlot Steers

Gary Goldy, Barb Downey,
Keith Bolsen, and Jack Riley

Summary

Steers fed high-concentrate limit-fed rations were more efficient during growing than steers fed silage plus grain at 25% of their dry matter (DM) intake, or silage only. The limit-fed cattle also tended to gain faster ($P<.10$) and were more efficient ($P<.05$) during the finishing phase and did not have the expected depressed DM intakes compared to cattle fed the other growing-phase rations. Steers fed barley had lower DM intakes ($P<.05$) but gained more efficiently ($P<.05$) than those fed grain sorghum.

Introduction

Limit feeding cattle during the growing phase involves restricting intake of energy-dense rations in order to control average daily gain. Several questions have been raised concerning limit-fed programs. Producers are concerned that all of the "gain" will be gone before the finishing phase because number of days on grain is high; that the cattle will finish too soon and have poor feed conversions, daily gains, and yield grades; and that intakes in the finishing phase will be less than those of cattle "grown" on a traditional program. In addition, feed and bunk management becomes paramount. Arguments in favor of limit feeding are that it is economically favorable when grain prices are low. Furthermore, since gain is controlled, cattle weights should be uniform at the end of the growing phase. However, proponents of the program concede that there might be an intake depression in the finishing phase.

Experimental Procedures

Eighty Hereford and Hereford X Angus crossbred steers with an average initial weight of 607 lbs were allotted to one of five growing phase treatments, with four pens of four steers per treatment. These five treatments were: (1) ad libitum high concentrate, (2) limit-fed high concentrate (35% roughage), (3) limit-fed high concentrate (20% roughage), (4) silage plus grain at 25% of dry matter (DM) intake, and (5) silage only. In the high energy rations, dry rolled barley and grain sorghum were compared as grain sources. In Table 26.1 are the compositions of the growing phase rations. All rations were formulated to contain 12.5% crude protein. The two limit-fed groups were fed once daily at 10 am, restricted to a DM intake of 2.1% of body wt., and targeted to gain 2 to 2.25 lbs per day. The other three rations were fed ad libitum twice daily. All steers were implanted with Ralgro at the start of the growing phase.

All steers were restricted to feed intakes of 2.1% of body wt. for 3 days, then shrunk overnight, prior to taking 84-day weights. On day 84, all steers were measured for backfat by ultrasound and reimplanted with Ralgro. Steers were switched to ad libitum finishing rations containing the respective grain they were fed during the growing phase. Steers receiving the silage only rations during the growing phase were fed either barley (2 pens) or grain sorghum (2 pens) as the grain source during the finishing phase. All finishing-phase rations included 80% grain, 15% silage, and 5% supplement and were formulated to contain 11.2% protein and 12.5 mg of Rumensin per pound.

Results and Discussion

The performance of limit-fed steers receiving the 20 or 35% level of roughage did not differ (P>.05) during the 84-day growing phase or the subsequent finishing phase. Therefore, all eight pens of limit-fed steers were pooled for analysis of main effects. There were no significant interactions. Performance data comparing ration treatments during the growing and finishing phases along with the performances during the combined phases are shown in Table 26.2.

Limit-fed steers gained more efficiently than steers fed silage + 25% grain or silage only during the growing phase. Steers that had been limit-fed during the growing phase tended to gain faster and were more efficient (P<.05) during the finishing phase than steers fed ad libitum during the growing phases, regardless of their ration energy level. Feed intakes were not different among rations during the finishing phase, ranging from 23.48 to 24.49 lbs of DM daily. It appeared that the limit feeding of high energy rations during the growing phase did not adversely affect finishing phase performance. It should be pointed out that steers fed the silage + 25% grain and silage only rations had exceptional gains during the growing phase, which might have had a negative impact on their efficiency during finishing.

The effect of grain source on the feedlot performance of steers is shown in Table 26.3. Barley-fed steers had lower DM intakes and better feed efficiencies than grain sorghum-fed steers during both phases. However, average daily gains did not differ for the two grain sources during any phase.

The effect of grain source on the performance of steers limit-fed during growing is shown in Table 26.4. Barley-fed steers gained faster (P<.05) and more efficiently (P<.05) than grain sorghum-fed steers during the growing phase. During the finishing phase, barley-fed steers had lower DM intakes (P<.05) and tended to have improved feed efficiencies compared to grain sorghum-fed steers. Therefore, when growing and finishing phases were combined, barley-fed steers had lower DM intakes and faster and more efficient gains overall compared to grain sorghum-fed steers. We observed that during the growing phase, limit-fed steers receiving barley took several hours longer to consume the same amount of ration DM than steers receiving grain sorghum.

Table 26.1. Composition of the Growing Phase Rations

Ingredient	Limit-Fed High Conc 20% Roughage	Limit-Fed High Conc Silage 35% Roughage	Ad Libitum High Conc	Ad Libitum Silage + 25% Grain	Ad Libitum Silage only
	--------------------	% of the Ration DM	--------------------		
Grain^{a}	67.6	52.6	72.6	25.0	---
Forage					
Sorghum Silage	20.0	35.0	15.0	62.6	87.6
Supplement^{b}	12.4	12.4	12.4	12.4	12.4

[a] Barley or grain sorghum.
[b] Provided 200 mg of Rumensin/Head/day.

Table 26.2. Effect of Growing Ration Treatments on the Feedlot Performance of Steers

Item	Ad Lib High Conc	Limit Fed High Conc	Silage + 25% Grain	Silage Only
No. of Pens	4	8	4	4
No. of Steers	16	31	16	16
Initial Wt.,lb	608	610	605	605
84-Day Wt.,lb	880^{a}	819^{c}	846^{b}	826^{bc}
174-Day Wt.,lb	1110	1095	1088	1078
GROWING PHASE: 84 days				
Intake (DM), lb/d	20.32^{a}	14.84^{c}	19.69^{ab}	19.14^{b}
ADG, lb	3.24^{a}	2.48^{c}	2.86^{b}	2.64^{bc}
Feed/Gain	6.27^{ab}	6.07^{a}	7.03^{bc}	7.25^{c}
Back Fat,in.	$.34^{a}$	$.25^{b}$	$.27^{b}$	$.19^{c}$
FINISHING PHASE: 90 days				
Intake (DM),lb/d	23.49	23.48	24.12	24.49
ADG, lb	2.54^{f}	3.07^{d}	2.68^{e}	2.80^{de}
Feed/Gain	9.23^{b}	7.68^{a}	9.01^{b}	8.78^{b}
Back Fat, in	.50	.48	.41	.38
COMBINED PHASES: 174 days				
Intake (DM), lb/d	21.96^{a}	19.31^{b}	21.98^{a}	21.91^{a}
ADG, lb	2.88	2.78	2.77	2.72
Feed/Gain	7.61^{ab}	6.98^{a}	8.00^{b}	8.04^{b}
Percent Choice	75.00	93.55	93.75	81.75
Liver Abscesses,%	18.75	6.45	0	0

[abc] Means in the same row with different superscripts differ ($P<.05$).
[def] Means in the same row with different superscrips differ ($P<.10$).

Table 26.3. Effect of Grain Source on Feedlot Performance of Steers

Item	Grain Source	
	Barley	Grain Sorghum
No. of Pens	10	10
No. of Steers	39	40
GROWING PHASE: 84 Days		
Intake (DM), lb	18.08^a	18.91^b
ADG,lb	2.89	2.72
Feed/Gain	6.25^a	7.03^b
FINISHING PHASE: 90 days		
Intake(DM),lb	21.78^a	26.01^b
ADG, lb	2.75	2.79
Feed/Gain	7.98^a	9.37^b
COMBINED PHASES: 174 days		
Intake(DM),lb	19.99^a	22.58^b
ADG,lb.	2.81	2.76
Feed/Gain	7.11^a	8.20^b

^{abc}Means in the same row with different superscripts differ ($P<.05$).

Table 26.4. Effect of Grain Source on Performance of Steers Limit-fed During Growing

Item	Grain Source	
	Barley	Grain Sorghum
No. of Pens	4	4
No. of Steers	15	16
GROWING PHASE: 84 days		
Intake (DM), lb/day	14.84	14.84
ADG, lb	2.78^a	2.18^b
Feed/Gain	5.33^a	6.80^b
FINISHING PHASE: 90 days		
Intake (DM), lb/day	21.37^a	25.59^b
ADG, lb	3.05	3.10
Feed/Gain	7.09	8.27
COMBINED PHASES: 174 days		
Intake (DM), lb/day	18.21^a	20.40^b
ADG, lb	2.92^a	2.65^b
Feed/Gain	6.27^a	7.68^b

^{ab}Means in the same row with different superscripts differ ($P<.05$).

Daily or Weekly Rotational Feeding of Bovatec® and Rumensin®/Tylan® to Cattle on a Steam-Flaked Corn Finishing Ration[1]

Robert Brandt Jr.[2]

Summary

One hundred sixty-five crossbred steers averaging 823 lb were utilized to evaluate the daily or weekly rotational feeding of ionophores. Treatments were (g/ton of feed, 90% dry basis): 1) Bovatec (B; 30), 2) Rumensin plus Tylan (RT; 25 and 10, respectively), 3) treatments one and two in a daily rotation (D), and 4) treatments one and two in a weekly rotation (W). Steers fed RT consumed less ($P<.05$) dry matter than B, D, or W steers. No differences ($P>.15$) in daily gain were observed, suggesting that the increased consumption by B, D, and W steers was accompanied by an alteration in passage rate and/or other kinetics of digestion, such that additional consumption was poorly utilized. Thus, RT steers gained 3.9% more efficiently ($P=.06$) than B steers and numerically more efficiently than D or W steers. No differences were observed among treatments for carcass quality or yield. Performance of D and W steers did not differ from that predicted by the performance of steers fed B and RT fed separately, indicating no synergism from alternate feeding of ionophores in this study.

Introduction

Much attention has been focused over the past several months on the rotational feeding of ionophores. Previous in vitro work has led some workers to conclude that ruminal microorganisms may adapt to an ionophore during a feeding period. Theoretically, then, alternating ionophores on a regular basis might maximize ruminal efficiency and feed utilization. Significant responses in daily gain and feed efficiency to weekly alternation of Bovatec (lasalocid) and Rumensin (monensin) compared to continual feeding of Rumensin were noted in a pilot study conducted at the Clayton Livestock Research Center, New Mexico State University. Several studies have been conducted to further evaluate the efficacy of ionophore rotation and length of rotation interval (daily, weekly, bi-weekly) on cattle performance. Presented here are the results of a study we conducted at the Southwest Kansas Experiment Station in late summer and early fall of 1987.

Experimental Procedures

One hundred sixty-five yearling steers, averaging 823 lbs and of mixed breeding (primarily the offspring Brangus bulls x exotic crossbred cows), were purchased from one source in western Kansas. Upon arrival, steers were individually weighed and ear-tagged for identification. Processing consisted of treatment for endo- and

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[1] Partial financial assistance provided by Hoffmann-LaRoche, Inc., Nutley, NJ.

[2] Research Animal Scientist, Southwest Kansas Experiment Station, Garden City.

ectoparasites with an anthelmintic drench and pour-on grubicide, vaccination against IBR, PI_3, BVD (MLV vaccine) and seven clostridial strains. The steers were implanted with Ralgro® at processing on July 1 and reimplanted on day 56 of the trial. Steers were randomly allotted within five weight replicates to one of four treatments. Ionophore treatments were (g/ton of feed, 90% dry basis): 1) Bovatec (B; 30), 2) Rumensin plus Tylan (RT; 25 plus 10, respectively), 3) treatments one and two alternated daily (D), and 4) treatments one and two alternated weekly (W). All steers receiving Rumensin plus Tylan were fed 12.5 and 10 g/ton, respectively, until all cattle were placed on the final ration on day nine (Table 27.1).

Initial and final weights were the average of two consecutive early morning full weights. These weights were then adjusted to payweights for calculation of daily gain and feed efficiency. Steers were slaughtered when an estimated 70% of a weight replicate reached the low choice grade. Therefore, steers in the two heavy replications were fed for 92 d, while steers in the three light weight replications were fed for 105 d. All steers were slaughtered at the IBP plant in Holcomb, KS. Hot carcass weights and liver abscess scores were obtained at slaughter. Following a 24-hour chill, carcasses were railed off and evaluated for quality and yield grade. Ribeye area and backfat thickness were measured directly, while marbling and percentage kidney, pelvic, and heart fat were called by a federal grader.

Results and Discussion

Performance by steers during the eight-day step-up period and for the entire feeding period are presented in Tables 27.2 and 27.3, respectively. Steers on the daily and weekly rotation treatments were started on Bovatec. The first rotation on the W treatment consisted of eight days of Bovatec and six days of Rumensin/Tylan. Therefore, data from the B and W treatments were pooled over the step-up period. After the first rotation, W steers were kept on a seven-day rotation schedule. Steers fed B consumed an average of 1.42 lbs of dry matter per day more ($P<.05$) than RT steers during the step-up period. Intake by D steers was intermediate to B and RT. For the entire feeding period, dry matter consumption by RT steers was 4.4, 4.3, and 2.7% lower ($P<.05$) than for B, D and W steers, respectively. No differences ($P>.15$) were observed in average daily gain, although D steers gained 1.6% faster than those fed RT. Steers fed RT were 3.9% more efficient ($P=.06$) in converting feed to liveweight gain than those fed B, and numerically more efficient than D or W steers.

The predicted performance of D and W steers is presented in Table 27.4. Performance of steers fed any proportion of RT and B during a feeding period is predicted by simple regression between the observed values for RT and B. Any deviation from the predicted value (positive or negative) is indicative of synergistic or antagonistic effects, more commonly referred to as associative action. Consumption by D steers was approximately 1.9% greater than predicted. However, there were no other significant deviations for predicted vs. observed values in feed intake, daily gain or feed efficiency. This suggests that, in this trial, there was no associative action from alternate feeding of B and RT. Dietary net energy for gain (NEg), calculated from animal performance, was increased 1.26, 4.40, 2.37, and 2.94% compared to the calculated NEg content of the basal diet by B, RT, D and W treatments, respectively. Thus, response to B, D, or W treatments in this study was minimal.

Carcass data are presented in Table 27.5. No differences due to treatment were observed for any carcass variable measured. Incidence of liver abscesses was 7.3, 0, 0, and 7.3% for B, RT, D, and W steers, respectively. These extremely low incidence rates were attributed to the short length of the feeding period and season of year. Steers in this trial had an average carcass weight of 776 lbs, a dressing percentage of 64.06%, yield grade of 2.76, and 69% graded choice or better.

In conclusion, no synergistic effects from alternating B and RT were observed for animal performance or carcass quality and yield in this trial. Significantly higher intakes for B, D, and W steers resulted in no additional gain, suggesting that rate of passage or other kinetics of the digestive systems were altered in such a way that additional intake was poorly utilized. Furthermore, fat addition to high grain rations may alter site of starch digestion, potentially exacerbating situations where the capacity of the gastrointestinal system to digest starch and absorb endproducts is challenged. The influence of fat source on site and extent of starch digestion is currently being investigated. More research is needed to ascertain potential interactive effects, such as ration type and components, nutrient levels, and levels of ionophores used in the rotation. Furthermore, if intake alteration is a result of ionophore rotation, it must be evaluated over different seasons of the year.

Table 27.1. Composition of Diets Fed in Ionophore Rotation Trial

Item	Ration 1	Ration 2	Ration 3	HMC:DRC[a] Finisher	Flaked Corn Finisher
Days Fed	3	3	2	8	76-89
	-------------------Percent of Dry Matter-------------------				
Ingredient:					
HM Milo	52.0				
HM Corn			35.8	40.1	
Rolled Corn		57.2	35.8	40.1	
Flaked Corn					80.6
Alfalfa Hay	21.3	16.5	8.6	4.0	4.0
Corn Silage	16.6	16.5	8.6	4.0	4.0
Molasses	5.7	5.0	5.0	4.4	4.0
Yellow Grease			1.5	2.5	2.5
Supp. 8707	4.4	4.8	4.7	4.9	4.9
	------Calculated Nutrient Content, Dry Matter Basis------				
Crude Protein, %	13.1	12.8	12.3	12.0	12.0
NEg, Mcal/cwt	55.6	57.8	63.4	67.2	72.5
Calcium, %	.93	.88	.74	.66	.66
Phosphorus, %	.31	.33	.33	.34	.31
Potassium, %	1.08	.99	.81	.68	.65
Salt, %	.46	.50	.50	.50	.50
Suffur, %	.25	.22	.20	.19	.20
Magnesium, %	.25	.18	.17	.15	.17
Zinc, ppm	71	72	74	74	70
Cobalt, ppm	.31	.24	.22	.21	.23
Copper, ppm	22	17	16	14	15
Selenium, ppm	.36	.34	.30	.30	.30

[a] High Moisture and Dry Rolled Corn Ration.

Table 27.2. Intake and Gain of Steers Through the Step-Up Period[a]

Item	Bovatec[b]	Rumensin/Tylan[c]	Daily Rotation	SE[d]
No. Pens	10	5	5	
No. Steers	82	42	41	
Pay Weight, lb	825	824	825	
8 Day Wt., lb	857	853	858	
DM Intake, lb	19.07[e]	17.65[f]	18.01[ef]	.38
Daily Gain, lb	4.03	3.66	4.16	.28

[a]Eight days. Three step-up rations were used containing 56 (3 days), 58 (3 days) and 64 (2 days) Mcal of NEg/cwt.
[b]30 g/ton (90% dry basis).
[c]12.5 and 10 g/ton, respectively, 90% dry basis.
[d]Pooled standard error.
[ef]Means not sharing the same superscript differ (P<.01).

Table 27.3. Steer Performance During the Entire Feeding Period (July - October, 1987)

Item	Bovatec[a]	Rumensin/ Tylan[a]	Daily Rotation	Weekly Rotation	SE
No. Pens	5	5	5	5	
No. Steers	41	41	41	41	
Pay Weight In, lb[b]	824	824	825	825	1
Pay Weight Out, lb[c]	1211	1209	1216	1214	7
Daily Gain, lb[d]	3.89	3.87	3.93	3.89	.07
Daily Intake, lb DM	23.44[e]	22.45[f]	23.41[e]	23.06[e]	.19
Feed/Gain, lb DM	6.03[g]	5.81[h]	5.97[gh]	5.93[gh]	.08

[a]Levels in final ration (g/ton, 90% dry basis) were Bovatec (30), Rumensin (25) and Tylan (10).
[b]Intial weights adjusted to pay weight.
[c]Final live weights pencil shrunk 4%.
[d]Average of 100 days on feed.
[ef]Means not sharing the same superscript differ (P<.05).
[gh]Means not sharing the same superscript differ (P<.10).

Table 27.4. Observed vs. Predicted Performance of Steers Fed Bovatec and Rumensin/Tylan in a Daily or Weekly Rotation

	Daily Gain, lb	Dry Matter Intake, lb	Feed/Gain	Ration NEg, Mcal/cwt
Daily Rotation:				
Observed	3.93	23.41	5.97	74.63
Predicted[a]	3.88	22.95	5.92	74.97
Difference	.05	.46	.05	-.34
Weekly rotation:				
Observed	3.89	23.06	5.93	75.04
Predicted[a]	3.88	22.95	5.92	74.97
Difference	.01	.11	.01	.07

[a] From performance of steers fed Bovatec and Rumensin/Tylan separately.

Table 27.5. Carcass and Liver Abscess Data of Ionophore Fed Cattle

Item	Bovatec	Rumensin /Tylan	Daily Rotation	Weekly Rotation	SE
No. Steers	41	41	41	41	
Hot Carcass Wt., lb	775	772	779	779	5
Dressing, %	64.02	63.90	64.05	64.24	.2
Ribeye Area, sq. in	13.39	13.15	13.04	13.16	.18
Backfat, in	.47	.44	.47	.46	.02
Marbling Score[a]	5.07	5.10	5.11	5.12	.07
KPH Fat, %[b]	1.79	1.92	1.87	1.83	.06
Yield Grade	2.69	2.72	2.84	2.76	.10
Percent Choice	68	68	68	71	
Liver Abscesses, no.					
None (0)	38	41	41	38	
Slight (A-)	0	0	0	2	
Small (A)	3	0	0	1	
Severe (A+)	0	0	0	0	

[a] Scored by federal grader to nearest 1/10. Slight 50=4.5, Small 50=5.5.
[b] Scored by federal grader to nearest .5%.

Effect of Cobactin on the Feedlot Performance and Carcass Traits of Beef Steers[1]

Larry Corah and Ron Pope

Summary

The addition of Cobactin to feedlot rations had no significant effect on average daily gain or feed efficiency, but did improve quality grade of steers fed for 110 days.

Introduction

Lactobacillus bacteria have been used in animal agriculture for several years. Several reports have indicated that microbials containing lactobacillus can improve the absorption of nutrients.

In this trial, Cobactin®, a newly developed microbial single strain of Lactobacillus acidophilus was evaluated. The product is used in the live form following activation with water.

Experimental Design

The study involved 150 black crossbred steers from a common origin in Louisiana. Following an intensive native grass grazing program until mid summer, the steers were allotted and placed on trial on August 14, 1986. They were randomized by complete block design using weight as a blocking factor and allotted to five treatments with six groups per treatment and five animals per group. The heaviest group averaged approximately 748 pounds; the lightest, approximately 610 pounds.

The five treatments were as follows: 1) negative control; 2) low level of Cobactin; 3) low level of Cobactin plus Rumensin®/Tylan; 4) medium level of Cobactin plus Rumensin/Tylan; 5) Rumensin/Tylan only.

The cattle were initially weighed after being held off feed and water overnight, and were weighed at 28-day intervals until slaughter (110 days), when a final weight was taken.

To determine the impact of treatments on how the cattle adapted to the feedlot ration, feed intake was recorded and analyzed over the first 5 days, the first 28 days, and for the 110-day trial duration.

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[1] Appreciation is expressed to Doug Ware and Patsy Read, Bio-Technic Laboratories, Inc., for their assistance in conducting the trial and to this company for financial support of the product.

The steers were started on a ration of 60% corn silage, 34.2% grain sorghum, and 5.8% supplement (dry basis). After 19 days, the cattle were gradually worked up to a diet of 15% corn silage, 79.2% grain sorghum, and 5.8% supplement (dry basis). The supplements used in the trial are shown in Table 28.1. Cobactin was mixed in a water solution and sprayed onto the appropriate rations at the time of feeding.

Carcass data collected included hot carcass weights, dressing percentage, actual loineye area, estimated fat cover, estimated yield grades, and quality grade.

Table 28.1. Supplements Fed (per ton)

Ingredient	Control and Cobactin steers	Steers fed Rumensin/Tylan
Soybean Meal	1408.3	1379
Limestone	385.7	385.7
Potassium Chloride	70.6	70.6
Salt	1.05	1.05
Z-10 Trace Mineral	7	7
Vit. A - 30,000	3.5	3.5
Tylan 10	--	20.7
Rumensin - 60	--	8.6
Fat	20	20

Results

There was no significant effect of treatment on average daily gain (Table 28.2). However, gain of steers fed the low level of Cobactin alone approached significance at a probability of .23, compared to the negative controls.

The most notable effect on feed intake and feed efficiency was the addition of the Rumensin/Tylan to the diet, which significantly reduced feed intake for the first 5 and 28 days. This result is consistent with previous research. Rumensin/Tylan addition significantly improved feed efficiency in all three treatments. The addition of Cobactin caused a slight improvement in feed efficiency both when fed alone and when combined with Rumensin/Tylan.

No apparent effect of treatment on dressing percent and loineye area was noted (Table 28.3). However, Cobactin improved actual quality grade and the percent of carcasses grading choice.

Table 28.2. Least Square Means for Treatment Effect on Weight Gain and Feed Efficiency

						Daily Feed Intake (DM)			
Treatment	No.	Starting Wt.	Final Wt.	Weight Change	ADG	1st 5 Days[1]	1st 28 Days[2]	110 Days[3]	Feed Efficiency
Control	29	700.3	1054.2	353.9	3.22^{a}	10.9^{c}	16.9^{c}	20.8	6.5
Cobactin-Low	30	700.8	1070.3	369.5	3.36^{b}	10.5^{c}	16.5^{c}	21.0	6.35
Rumensin/Tylan + Cobactin-Medium	30	696.8	1062.8	366	3.36^{b}	7.9^{d}	14.5^{d}	19.8	5.97
Rumensin/Tylan + Cobactin-Low	30	694.8	1054.3	359.4	3.27	8.6^{d}	14.9^{d}	19.6	5.94
Rumensin/Tylan	30	701.6	1065.3	363.7	3.31	8.0^{d}	14.7^{d}	19.9	6.03

[1] Moisture content = 58.6%

[2] Moisture content = 46%

[3] Moisture content = 35%

[ab] Significantly different at P = .23

[cd] Different superscript significantly different at P<.05

Table 28.3. Least Square Means for Treatment Effect on Carcass Traits

Treatment	No.	Hot Carcass Wt.	Dressing %	Loineye Area	Est. Fat Cover	Est. Yield Grade	Quality Grade[1]	% Choice or Better
Control	29	641	60.55	11.3	$.53^{a}$	3.09	4.34^{a}	84.6
Cobactin-Low	30	647.4	60.73	11.5	$.55^{d}$	3.11	4.63^{ab}	89.2
Rumensin/Tylan + Cobactin-Medium	30	645	60.61	11.2	$.57^{b}$	3.23^{a}	4.84^{b}	93.1
Rumensin/Tylan + Cobactin-Low	20	641.8	60.67	11.4	$.52^{ab}$	3.03^{b}	4.76^{ab}	75.0
Rumensin/Tylan	30	646.6	60.70	11.7	$.51^{acd}$	2.93^{b}	4.56^{ab}	93.3

3 = slight marbling (good grade)
4 = small marbling (choice grade)
5 = modest marbling (choice grade)

[abcd] Different superscript significantly different at P<.05.

Feedlot Performance by Steers Fed Sprout-Damaged Milo

Kenneth P. Coffey and Lyle W. Lomas[1]

Summary

Forty-eight Charolais crossbred steers were fed sprouted or nonsprouted milo for 139 days in a finishing study. Steers fed sprouted milo (51% sprout damage, 60 lb. per bu.) were 28 lb. heavier ($P<.10$) and gained 8.4% faster ($P<.10$) while consuming 2.7% less ($P>.10$) feed per pound of gain. Sprout damaged milo had no significant ($P>.10$) effect on carcass characteristics. These data indicate that cattle fed sprouted milo should perform as well or better than those fed nonsprouted milo.

Introduction

Excessive rain and flooding in Southeast Kansas in the fall of 1986 caused considerable damage to unharvested milo. Much of the milo crop sprouted while still in the head. Grain dealers substantially discounted sprouted milo, resulting in an immense economic loss to area milo producers. Many producers chose to feed the milo rather than accept the reduced price. Such decisions stimulated many questions concerning the feeding value of the sprouted grain. This project was conducted to answer some of those questions.

Experimental Procedure

Forty-eight Charolais crossbred steers were randomly allotted by weight into six pens, each containing eight head. The pens were then randomly assigned to receive finishing diets containing sprouted or unsprouted milo. Both sprouted and unsprouted milo were Hogemeyer 688 red milo. The sprouted milo contained 51% sprout-damaged kernels. Both diets consisted of 74% milo, 20% corn silage and 6% supplement on a dry matter basis. The supplement contained soybean meal and monensin (Rumensin®) (22.5 g/ton of complete diet). All steers were dewormed, implanted with Ralgro®, and vaccinated for IBR, PI_3, Vibrio, Lepto 5, and 7-way blackleg, and were fed the respective diets from November 13, 1986 to April 1, 1987. At the end of the 139-day feeding period, the cattle were slaughtered and carcass data were obtained.

Results

Steers fed sprouted milo gained 28 lb more ($P<.10$) and 8.4% faster ($P<.10$) than those fed unsprouted milo (Table 29.1). Quality grades, yield grades and backfats of steers fed sprouted milo tended to be greater ($P>.10$) than those of steers fed unsprouted milo. Steers fed sprouted milo consumed 5.3% more feed than those fed

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[1] Southeast Kansas Branch Experiment Station.

unsprouted milo but required 2.7% less feed to produce each pound of gain. Feedlot performance of steers fed both types of milo was lower than expected, probably because of extremely muddy conditions during the experiment.

These data indicate that sprout damaged milo is an acceptable feed source for finishing cattle. However, grain quality should still be considered. The milo used in this study had a test weight greater than 60 lb/per bu., even though it was sprouted. Because sprout damage (51%) was not exceptionally severe, and the test weight was high, we cannot project how cattle might perform on more severely damaged milo.

Table 29.1. Feedlot Performance and Carcass Characteristics of Steers Offered Sprouted and Unsprouted Milo in a Finishing Ration

Item	Sprouted	Unsprouted
No. Steers	24	24
Initial wt., lb.	828	829
Final wt., lb.	1206[a]	1178[b]
Total gain, lb.	378[a]	350[b]
Daily gain, lb.	2.72[a]	2.51[b]
Dry matter intake, lb/day	24.3	23.1
Feed/gain	8.93	9.18
Hot carcass wt., lb.	730	718
Dressing %	60.5	60.9
Quality grade[c]	11.1	10.5
Backfat, in.	.37	.33
Ribeye area, in^2	13.1	13.6
Yield grade	2.0	1.7

[a,b] Means within the same row with unlike superscripts differ ($P < .10$).

[c] Low choice = 10; Average choice = 11, etc.

Effect of Fat Source on Performance and Carcass Quality of Finishing Steers[1]

Robert Brandt Jr.[2]

Summary

Two trials that utilized 356 steers were conducted to evaluate the effects of various fat sources (3.5% of ration dry matter) on performance and carcass traits of finishing cattle fed flaked milo diets. In trial 1, soybean oil, bleachable tallow, and yellow grease (blend of tallow and restaurant grease) were compared to a nonfat control. Feeding fat increased ($P<.05$) daily gain, feed efficiency, carcass weight, and dressing percent of steers. Soybean oil and yellow grease also tended to increase 12th rib backfat thickness and marbling. Feed costs of gain were improved only by yellow grease. However, when increased carcass yield and quality were considered, there was a significant economic return from all fat sources. In trial 2, fat treatments were acidulated soybean soapstock (SBSS), tallow, a blend of 70% SBSS:30% tallow, and yellow grease. Feeding tallow or the SBSS: tallow blend improved ($P<.05$) feed efficiency by 7.7% compared to the nonfat control. Pooled across source, feeding fat increased ($P<.10$) backfat thickness and marbling. Compared to the control, feed cost of gain was reduced 6 cents/lb by the SBSS:tallow blend. However, when increased carcass value was accounted for, net returns of \$3.50 to \$6.00 per head were seen for SBSS, tallow, and SBSS:tallow priced at 13, 17, and 13 cents per lb, respectively. The SBSS:tallow blend provided greater performance than was predicted by observed performance of steers fed SBSS or tallow separately, an indication of associative response. In trial 2, intake and gain were lowest for yellow grease, resulting in a negative economic return,which isin complete disagreement with results obtained in trial 1.

Introduction

Much confusion exists concerning the feeding value of various fat sources available to Kansas feedyards. The composition of blended fats varies considerably with the availability and price of components of the blend. The Southwest Branch Station is determining the effect of fat sources varying in origin (plant vs animal) and degree of saturation on finishing performance, carcass quality, and fatty acid composition of depot fat. This paper will discuss feeding results obtained to date.

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[1] Appreciation is expressed to National Byproducts, Inc., Wichita, KS, and Western America Feed Fat, Inc., Douglasville, TX for supplying fats used in this research.

[2] Southwest Kansas Experiment Station, Garden City.

Composition of Feed Fats. Typical analyses of some common fats are presented in the Table 30.1. Estimates of 1986 production are included for comparative purposes. Fatty acid proportions vary considerably among fat sources, particularly for ratios of unsaturated to saturated fatty acids. Whether feeding a high amount of unsaturated fatty acids will impact carcass fat composition is unknown, although it is generally (and probably incorrectly) assumed that through ruminal fermentation, almost all di- and tri-glycerides are hydrolyzed and the unsaturated fatty acids are hydrogenated. However, values published by the Meat Board show that less than 50% of the fatty acids in beef fat are saturated. Therefore, carcass fat composition may potentially be altered by feeding highly unsaturated fat sources, increasing ruminal fat bypass through formation of calcium or potassium soaps, or otherwise protecting fatty acids. Of particular interest in this regard are linoleic and linolenic acids, implicated recently in the reduction of high blood pressure and incidence of heart disease. Vegetable oils and soapstocks are rich sources of these fatty acids.

Table 30.1. Fatty acid composition of commercial fat sources

	Oil or Fat				
Item	Soybean	Tallow	Yellow Grease	Lard	Poultry
1986 production, mill. lbs	11,880	5,333	1,678	816	300
Fatty acids, %					
Myristic (C14)		2.0	1.0	1.5	2.0
Palmitic (C16)	11.5	30.0	26.0	27.0	21.0
Palmitoleic (C16:1)		3.5	4.0	3.0	8.0
Stearic (C18)	4.0	19.0	12.5	13.0	6.0
Oleic (C18:1)	24.5	44.0	42.0	43.0	39.0
Linoleic (C18:2)	53.0	2.0	12.0	10.5	22.0
Linolenic (C18:3)	7.0		.6	.5	
Unsaturated/saturated	5.45	.97	1.24	1.37	2.37

Quality of a given fat may vary considerably between vendors as well as within one source over time. This is particularly true for blended products, whose composition will depend upon availability and price of component fats. Therefore, more stringent quality control on feed fats is required. Rouse (1987 Kansas Formula Feed Conference, KSU, Manhattan) suggested the following as minimum specifications for fats and blends (shown in Table 30.2 and list following).

Table 30.2. Minimum specification for feed fats (Rouse)

Item	Animal	Blended Animal	Blended Animal + Vegetable	Feed Grade Vegetable
Total fatty acids, Min. %	90	90	90	90
Free fatty acids, Max. %	15	15	30	50
Moisture, Max. %	1	1	1	1.5
Impurities, Max. %	.5	.5	.5	1.0
Unsaponafiable, Max. %	1	1	3.5	4.0
Total MIU, Max. %	2	2	5	6

Additional specifications:

1) Fats must be stabilized with a feed or food grade antioxidant added at levels recommended by the manufacturer.
2) Blended fats shall include only tallow, grease, poultry fat, and acidulated vegetable soapstock. Any other by-products should be included only with the knowledge and consent of the buyer.
3) It must be certified that PCB and pesticide residues in fats are within allowable limits set by state and/or federal agencies.
4) Fats shall not contain more than trace levels of any heavy metal or other contaminant.
5) Suppliers should make every effort to provide a uniform fat formulation in each delivery. This can be accomplished through the use of minimum or maximum iodine values.
6) Suppliers should furnish research data to support metabolizable or net energy claims.

Experimental Procedures

Trial 1. One hundred-forty exotic crossbred steers (primarily Simmental and Charolais x English breeds) were assigned to five weight replicates to evaluate four treatments (7 head/pen): 1) nonfat control, 2) soybean oil, 3) fancy tallow, and 4) yellow grease. Estimated ratios of unsaturated:saturated fatty acids were 5.45, .97, and 1.24 for treatments two, three, and four, respectively. Fat sources were included at 3.5% of diet dry matter and were introduced to cattle in the final ration (Table 30.3).

Starting and ending weights were the average of two consecutive early morning full weights. Ending weights were pencil shrunk 4%. Starting weights were obtained at the time steers were placed on the final ration. Steers had been weighed and allotted to treatments prior to the step-up period, which explains the slight variability in starting weights (Table 30.4).

Trial 2. Two hundred-sixteen steers were allotted to five weight replicates to evaluate five treatments in an incomplete randomized block design. Treatments were 1) a nonfat control, 2) acidulated soybean soapstock (SBSS), 3) tallow, 4) a blend of 70% SBSS: 30% tallow, and 5) yellow grease.

Steers were individually weighed and ear-tagged upon arrival. The following day, they were processed and sorted to their appropriate pen. Off truck weights, adjusted up to pay weight, were used as initial weights.' Final weights were the average of two consecutive early morning full weights and pencil shrunk 4%. Fat sources were introduced in the third "step-up" ration at 1.5% on a dry matter basis. Fat sources were increased to 3.5% of diet dry matter when cattle were placed on the final ration (Table 30.5), 11 days after arrival.

In both trials, fat sources were maintained at 130-140°F in 55 gallon barrels equipped with wrap-around heaters. Hot fat was applied to the grain portion of the ration at mixing time.

Results and Discussion

Trial 1. Steers fed fat in this trial gained faster ($P<.05$) than control steers (Table 30.4). Steers fed yellow grease had the highest dry matter consumptions, which were 1 lb/head/day higher ($P<.05$) than those of steers fed tallow.

Steers fed fat had higher ($P<.05$) dressing percentages and carcass weights than control steers. With the exception of tallow, fat feeding tended to increase carcass quality (marbling). It is probable that tallow had less impact on carcass quality because that treatment had lower dry matter intakes relative to the other fat treatments.

Feed costs of gain and economic return of fat sources in this trial are presented in Table 30.7. Ration costs presented are ingredient costs plus $20/ton. Raw soybean oil, tallow, and yellow grease were priced at 22, 17, and 13 cents per lb, respectively. Relative to the nonfat control, costs of gain (feed cost/lb of gain) were reduced (7 cents/lb) only by yellow grease. However, because of increased carcass yield and quality, feeding fat produced more pounds of salable product with the same number of days on feed. Thus, there was an economic benefit to feeding fat in this trial, even for raw soybean oil at 22 cents per lb.

Trial 2. Dry matter intake (Table 30.6) by steers fed yellow gease in this study was lower ($P<.05$) than that by steers fed either no fat or acidulated soybean soapstock (SBSS) and also tended to be lower than for steers fed the blend of 70% SBSS and 30% tallow (SBSS:tallow). As a result, daily gain for steers fed yellow grease was lower ($P<.05$) than that for steers fed the other fat sources. Relative to the nonfat control, feed efficiency was improved 2.8, 7.1 ($P<.05$), 7.7 ($P<.05$), and 3.6% by SBSS, tallow, SBSS:tallow, and yellow grease, respectively.

Performance of steers fed SBSS:tallow was greater than that predicted from the weighted average of SBSS and tallow fed separately in this trial. The magnitude of the difference is depicted in Table 30.8.

The reason for this positive associative action is unclear. In monogastrics, similar ratios of vegetable oil to tallow have produced positive associative effects on carcass energy retention.

Steers fed SBSS, tallow, or SBSS:tallow had heavier carcasses ($P<.10$) than steers fed yellow grease and were numerically heavier than control steers (Table 30.6). No differences in dressing percentages were noted. Overall low carcass yields are attributed to extremely heavy mud conditions prior to slaughter. Adding fat to the diet increased backfat thickness by an average of 14.5% ($P<.05$) and marbling by 2% ($P<.10$).

Feed costs of gain and economic return in this trial are shown in Table 30.9. Ration costs reflect ingredient costs plus $20 per ton. Soybean soapstock, SBSS:tallow, and yellow grease were priced at 13 cents per lb, and tallow was priced at 17 cents in this comparison. The SBSS:tallow blend was the only fat source in this trial that reduced costs of gain compared to the control. However, when the differences in carcass value were considered, SBSS, tallow, or SBSS:tallow returned 3 to 5 dollars per head above the cost of the respective fat. The return on yellow grease was negative in this trial, in complete disagreement with results obtained in trial 1. That probably illustrates the effects of the variability encountered with some blended fats.

Based on performance of steers in these studies, NEg values were obtained for the various fat sources (Tables 30.4 and 30.6). In order to be confident of these energy values, interactive factors such as grain processing method, fat level, ionophore level, dietary levels of various minerals, and environment must be understood. Also, when blended fats are used, their composition and quality must be stringently controlled.

Table 30.3. Composition of Final Diets Fed in Trial 1

Ingredient	Control	Soybean oil	Tallow	Yellow grease
Flaked milo	80.00	80.00	80.00	80.00
Alfalfa hay	4.75	4.75	4.75	4.75
Corn silage	4.00	4.00	4.00	4.00
Supp. 8703	5.25	5.25	5.25	5.25
Molasses	6.00	2.50	2.50	2.50
Soybean oil	--	3.50	--	--
Tallow	--	--	3.50	--
Yellow grease	--	--	--	3.50

[a] Dry matter basis. Formulated to contain 12.0% CP, .65% Ca, .29% P and .6% K. Rumensin and Tylan fed at 25 and 10 g/ton, respectively (90% dry basis).

Table 30.4. Influence of Fat Source on Performance and Carcass Quality of Finishing Steers in Trial 1 (March 4 to June 30 or July 14, 1987; average of 122 days fed)

Soybean		Yellow			
Item	Control	oil	Tallow	grease	SE
No. pens	5	5	5	5	
No. steers	35	35	35	35	
Starting weight, lb	810	798	797	813	7
Pay weight out, lb[1]	1189	1210	1198	1234	11
Daily gain, lb	3.13^{c}	3.38^{ab}	3.31^{b}	3.48^{a}	.06
Daily feed, lb DM	19.59^{ab}	19.61^{ab}	19.08^{b}	20.08^{a}	.34
Feed/gain	6.28^{b}	5.80^{a}	5.79^{a}	5.77^{a}	.13
NEg fat, Mcal/cwt	--	142.9	155.9	167.0	--
	-----------------	Carcass traits	-----------------		
Hot weight, lb	755^{b}	778^{ab}	770^{ab}	9	
Dressing percent	63.42^{b}	64.57^{a}	64.15a	64.13a	.25
Backfat, in	.32	.37	.33	.34	.02
Marbling score[2]	5.07	5.12	5.00	5.15	.08
Percent choice	62	79	62	79	

[1] Final live weights shrunk 4%.
[2] Slight 50=4.5, small 50=5.5.
[abc] Means in a row with different superscripts differ (P<.05).

Table 30.5. Composition of Final Diets Fed in Trial 2

Ingredient	Control	SBSS[b]	Tallow	70 SBSS: 30 Tallow	Yellow grease
Flaked milo	83.9	83.9	83.9	83.9	83.9
Alfalfa hay	4.0	4.0	4.0	4.0	4.0
Corn silage	4.0	4.0	4.0	4.0	4.0
Supp. 8710	4.6	4.6	4.6	4.6	4.6
Molasses	3.5	--	--	--	--
SBSS	--	3.5	--	2.45	--
Tallow	--	--	3.5	1.05	--
Yellow grease	--	--	--	--	3.5

[a] Dry matter basis. Formulated to contain 12% CP, .65% Ca, .32% P and .7% K.
[b] Rumensin and Tylan fed at 20 and 10 g/ton, respectively (90% dry basis).
[b] Acidulated soybean soapstock.

Table 30.6. Influence of Fat Source on Performance and Carcass Quality of Finishing Steers in Trial 2 (September 23 to December 21, 1987; 89 days fed)

Item	Control	SBSS4	Tallow	70 SBSS4: 30 Tallow	Yellow grease	SE
No. pens	5	5	5	5	4	
No. steers	45	45	45	45	36	
Pay weight in, lb[1]	845	845	845	844	844	1
Pay weight out, lb[2]	1147	1157	1159	1162	1138	6
Daily gain, lb	3.40^{de}	3.50^{cd}	3.52^{cd}	3.57^{c}	3.30^{e}	.07
Daily feed, lb DM	21.62^{a}	21.69^{ab}	20.86^{ab}	21.01^{ab}	20.28^{b}	.36
Feed/gain	6.38^{b}	6.20^{ab}	5.93^{a}	5.89^{a}	6.15^{ab}	.12
NEg fat, Mcal/cwt	-	97.5	171.8	179.9	123.0	
	---------------------Carcass traits---------------------					
Hot weight, lb	712^{cd}	719^{c}	719c	721^{c}	707^{d}	4
Dressing percent	62.05	62.12	62.07	62.02	62.09	.25
Backfat, in	$.31^{b}$	$.35^{ab}$	$.37^{a}$	$.34^{ab}$	$.36^{ab}$	.02
Marbling score[3]	5.03^{d}	5.07^{cd}	5.20^{c}	5.07^{cd}	5.18^{c}	.07
Percent	56	69	62	58		

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[1] Initial weights adjusted to pay weight.

[2] Final live weights shrunk 4%.

[3] Slight 50=4.5, small 50=5.5.

[4] Acidulated soybean soapstock.

[ab] Means in a row with different superscripts differ (P<.05).

[cde] Means in a row with different superscripts differ (P<.10).

Table 30.7. Effect of Fat Source on Cost of Gain and Economic Return (Trial 1)

Item	Control	Soybean oil	Tallow	Yellow grease
Ration cost, \$/ton[a]	84.20	94.50	91.76	89.36
Ration cost, \$/head	134.16	150.72	142.40	145.94
Cost above control, \$/head	---	16.56	8.24	11.78
Feed cost of gain, \$/lb	.354	.366	.355	.347
Economic return, carcass basis[b]				
Carcass value, \$/head	777.58	808.65	793.02	823.44
Value above control, \$/head	---	31.07	15.44	45.86
Return above feed cost, \$/head	---	14.51	7.20	34.08
Economic return, live basis[c]				
Final weight, lb[d]	1185	1217	1205	1225
Value, \$/head	788.03	809.31	801.33	814.63
Value above control, \$/head	---	21.28	13.30	26.60
Return above feed cost, \$/head	---	4.72	5.06	14.82

[a] Ingredient costs plus \$20/ton. Soybean oil, tallow, yellow grease priced at 22, 17 and 13 cents per lb, respectively. Blended molasses priced at \$70 per ton.

[b] Carcass prices: \$105 choice, \$100 good.

[c] Cash price: \$66.50

[d] Adjusted for initial weight and shrunk 4%.

Table 30.8. Effect of a 70:30 Blend of Acidulated Soybean Oil Soap Stock and Tallow on Steer Performance

	Daily gain	Dry matter consumption (lb/day)	Feed/ gain
Predicted	3.51	21.44	6.12
Observed	3.57	21.01	5.89
Difference	1.7%	-2.1%	3.9%

Table 30.9. Effect of Fat Source on Cost of Gain and Economic Return (Trial 2)

Item	Control	SBSS[a]	Tallow	70 SBSSa: 30 Tallow	Yellow grease
Ration cost, $/ton[b]	83.50	88.98	91.16	88.98	88.98
Ration cost, $/head	107.11	114.51	112.83	110.92	107.07
Cost above control, $/head	-	7.40	5.72	3.81	.16
Feed cost of gain, $/lb	.355	.367	.359	.349	.364
Economic return, carcass basis[c]					
Carcass value, $/head	731.94	743.81	741.29	741.91	729.62
Value above control, $/head	--	11.87	9.37	9.97	-2.32
Return above cost, $/head	-	4.47	3.63	6.16	-2.48
Economic return, live basis[d]					
Value, $/head	757.02	763.62	764.94	766.92	751.08
Value above control, $/head	-	6.60	7.92	9.90	-5.94
Return above feed cost, $/head	-	-.80	2.20	6.09	-6.10

[a] Acidulated soybean soapstock.

[b] Ingredient costs plus $20/ton. Soapstock, tallow, blend and yellow grease priced at 13, 17, 13 and 13 cents per lb., repectively. Blended molasses priced at $70 per ton.

[c] Carcass price: $105 choice, $100 good.

[d] Cash price: $66.50.

Incidence of Pregnancy in Feedlot Heifers at Slaughter

Scott B. Laudert[1]

Summary

Nearly 83,000 heifers were observed at slaughter during 1986 and 1987 to determine their reproductive status. Slightly less than 4 percent were found to be pregnant. Highest incidences of pregnancy were found during the winter months of November through March. Lowest incidences were found during August, September, and October.

Introduction

The incidence of pregnant heifers entering feedyards has been fairly well documented in recent years. Dr. A.J. Edwards, Kansas State University College of Veterinary Medicine, reported that 15 percent of 20,526 feedlot heifers examined in 1982 and 9 percent of 19,924 feedlot heifers examined in 1985 were pregnant. Drs. B.W. Bennett and G.P. Rupp of Colorado State University College of Veterinary Medicine reported in 1983 that a survey of Colorado cattle feeders indicated a 16.5 percent pregnancy rate for incoming feedlot heifers. More recently, K-State's Dr. Edwards found 6 percent of 40,000 heifers entering one particular feedyard pregnant in 1986, whereas 4.4 percent of 58,000 heifers entering the same feedyard were pregnant in 1987.

The incidence of pregnancy in feedlot heifers at slaughter has not been as thoroughly documented. The Colorado survey conducted by Bennett and Rupp in 1983 also included slaughter plants. They reported a 17.0 percent pregnancy rate in slaughtered heifers. The following data were collected to establish the reproductive status of Kansas feedlot heifers at slaughter.

Experimental Procedures

Random lots of heifers originating from Kansas feedyards were observed during slaughter at five Kansas slaughter plants. The number of fetuses appearing at the evisceration table within each lot was recorded.

Results and Discussion

Annual observations for 1986 and 1987 are reported in Table 31.1 and the combined 2-year data in Table 31.2. Highest rates of pregnancy were found during the winter months of November through March, ranging from 5.17 to 7.90 percent. Lowest pregnancy rates were observed during August, September, and October.

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[1] Extension Specialist, Animal Sciences and Industry, Southwest.

The 2-year average annual pregnancy rate of 3.93 percent is considerably lower than the 17.0 percent reported by Bennett and Rupp in their 1983 Colorado packer survey. Pregnancy rate on 188 pens totaling 24,658 heifers originating from Colorado feedyards and slaughtered at Kansas packing plants during 1986 and 1987 was 4.1 percent. This apparent substantial reduction in pregnancy rate of slaughtered heifers is likely due to intensified efforts of feedlots to abort pregnant heifers upon arrival at the feedyard and attempts of stocker operators to keep heifers from being bred. The survey work of Edwards would suggest that fewer pregnant heifers are entering feedyards.

The distribution of pregnancy rates is presented in Table 31.3. Nearly one-third of all pens of heifers observed had no pregnancies. Only 4.1 percent of all pens, which represented 2.9 percent of all heifers, had over 20 percent pregnancies. Feedyards with aggressive management programs for pregnancy and abortion should continually remind their packer buyers of this fact and strive to narrow their price spread between comparable quality steers and heifers.

Table 31.1. Incidence of Pregnancy at Slaughter in Feedlot Heifers Originating from Kansas Feedyards

Month Slaughtered	No. Pens	Head Slaughtered	Number Pregnant	Percent Pregnant
		------1986------		
January	1	215	13	6.05
February	0	0	0	----
March	30	4710	245	5.20
April	22	3529	139	3.94
May	60	11077	423	3.82
June	50	8976	167	1.86
July	34	6286	140	2.23
August	23	3937	41	1.04
September	1	140	0	0.00
October	11	1698	0	0.00
November	4	1001	0	0.00
December	27	4310	259	6.01
Total	263	45879	1427	3.11
		------1987------		
January	49	7335	454	6.19
February	25	3027	239	7.90
March	12	1875	144	7.68
April	16	2700	122	4.52
May	10	1916	36	1.88
June	17	3061	182	5.95
July	23	3250	71	2.18
August	6	979	4	0.41
September	15	2858	21	0.74
October	7	675	2	0.30
November	15	2849	199	6.98
December	32	6329	354	5.59
Total	227	36854	1828	4.96

Table 31.2. Incidence of Pregnancy at Slaughter in Feedlot Heifers Originating From Kansas Feedyards, Two Year Average

Month Slaughtered	No. Pens	Head Slaughtered	Number Pregnant	Percent Pregnant
January	50	7550	467	6.19
February	25	3027	239	7.90
March	42	6585	389	5.91
April	38	6229	261	4.19
May	70	12993	459	3.53
June	67	12037	349	2.90
July	57	9536	211	2.21
August	29	4916	45	0.92
September	16	2998	21	0.70
October	18	2373	2	0.08
November	19	3850	199	5.17
December	59	10639	613	5.76
Total	490	82733	3255	3.93

Table 31.3. Distribution of Pregnancy Rates at Slaughter in Feedlot Heifers

Pregnancy Rate, %	No. Pens	Percent Pens	No. Head	Percent Head	No. Slunks
1986					
0.0	92	35.0	14130	30.8	0
0.1 to 5.0	114	43.4	22048	48.4	466
5.1 to 10.0	34	12.9	6525	14.2	486
10.1 to 20.0	20	7.6	2587	5.6	324
over 20.0	3	1.1	589	1.3	151
1987					
0.0	65	28.6	8950	24.3	0
0.1 to 5.0	78	34.4	15921	42.4	351
5.1 to 10.0	38	16.7	6395	17.4	459
10.1 to 20.0	29	12.8	3793	10.3	551
over 20.0	17	7.5	1795	4.9	467
Combined Data					
0.0	157	32.0	23080	27.9	0
0.1 to 5.0	192	39.2	37969	45.9	817
5.1 to 10.0	72	14.5	12920	15.6	945
10.1 to 20.0	49	10.0	6380	7.7	875
over 20.0	20	4.1	2384	2.9	618

Effect of Tetronasin on Frothy Bloat In Cattle Caused by High-Grain Diet[1]

Lisa R. Neibarger and T.G. Nagaraja

Summary

Feeding Tetronasin reduced incidence of frothy bloat in cattle fed a high-grain diet. The effective dose was 0.25 mg/kg body weight when administered prior to the onset of frothy bloat. At 0.15 mg/kg body weight, the antibiotic was less effective but the degree of bloat was considerably less than that of steers fed no antibiotic. Tetronasin also reduced the severity of bloat in steers that were already bloating prior to its administration.

Introduction

Feedlot or grain bloat is a frothy bloat resulting from the development of foam in the rumen. When cattle are fed high-grain diets, gas from normal ruminal microbial fermentation becomes trapped in the digesta and forms foam. The foam inhibits eructation and causes bloat.

It is recognized that rumen microorganisms are involved in causing bloat. Coopers Animal Health, Inc. has developed a new feed additive ionophore antibiotic, Tetronasin, which has shown promise for improving feed efficiency and weight gain of feedlot cattle. We studied the effect of Tetronasin in controlling feedlot bloat.

Experimental Procedures

Nine ruminally cannulated steers adapted to an all-alfalfa hay diet were switched to a high-concentrate, bloat provocative diet. The diet was 60% cracked sorghum grain, 16% soybean meal, 22% dehydrated alfalfa pellets, 1% salt, and 1% dicalcium phosphate.

The change-over from the all-hay diet was accomplished in about 10 days. Steers were allocated at random to one of three treatment groups. The control group received no antibiotic and the remaining two groups received Tetronasin at 0.15 or 0.25 mg/kg body weight, respectively. Antibiotic feeding, administered as a top-dressing, was initiated with the grain feeding.

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[1] Tetronasin is an experimental feed additive and is not yet approved for use in cattle.

Ruminal contents of each steer were examined daily (3 hours after morning feeding) to assess the frothiness. The degree of bloat was visually scored in one-half units using the following scale:

0 = no froth

1 = slight froth in the rumen, but no pressure and abdominal distension

2 = definite froth with sufficient pressure to expel froth from the fistula when the cap was opened

3 = definite froth with sufficient pressure to cause abdominal distension on the left side

4 = definite froth with sufficient pressure to cause abdominal distension of the left and right side

5 = definite froth, severe abdominal distension, animal in extreme distress, terminal unless pressure is relieved

The treatment period lasted for 6 weeks. Then antibiotic feeding was terminated for the treatment group and the control group was fed the antibiotic at 0.25 mg/kg body weight. This "switchback" phase lasted for 4 weeks.

Results and Discussion

The control group (no antibiotic) began to bloat within 3 days after completing the switch to the bloat provocative diet. All three steers bloated consistently with a bloat score of 2.0 or higher. Steers fed Tetronasin at 0.15 mg/kg had consistently lower bloat scores than the control group (Table 32.1). However, after 3 weeks, two of the three steers began to bloat slightly (average bloat score less than 1.6) and there was a trend toward a gradual increase in the bloat score. Tetronasin at 0.25 mg/kg body weight was extremely effective in preventing bloat in steers fed the bloat-provocative grain diet. Only occasionally did those steers exhibit slight froth in the rumen.

During the switchback phase, both groups of steers that had the antibiotics withdrawn began to bloat and had an average bloat score of 2 within 2 weeks. Control steers that started receiving antibiotic in their feed began to respond to the drug in about 2 weeks.

Table 32.1. Effect of Tetronasin on Frothy Bloat Scores[a] in Cattle Fed High Grain Diets

Days	Control	Tetronasin 0.15 mg/kg	Tetronasin 0.25 mg/kg
1-7	1.5[a]	0.3	0.07
8-14	2.6	0.4	0.17
15-21	2.3	0.6	0.30
22-28	1.7	0.9	0.13
29-35	2.3	1.0	0.13
Post-treatment (Tetronasin withdrawn)			
1-7		0.87	0.63
8-14		1.90	2.00
15-21		2.03	2.10
22-28		1.77	2.40
Tetronasin fed to controls (0.25 mg/kg)			
1-7	0.93		
8-14	1.40		
15-21	0.63		
22-28	0.40		

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[a] Mean bloat score of three steers in each group. 0 = no bloat, 5 = severe bloat, terminal unless relieved.

Experimental Induction and Monitoring of Liver Abscesses in Cattle With Ultrasonography

K.F. Lechtenberg, T.G. Nagaraja,
and T.B. Avery[1]

Summary

We have demonstrated that ultrasonography can be used to visualize liver abscess in live cattle. We have also developed a nonsurgical method of catheterizing the bovine portal vein and experimentally inducing liver abscesses by inoculating the portal vein with Fusobacterium necrophorum bacteria.

Introduction

Researchers have documented decreased average daily gains and feed efficiency among feedlot cattle with liver abscesses. Losses are likewise incurred by the packers who condemn over three million beef livers annually, the majority because of abscessation. Studies have shown that cattle on high energy rations that do not include antibiotics to control the bacterium, Fusobacterium necrophorum, have abscess incidences of approximately 30%, with different feedlots having ranges from 5-90%.

Experimental Procedure

Six Holstein steers weighing 450 to 650 lbs were used for this study. Animals were placed in a head gate. The right side of the abdomen was clipped and scrubbed. Sterile acoustic jelly was applied on the skin, and the liver was examined with ultrasound equipment to ensure that no liver abscesses were present. A 10 cm square area directly over the portal vein was cleansed with surgical scrubs. Local anesthetic was injected in the 10th rib space over the location of the portal vein. A small incision was made through the skin, and the portal vein was located using ultrasound. A 5 1/4 inch, 14 gauge flexible catheter with stainless steel stylet was guided through the skin incision, muscles, diaphragm, capsule of the liver, liver tissue, and into the portal vein, while observing the procedure with the ultrasound. The steel stylet was removed and sterile flexible tubing was threaded through the larger catheter. An 18-hour broth culture of Fusobacterium necrophorum was injected into the portal circulation via the tubing. The tubing was withdrawn back into the larger catheter and both were removed. No closure of the skin was required. The calves were monitored with the ultrasound equipment daily for 14 days.

Results and Discussion

Prior to our work, the research and testing of compounds to control liver abscesses took one of two approaches. Experimentally induced liver abscesses were

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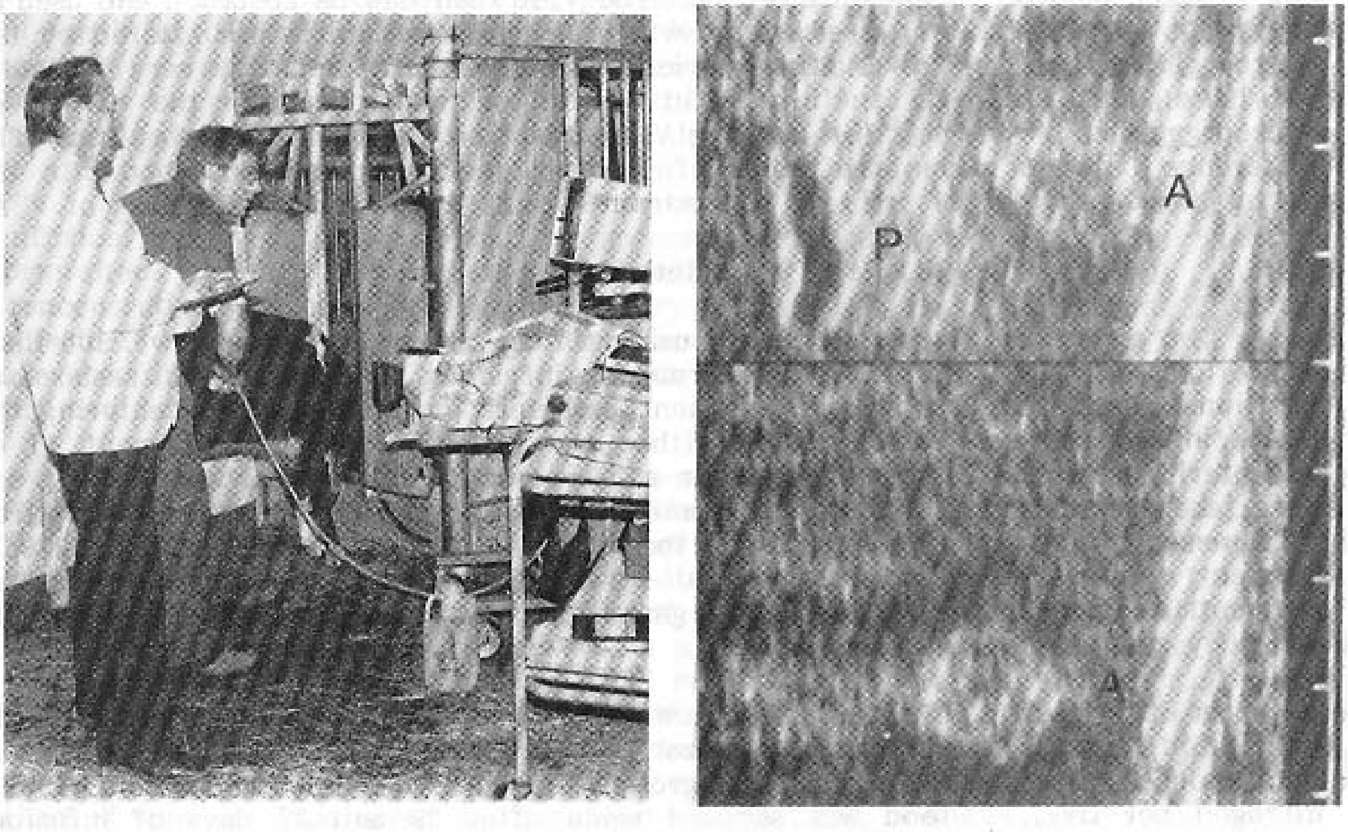
[1] Department of Surgery and Medicine.

the result of tedious and expensive abdominal surgeries, in which the animal was opened up and the portal vein was catheterized and infused. Such an operation obviously stressed the animal. The number of cattle was often limited because of expense and personnel limitations. The other method of liver abscess study, for product evaluation has depended on the incidence of spontaneous abscesses. Cattle were separated into groups and placed on rations containing compounds designed to prevent liver abscesses. The animals were followed to slaughter and incidence of abscesses was determined. The approach is certainly practical, however, it is subject to several unknown variables because there is no certainty that liver abscesses will develop in either treatment or control groups.

All six steers in our study developed multiple liver abscesses. Abscesses were detected by ultrasound within 7 to 8 days in all steers and in some instances as early as 3 days after inoculation of the bacterial culture. The number and location of abscesses were confirmed during postmortem examination of the liver following slaughter. Therefore, ultrasound equipment permits us to visualize the presence of liver abscesses in live cattle. Also, the ability to experimentally induce liver abscesses in cattle provides an ideal experimental model for evaluating new products for prevention of liver abscesses.



On the left, a calf's liver is examined with ultrasonic scanning equipment. The image is sent to both a screen and a camera, producing the image shown on the right. P denotes the portal vein. The circular structures labeled A are liver abscesses.

Evaluating the Availability of Nutrients for Maintenance and Growth in Ruminants

Kathy Gross, Dave Harmon, and Tom Avery[1]

Summary

Two experiments were performed with mature wether lambs to evaluate availabilty of selected nutrients and volatile fatty acids for maintenance and growth. We used a technique in which known amounts of volatile fatty acids were infused into the rumen and casein into the abomasum. Sampling portal blood allowed measurement of nutrients absorbed across the gastrointestinal tract. Approximately 49, 62, and 21% of the infused acetate, propionate, and butyrate, respectively, were absorbed across the gastrointestinal tract.

Introduction

The microorganisms that inhabit the rumen ferment fiber and other nutrients and produce volatile fatty acids (VFA). The VFA then can be absorbed and used as energy to support maintenance and growth. Because feedstuffs are altered by the microorganisms, research evaluating nutrients available to the animal is very difficult. We have been using a technique in which we can eliminate the effect of microorganisms in the rumen by infusing VFA, and then studyingVFA absorption. The difference between amounts of VFA infused into the rumen and absorbed into the portal blood provides an estimate of gastrointestinal tract tissue utilization of VFA.

Methods

Two experiments were conducted using mature wether lambs (avg. wt. 100 lbs.) whose only nutrient intake was intraruminal infusions of VFA and intraabomasal infusions of casein. Lambs had permanent catheters in the portal vein entering the liver, in a mesenteric vein, and in either the femoral artery (Experiment 1) or mesenteric artery (Experiment 2). Four sets of portal and arterial samples per day were taken at 1.5 hour intervals on 2 consecutive sampling days. Portal nutrient flux measurements were made by multiplying the difference between artery and portal vein nutrient concentration by portal blood flow. Portal flux of nutrients measures nutrients that are absorbed across the gastrointestinal tract, and are thus available for body maintenance and growth.

In Experiment 1, blood samples were taken when lambs were fed pelleted alfalfa calculated to supply 1.95 Mcal metabolizable energy (ME) per day and then started on continuous infusions of VFA (2.0 Mcal gross energy (GE) per day) and casein (13.3 g nitrogen per day). Blood was sampled again after 29 and 37 days of infusion.

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[1] Department of Surgery and Medicine.

Acetate, propionate, and butyrate were infused into the rumen in molar proportions of 65:25:10, respectively. Ruminal fluid samples for pH and VFA concentration were taken at the same time as blood samples.

In Experiment 2, lambs were sampled and infused by the same protocol used in Experiment 1. Total energy from VFA and casein infusions were 1.64, 1.82, and 2.37 Mcal GE per day and nitrogen infusions were 10.9, 12.3, and 15.0 g per day. Blood was sampled at each level of infusion, and total urine and feces were collected for a 3-day period at each infusion level to determine nitrogen balance.

Results and Discussion

Experiment 1. Ruminal fluid pH and VFA concentrations in lambs maintained on infusions are in shown Table 34.1. Molar proportions of ruminal acetate, propionate, and butyrate were similar to the infusion solution, although ruminal concentrations of branched chain VFA increased for both infusion periods.

Arterial concentration of most nutrients were within normal ranges (Table 34.2) but glucose and ammonia-N were higher ($P<.05$) and alpha-amino-N and urea-N were lower ($P<.05$) in the infused lambs compared to alfalfa-fed lambs. Acetate was the VFA in highest concentration in arterial blood in both alfalfa-fed and infused lambs.

Net portal flux of total VFA, propionate, and butyrate (Table 34.3) was greater in the infused lambs compared to alfalfa-fed lambs. In this experiment, only 51, 58, and 23% of ruminally infused acetate, propionate, and butyrate, respectively, were found in the portal blood, which indicated that significant quantities of all VFA were metabolized by the gastrointestinal tract during absorption.

Experiment 2. Ruminal fluid pH decreased linearly ($P<.10$) as the level of VFA infusion increased (Table 34.4). Molar concentrations of propionate, butyrate, and branched chain VFA increased as level of VFA infusion increased. Arterial concentrations of most nutrients were very similar to those in Experiment 1 for both alfalfa-fed and infused lambs with the exception that arterial ammonia (NH_3) levels averaged .21 mM over all sampling periods and urea-N was 6.8 mM when alfalfa was fed and 2.8 mM during infusion periods.

Net portal flux of glucose, alpha-amino-N, and urea (Table 34.5) were not significantly different for lambs given alfalfa or any level of energy infusion. Net flux of NH_3 decreased linearly as level of infusion increased. Glucose fluxes were negative, indicating that glucose was used by gastrointestinal tissue. Portal oxygen flux values were negative, indicating use of oxygen by gastrointestinal tract tissue for nutrient metabolism. The lambs were in a positive nitrogen (N) balance when fed alfalfa and during 1.82 and 2.37 Mcal GE infusion periods. Lambs were in a negative nitrogen balance when infused with 1.64 Mcal GE and 10.9 g nitrogen per day; these levels are below calculated maintenance requirements. The energy from VFA in the portal blood accounted for 39% of total energy fed or infused. Results, similar to those found in Experiment 1, indicated that 47, 65, and 19% of infused acetate, propionate, and butyrate, respectively, were found in the portal blood and did not differ for any level of VFA infusion.

Table 34.1. Ruminal Fluid pH and VFA Concentration in Lambs Maintained by Infusions of VFA and Casein in Experiment 1

Item	Day of Infusion 29	Day of Infusion 37
Ruminal pH	5.58	5.97
VFA, mM:		
Acetate	112.1	111.7
Propionate	39.5	36.2
Butyrate	12.9	12.2
Branched Chain VFA[a]	.2	.6
Acetate:Propionate:Butyrate	68:24:8	69:22:8

[a] Day 29 different than day 37, P<.001.

Table 34.2. Arterial Concentrations of Nutrients in Lambs Maintained on Pelleted Alfalfa or Infusions of VFA and Casein in Experiment 1

Arterial Concentration, mM	Alfalfa day 34	VFA Infusion day 29	VFA Infusion day 37
Glucose[ab]	3.66	4.15	4.16
L-lactate[ac]	.98	1.55	.96
D-ß-hyroxybutyrate[b]	.31	.30	.27
L-glutamate[ac]	.32	.20	.27
Alpha-amino-N[ab]	3.43	2.21	2.45
Ammonia-N[abc]	.06	1.12	1.42
Urea-N	13.18	5.16	8.67
Acetate	1.30	1.37	1.22
Propionate	.10	.13	.10
Butyrate	.02	.03	.02
Branched Chain VFA	.01	.01	.01

[a] Alfalfa different than day 29, P<.05.
[b] Alfalfa different than day 37, P<.05.
[c] Day 29 different than day 37, P<.001.

Table 34.3. Net Portal Flux of VFA in Lambs Maintained on Pelleted Alfalfa or Infusions of VFA and Casein in Experiment 1

VFA flux, mmol/hr.	Alfalfa day 34	VFA Infusion day 29	 day 37
Acetate	47.5	86.0	83.1
Propionate[ab]	11.2	37.3	43.0
Butyrate[ab]	.1	5.8	6.2
Branched Chain VFA	3.7	.7	2.1
Total VFA[ab]	64.5	129.8	138.3

[a] Alfalfa different than day 29, $P<.05$.
[b] Alfalfa different than day 37, $P<.05$.

Table 34.4. Ruminal Fluid pH and VFA Concentrations in Lambs Fed Pelleted Alfalfa or Infused with Various Levels of VFA and Casein in Experiment 2

Item	Alfalfa-Fed 1.95 Mcal ME	VFA Infusion, Mcal GE 1.64	 1.82	 2.37
Ruminal pH[b]	6.76	6.18	6.00	5.85
VFA, mM:				
Acetate	42.2	60.6	62.2	77.5
Propionate[a]	10.3	19.8	21.1	26.5
Butyrate[b]	6.1	5.9	6.7	8.3
Branched Chain[a]	1.8	.1	.1	.1
Total VFA	60.3	86.3	90.2	112.4

[a] Linear effect, $P<.05$.
[b] Linear effect, $P<.1$.

Table 34.5. Net Portal Flux of Nutrients in Lambs Fed Pelleted Alfalfa or Infused with Various Levels of VFA and Casein in Experiment 2

Flux mm/hr.	Alfalfa-Fed 1.95 Mcal ME	VFA Infusion, Mcal GE 1.64	1.82	2.37
Acetate	56.4	72.0	68.4	104.0
Propionate	20.9	35.4	28.2	46.0
Butyrate	3.4	4.5	3.4	6.4
Branched Chain				
VFA[a]	1.1	.2	.2	.2
Glucose	-4.9	-6.0	-5.3	-8.8
Alpha-amino-N	38.3	28.2	18.2	20.9
NH_3[a]	36.0	21.3	19.2	17.5
Urea	-7.2	-5.9	-5.9	-6.1
Oxygen	-135.3	-85.7	-51.1	-118.4

[a] Linear effect, $P<.05$.

Glucose, Starch, and Dextrin Utilization in the Small Intestine of Steers

K.K. Kreikemeier, D.L. Harmon,
T.B. Avery[1], and R.T. Brandt, Jr.[2]

Summary

Glucose infused into the abomasum of Holstein steers resulted in higher arterial glucose concentrations and increased net glucose absorption than either starch or dextrin infusions. Increasing infusion rates above 20 g/hr for both starch and dextrin resulted in no further increases in net glucose absorption. Even though the enzymatic starch and dextrin hydrolysis became saturated above 25 g/hr, the amount of starch and dextrin disappearing in the small intestine increased with higher infusion rates. This was accompanied by increased volatile fatty acid concentrations in the ileal fluid with starch and dextrin infusions, but not when glucose was infused. These data support two concepts: (1) microbial fermentation is involved in small-intestinal starch disappearance and (2) starch and dextrin hydrolysis in the small intestine of steers is more rate limiting than glucose absorptive capacity.

Introduction

Because feed grains are about 70% starch, starch is the primary energy source in the diet of finishing beef cattle. Digestion of starch can occur either by microbial fermentation in the rumen and hindgut or by enzymatic hydrolysis in the small intestine. Total tract starch digestion in beef cattle ranges from 80 to 95% and is affected by grain type, as well as processing method. Extensive processing of grain will increase its digestibility, but may increase the potential for acidosis. Underprocessing, however, results in decreased starch digestion and poor feed efficiency. Starch being digested and absorbed in the small intestine as glucose is more energetically efficient than its fermentation to volatile fatty acids. However, as the amount of starch escaping ruminal fermentation increases, so does fecal starch excretion, indicating a limit to the rate of small-intestinal starch digestion. Therefore, a series of experiments was conducted to evaluate small-intestinal starch digestion and to determine factors that may be limiting.

Experimental Procedure

Two groups of four Holstein steers (group 1, 660 lbs; group 2, 890 lbs) were surgically fitted with abomasal and ileal cannulae, portal and mesenteric catheters, and an elevated carotid. A temporary catheter was placed in the carotid

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[1] Department of Surgery and Medicine.

[2] Southwest Kansas Experiment Station, Garden City.

artery during sampling periods. Glucose, corn starch, and corn dextrin were infused abomasally at 0, 20, 40, and 60 g/hr. Ileal digesta samples were collected, and disappearance of carbohydrate in the small intestine was determined using Cr:EDTA as an indigestible marker. Simultaneous blood samples were collected from the portal vein and carotid artery, and glucose absorption across the small intestine was calculated. Portal blood flow was determined by a primed continuous infusion of para-amino-hippuric acid (PAH) into a small mesenteric vein.

With the first group of steers, glucose (Experiment 1) or corn starch (Experiment 2) were continuously infused into the abomasum at 0, 20, 40, or 60 g/hr for 10 h. Infused volume was 250 ml of solution per hour, consisting of tap water, the appropriate carbohydrate, and Cr:EDTA. Steers were fed chopped alfalfa hay at 1.5% of body weight (dry matter basis). Animals and treatments were randomized to an 8-period crossover design for each experiment. During each infusion period, 7 ileal digesta samples and 5 sets of blood samples were collected from each steer. Ileal digesta was analyzed for VFA concentration, dry matter, starch, glucose, and chromium. Plasma samples were analyzed for glucose and PAH.

The second group of steers was infused with glucose (Experiment 3), corn starch (Experiment 4), or corn dextrin (Experiment 5). Infusions, digesta and blood collections, lab analyses, and animal care were identical to those in Experiments 1 and 2. Animals and treatments were randomized to a 4 x 4 Latin square design for Experiments 3 and 4, whereas Experiment 5 was an 8-period crossover design.

Results and Discussion

Experiment 1. Steers consumed 9 lbs of alfalfa hay daily (dry matter basis) during the glucose infusions (Table 35.1). Increasing levels of abomasal glucose infusion resulted in glucose passing the ileum into the large intestine, yet there was no change in ileal fluid VFA concentration. This indicated that there was little microbial fermentation of glucose in the small intestine. Arterial glucose concentration as well as net glucose absorption continued to increase with higher glucose infusions. The amount of glucose absorbed was approximately equal to the amount of glucose disappearing in the small intestine.

Experiment 2. Steers consumed 7.25 lbs of alfalfa daily (Table 35.2). Even though corn starch was infused, both free glucose and starch passed the ileum. The amount of starch that escaped small-intestinal digestion increased with increasing amounts of starch infusion. In addition, as starch passing the ileum increased, ileal fluid VFA concentration also increased. This indicates that small-intestinal starch digestion included microbial fermentation. Arterial glucose and net glucose absorption increased as the infusion rate was raised from 0 to 20 g/hr, with no additional change as infusion increased further. It appears that the processes for small-intestinal starch hydrolysis became saturated at approximately the 20 g/hr infusion level.

Experiment 3, 4, 5. The results of Experiments 3 and 4 (Table 35.3 and 35.4) conducted with group 2 steers were similar to trends observed in the first two experiments. The final experiment (Table 35.5) was the infusion of corn dextrin. Dextrin is partially hydrolyzed starch, consisting of straight chain glucose polymers with an average chain length of 17 glucose units. Dextrin has none of the granules or molecular branching points that are found in starch and may limit enzymatic hydrolysis. When corn dextrin was infused, steers consumed 11.5 lbs of alfalfa hay daily. At higher levels of infusion, free glucose as well as dextrin flowed past the ileum to the large intestine. There was an increase in ileal fluid VFA concentration, whereas arterial glucose levels and net glucose absorption both plateaued at the 20 g/hr infusion rate, as in previous experiments with starch.

Regardless of the type of carbohydrate infused, increased infusion rates resulted in increased amounts of small-intestinal carbohydrate disappearance. When glucose was infused, most of the disappearance could be accounted for by glucose absorption. With starch and dextrin infusions, arterial glucose and glucose absorption plateaued near the 20 g/hr infusion rate. This was accompanied by a gradual increase in ileal fluid VFA concentration. Therefore, it is probable that a large amount of starch digestion in the small intestine is by microbial fermentation. It also appears that enzymatic processes responsible for starch and dextrin hydrolysis are more rate limiting than the glucose absorption capacity of the small intestine.

Table 35.1. Effect of Abomasal Glucose Infusions on Small-intestinal Disappearance and Net Portal Glucose Absorption (Experiment 1)

	Glucose Infusion rate, g/hr				
Item	0	20	40	60	SE
Daily feed, lbs	9.2	9.7	9.2	8.6	0.4
Glucose flowing past ileum, g/hr[ab]	0	0.8	8.0	20.6	1.5
VFA in ileal fluid, mM	20.8	21.3	22.0	21.3	1.5
Arterial glucose, mM[a]	4.1	4.5	4.6	5.0	0.1
Net portal glucose absorption, g/hr[a]	-2.5	13.4	18.2	34.2	5.5

aLinear effect, P<.01,

[b]Quadratic effect, P<.01.

Table 35.2. Effect of Abomasal Starch Infusions on Small-intestinal Disappearance and Net Portal Glucose Absorption (Experiment 2)

Item	Starch Infusion rate, g/hr				SE
	0	20	40	60	
Daily feed, lbs	7.5	7.5	6.6	7.5	0.4
Glucose flowing past ileum, g/hr[a]	0	0.5	0.9	1.1	0.1
Starch flowing past ileum, g/hr[ab]	0	1.3	13.3	26.2	1.8
VFA in ileal fluid, mM[a]	23.3	26.2	28.9	30.2	1.9
Arterial glucose, mM[a]	4.1	4.3	4.4	4.3	0.1
Net portal glucose absorption, g/hr[a]	-5.7	5.0	2.1	6.3	3.2

[a] Linear effect, P<.05.

[b] Quadratic effect, P<.05.

Table 35.3. Effect of Abomasal Glucose Infusions on Small-intestinal Disappearance and Net Portal Glucose Absorption (Experiment 3)

Item	Glucose Infusion rate, g/hr				SE
	0	20	40	60	
Daily feed, lbs	12.5	13.0	10.4	12.3	1.3
Glucose flowing past ileum, g/hr[a]	0	0	4.90	13.8	2.8
VFA in ileal fluid, mM	23.9	25.8	27.9	20.5	2.8
Arterial glucose, mM[a]	4.4	4.9	5.1	5.1	0.1
Net portal glucose absorption, g/hr[a]	-7.3	19.8	20.0	36.6	7.9

[a] Linear effect, P<.01.

Table 35.4. Effect of Abomasal Starch Infusions on Small-intestinal Disappearance and Net Portal Glucose Absorption (Experiment 4)

Item	Starch Infusion rate, g/hr				SE
	0	20	40	60	
Daily feed, lbs	11.9	13.2	13.2	13.0	0.9
Glucose flowing past ileum, g/hr[a]	0	0.7	2.3	2.7	0.5
Starch flowing past ileum, g/hr[a]	0	5.5	10.9	26.1	4.1
VFA in ileal fluid, mM	26.9	30.9	29.8	29.6	2.3
Arterial glucose, mM[a]	4.1	4.2	4.3	4.4	0.1
Net portal glucose absorption, g/hr[a]	-6.7	8.5	12.0	12.1	1.9

[a] Linear effect, P<.01
[b] Quadratic effect, P<.01.

Table 35.5. Effect of Abomasal Dextrin Infusions on Small-intestinal Disappearance and Net Portal Glucose Absorption (Experiment 5)

Item	Dextrin Infusion rate, g/hr				SE
	0	20	40	60	
Daily feed, lbs	11.0	13.2	9.9	10.6	1.4
Glucose flowing past ileum, g/hr[ab]	0	0	0.4	1.0	1.3
Dextrin flowing past ileum, g/hr[a]	0	6.2	5.1	11.1	1.3
VFA in ileal fluid, mM[a]	22.3	24.7	22.4	30.7	3.2
Arterial glucose, mM[ab]	4.3	4.6	4.7	4.6	0.1
Net portal glucose absorption, g/hr[ab]	-7.3	14.4	14.3	9.4	4.6

[a] Linear effect, P<.05.
[b] Quadratic effect, P<.05.

Serum Cholesterol Concentrations in Yearling Bulls

Gary Goldy, Jack Riley, and Willard Olsen

Summary

A wide range in serum cholesterol concentrations was observed within and between all four breeds of yearling bulls studied. The significance of this observation is unknown at this time. Addition research is necessary to determine the heritability of serum cholesterol, and the relationship between serum cholesterol of sires and the tissue cholesterol of their progeny.

Introduction

A research project is under way at Kansas State University to study the effects of management and nutritional strategies on serum and tissue cholesterol concentrations in beef cattle. Our study was conducted in conjunction with that project to help establish a preliminary data base for evaluating ranges and differences in serum cholesterol of bulls being fed a similar ration. Previous research has indicated that there is no correlation between serum and tissue cholesterol concentrations in feedlot cattle.

Experimental Procedures

Blood samples were obtained from yearling bulls when they were weighed off test at a bull test at Beloit, Kansas in April, 1987. The bull test ration was composed of corn, 27.6%; milo, 15%; chopped hay, 42.8%; supplement, 3.1%; hominy, 5%; fat, 1.5%; and molasses, 5%. Serum was harvested and frozen until analyzed for cholesterol concentration by an auto-analyzer procedure.

Results and Discussion

Table 36.1. shows the serum cholesterol minimums, maximums, and means for Angus, Charolais, Simmental, and Gelbvieh yearling bulls. Serum cholesterol concentrations ranged from 60 to 265 mg/dl in yearling bulls that were fed the same ration. All four breeds had similar within-breed serum cholesterol ranges. Charolais bulls had higher ($P<.05$) serum cholesterol levels than the other three breeds studied. Gelbvieh bulls also had higher ($P<.05$) serum cholesterol concentrations than Simmental bulls. The significance of the ranges and means is unknown at this time.

Table 36.1. Serum Cholesterol Concentrations of Yearling Bulls

	Serum Cholesterol Concentration (mg/dl)				
Breed	Number	Minimum	Maximum	Mean	SE
Angus	45	73	253	141.5^{bc}	4.5
Charolais	44	86	265	170.0^{a}	4.6
Simmental	173	60	225	134.8^{c}	2.3
Gelbvieh	55	93	201	150.0^{b}	4.1

^{abc}Means in the same column with different superscripts are different (P<.05).

* * *

The chief dietary source of cholesterol is foods of animal origin. However, the American Heart Association says that lean beef can be included as a part of a balanced diet without exceeding the recommended 300 milligrams of cholesterol per day. Some examples of cholesterol contents of animal foods are listed below.

Food Item	Mg/3.5 oz. Serving
Beef	73
Pork	79
Lamb, Veal	78-150
Chicken (no skin)	73
Fish	50-60
Wild Game	52-140
Shrimp, Lobster	130-170
Egg, Whole	250
Milk	34

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Effect of Grain Source and Brewer's Grain on the Performance and Serum Cholesterol Concentration of Finishing Steers

Gary Goldy and Jack Riley

Summary

The inclusion of brewer's grains at 20% of the ration dry matter increased dry matter intake, resulting in poorer feed efficiency. Brewer's grain appeared to increase serum cholesterol. Serum cholesterol increased as days on feed increased, similar to other reported studies. Steers fed grain sorghum had greater dry matter intakes and poorer feed efficiencies than those fed barley or wheat. Analysis of tissue samples has not been completed at this time, which prohibits drawing any conclusions as to the effect on tissue cholesterol concentrations.

Introduction

The acceptance and consumption of beef might be enhanced if the cholesterol content of beef could be effectively lowered, and still maintain its high eating quality.

Barley and barley byproducts have been shown to have serum cholesterol-lowering properties in monogastrics. One study has indicated that barley may lower tissue cholesterol content in swine. Our objective was to evaluate the effect of various grains and a barley-based brewer's grain on the performance and the cholesterol content of serum and tissue of finishing steers.

Experimental Procedures

Thirty six Hereford and Hereford x Angus crossbred steers were blocked by weight to one of six treatment rations in a 2 X 3 factorial design. Dried brewer's grains were fed at 20% of the ration (dry matter basis) or omitted. The grain portion of the ration was either barley, grain sorghum, or wheat. All of the grains were dry-rolled. The composition of the experimental diets is shown in Table 37.1. Steers were housed and fed in individual pens at the Kansas State University Beef Research Unit, during the fall of 1987. Initial and final weights were determined after an overnight shrink. Jugular blood samples were taken on days 0, 28, 56, 70, 84, and 112 of the trial. Serum was harvested and stored frozen until analyzed for cholesterol concentration by an auto-analyzer procedure. A steak from the 12th rib was recovered from each carcass for cholesterol analysis of the lean and adipose tissue.

Results and Discussion

Effect of Grain Source. The performance of finishing steers fed the three grains is shown in Table 37.2. Dry matter intakes of steers consuming grain sorghum were greater ($P<.05$) than those of steers fed barley or wheat. Average daily dry matter intakes ranged from 20.95 to 23.71 pounds. Since average daily gains did not differ significantly among cattle on the three grains, (range, 3.00 to 3.28 lb per day), feed efficiencies of steers fed grain sorghum were poorer ($P<.05$) than those of steers fed either barley or wheat. Feed efficiencies ranged from 6.61 to 7.90. Carcass characteristics were not affected by grain type. Serum cholesterol increased with days on feed for all grain types. Significant differences in serum cholesterol were found between different grain sources. However, the interpretation of this observation is still uncertain.

Effect of Brewer's Grain. The performance and serum cholesterol content of finishing steers consuming brewer's grain is shown in Table 37.3. The average daily dry matter intake of steers was significantly increased with the addition of brewer's grain to the diet; however, average daily gains did not differ. Therefore, steers consuming 20% of their ration as brewer's grain had poor feed efficiencies compared to controls. Carcass characteristics were not affected by the addition of brewer's grain to the diet. The serum cholesterol concentration of steers consuming brewer's grain was significantly increased from day 28 to day 112. Tissue cholesterol analyses are not yet complete, so conclusions regarding the significance of that finding are premature.

Table 37.1. Composition of Experimental Diets

Item	Brewer's Grain	
	+	-
	(% Dry Matter Basis)	
Dry Rolled Grain	60	80
Brewer's Grain	20	0
Sorghum Silage	15	15
Supplement[1]	5	5

[1] Barley, grain sorghum or wheat supplements (six steers per grain source) each containing 12.5 mg Rumensin per lb.

Table 37.2. Effect of Grain Source on the Performance and Serum Cholesterol Concentration of Finishing Steers

Item	Grain Source Barley	 Grain Sorghum	 Wheat
No. Steers	11	12	12
Initial Wt.,lb	747	742	742
Final Wt.,lb	1115	1079	1083
Daily Feed Intake,lb	21.44^{b}	23.71^{a}	20.95^{b}
ADG,lb	3.28	3.00	3.04
Feed/Gain	6.61^{b}	7.90^{a}	6.92^{b}
No. Liver Abscesses	0	0	4
Percent Choice	72.7	83.3	75.0
Serum Cholesterol, mg/dl			
Day 0	100	106	105
Day 28	139^{b}	170^{a}	130^{b}
Day 56	127^{b}	146^{a}	134^{ab}
Day 70	155	169	150
Day 84	168^{b}	214^{a}	188a^{b}
Day 112	208	241	288

^{abc}Means in the same row with different superscripts are different (P<.05).

Table 37.3. Effect of the Addition of Brewer's Grain on the Performance and Serum Cholesterol Concentration of Finishing Steers

Item	Brewer's Grain –	 +
No. Steers	18	17
Initial Wt., lb	744	744
Final Wt., lb	1088	1097
Daily Feed Intake, lb	22.69^{a}	1.38^{b}
ADG., lb	3.07	3.14
Feed/Gain	7.46^{a}	6.83^{b}
Percent Choice	83.3^{b}	91.4^{a}
No. Liver Abscesses	3	1
Serum Cholesterol,mg/dl		
Day 0	103	105
Day 28	168^{a}	125^{b}
Day 56	164^{a}	136^{b}
Day 70	180^{a}	142^{b}
Day 84	238^{a}	142^{b}
Day 112	267^{a}	184^{b}

^{ab}Means in the same row with different superscripts are different (P<.05).

Testing Feedstuffs Using Near-infrared Reflectance Spectroscopy (NIRS)

P.C. Dubois and L.H. Harbers

Introduction

Over 16 years ago, an analytical instrument was developed that could rapidly determine the concentration of organic compounds from the spectra produced by the bonding between certain molecules. The instrument is based on the principle that those molecules absorb electromagnetic radiation in the infrared region. Compounds may be quantitated by using a computer to compare absorption bands in the near-infrared spectrum to those from a large calibration set of known composition. Peaks from compounds such as water, protein, fat, and carbohydrate may be translated into nutrient components such as moisture, crude protein, crude fat, acid detergent fiber, etc. All this can be accomplished in minutes rather than the hours or days required for the routine chemical analyses presently available.

The Instrument

The instrument consists of a near-infrared scanning sensor with either a scanning monochrometer (research instrument) or a set of rotating filters (routine unit). A computer, specialized software for data analyses and a grinder and sample cups for sample preparation are also needed. A chemical laboratory is necessary to analyze reference standards used as a learning set for the instrument.

The advantages of such an instrument are several. The analyses are rapid--one person can analyze 200 samples daily. It would take several technicians 3 or 4 months to make these determinations by traditional chemical means. Dr. Frank Barton III of the USDA lab in Athens, Georgia, predicts that near-infrared reflectance spectroscopy (NIRS) will be the method of choice for forage analyses in the 21st century. It is a nondestructive method that can analyze for any organic compound at concentrations of about 1% or more of the feed dry matter. It is especially valuable for analyzing the small samples generated by plant breeders. Mixed feeds can be analyzed, if appropriate learning sets are available.

There are several disadvantages to such a system. The initial cost of a research instrument is between $75,000 and $100,000; an instrument for routine analyses would cost much less. A minimum "learning set" of 30 reference standards analyzed for nutrient composition by traditional chemical means is necessary. Each type of feed needs its own calibration set, and equations must be updated as environmental, varietal, or regional factors change.

Forage Testing Programs Using NIRS

Several states use NIRS units for routine testing of forage samples. Many testing programs are designed to span a 3- to 5-year period as an education tool to encourage feed analysis and proper ration formulation. Most of those programs have been highly successful, especially where forage diversity is low, i.e., limited to alfalfa, clovers, and corn silages.

Kansas State University has NIRS units for research purposes. The Grain Science Department does extensive testing of wheat and its products. The Department of Animal Sciences and Industry has recently obtained a NIRS unit. The equations delivered with the instrument work well for alfalfa hay, mixed hay, and corn silage. Work with other forages suggests shortcomings in equations and software, but not in instrumentation.

Kansas has a diverse group of forages, ranging from brome and fescue to wheat straw and a large number of forage sorghums. The software to accurately determine the constituents in this diverse group has not been sufficiently refined for routine use. Once reliable calibration data are available, the near-infrared scanning spectrometer may become the method of choice for feedstuff analyses.

* * *

To do a nutrient analysis by scanning infrared spectroscopy, the sample is first ground in a special mill, then tightly packed into a special sample holder. Specific wavelengths of infrared light are projected onto the sample, and a detector reads the amount of each wavelength reflected. Specific nutrients absorb specific wavelengths, so the more of a particular nutrient, the less infrared light is reflected. All this information is passed into a computer, which compares the spectrum of the sample with spectra from forages of known composition. Through a complex mathematical process, nutrient composition is derived and printed. The whole process takes about 45 seconds after the sample is placed in the scanner. A photograph of the system appears on the cover,

* * *

Effect of Commercial Inoculants on Fermentation of 1987 Silage Crops

Keith Bolsen, Ahmed Laytimi, Renee Hart,
Lesa Nuzback, Fahimeh Niroomand,
Liz Leipold, and Harvey Ilg

Summary

Fourteen commercial silage inoculants were evaluated in 32 trials using nine different crop species harvested in 1987 and ensiled in PVC laboratory silos. Microorganism profiles of the crops showed high numbers of lactic acid bacteria (LAB) in all but one trial. Most inoculants supplied relatively high numbers of LAB per gram of crop--52 of the 66 inoculant samples supplied more than 10^5 (100,000) viable LAB per gram.

The forage crops--wheat, bromegrass, sudangrass, and alfalfa--were highly responsive to the inoculants. When compared to untreated silages, treated silages had lower pH, acetic acid, ethanol, and ammonia-nitrogen values and higher lactic acid content.

In general, late summer- and early autumn-harvested row crops--corn, grain sorghum, forage sorghum, and high moisture shelled corn--ensiled rapidly, and most inoculants had limited effect on the rate and efficiency of fermentation.

Introduction

Our objective was to continue evaluating how commercial inoculants affect the rate and efficiency of silage fermentation. We included 32 crops to provide a much wider range of ensiling conditions than in our previous studies (KAES, Reports of Progress 494 and 514).

Experimental Procedures

The 14 inoculants evaluated and active ingredients as listed by the manufacturer or distributor are shown in Table 39.1. All silages were made from crops grown near Manhattan in 1987. A description of the crops used, harvest dates, and chemical compositions are presented in Table 39.2.

The laboratory silos were 4 x 14 inch PVC pipes closed with Jim-Caps on each end. One Jim-Cap was fitted with a Bunsen valve to allow gases to escape. For filling, 100 to 125 lbs of fresh crop were placed on a plastic sheet, and the inoculant was applied and mixed thoroughly. All inoculants, except Silagest, were applied as liquids and all were used within 3 to 4 weeks after being received from the manufacturer. After all silage treatments were prepared, the silos were filled on an alternating schedule, which distributed the time from harvest through silo filling equally across all treatments. The silos were packed with a hydraulic press, which excluded air and filled all silages to similar densities. Silos were stored at approximately 85 F. Three silos per treatment were opened at various times post-filling during the first week, and end-product silages were evaluated at 42 or 90 days.

Chemical Analyses of the Pre-ensiled Crops and Silages. Pre-ensiled crops were analyzed for dry matter (DM), pH, total nitrogen, water soluble carbohydrates, acid detergent fiber, neutral detergent fiber, and buffer capacity. Silages fermented from 6 hours to 7 days were analyzed for pH and lactic acid; end-product silages (42 or 90 days), for pH, lactic acid, volatile fatty acids, total nitrogen, and ammonia-nitrogen.

Microbiological Evaluations. Post-harvested, pre-ensiled samples of the crops and inoculants were weighed, mixed in a high-speed blender, and diluted in sterile buffer. The following microorganism counts were made after appropriate dilutions with sterile buffer:

Mesophilic count. That count provided an index of the number of aerobic and facultative anaerobic bacteria. Samples were added to Standard Plate Count agar (DIFCO) and incubated for 3 days at 32 C.

Yeast and mold count. Potato Dextrose agar was used with tetracycline and chloramphenicol (100 ug/ml each) to kill bacteria. The plates were incubated at 21 C for 3 days.

Lactic acid bacteria count. This measured the natural populations of lactic acid bacteria (LAB) present on the crops and the LAB provided by inoculants at the time they were applied to the crops. Samples were added to Bacto Lactobacilli MRS Broth to which 1.5% Agar (Difco) was added and incubated 3 days at 32 C.

All counts were converted to colony-forming units per gram of crop or per gram or ml of inoculant.

Statistical Analyses. Mean responses of each inoculated crop were compared to the mean response of the untreated (control) crop by the analyses of variance procedure for a complete block design.

Results and Discussion

Presented in Tables 39.3 to 39.7 are the microorganism profiles of the crops and number of LAB supplied to the pre-ensiled corp by the inoculants used in the 32 trials. Presented in Tables 39.8 to 39.16 and Figures 39.1 to 39.2 are silage fermentation results over time for the 32 crops and 53 of the 66 inoculant vs. control comparisons made in 1987. Results from Trials 11 through 32 are preliminary and inoculant effects on the ensiled crops are limited to pH and lactic acid data.

Trials 1 to 5. Wheat, sudangrass, and bromegrass all had relatively high numbers of LAB on the pre-ensiled forage, but all five were highly "responsive" to the inoculants (Table 39.8; 39.9; and 39.10). With few exceptions, the inoculated silages had significantly lower pH and higher lactic acid values than control silages at every opening time. End product-inoculated silages had lower (P<.05) pH, acetic acid, ethanol, and ammonia-nitrogen values and higher (P<.05) lactic acid content than control silages. Inoculants that provided less than 10^5 LAB per gram of crop did not increase the fermentation rate as fast as those that provided 10^5 or more per gram.

In Trial 1, Medipharm Soluble, which supplied the greatest number of LAB per gram of crop (420,000), gave the fastest drop in pH and highest lactic acid production during the first 48 hours (Figures 39.1 and 39.2). However, there was no relationship between number of LAB and rate of fermentation for the inoculants that supplied 140,000 to 310,000 per gram. Pioneer 1174, which provided 140,000 per gram, gave the second lowest pH and second highest lactic acid values among the inoculated silages at 48 hours post-filling.

Trials 6 to 13. The eight alfalfa crops harvested between June 19 and November 11 represented a wide range of ensiling conditions--DM content ranged from 32.5 to 53.3%; crude protein, from 17.1 to 24.4%; acid detergent fiber, from 18.7 to 34.1%; buffer capacity, from 42.6 to 68.6 milliequivalents; and water soluble carbohydrates, 3.5 to 7.5 percent. The pre-ensiled material had 10^5 or more LAB per gram, with alfalfa in Trial 10 being the only exception.

All 11 inoculants increased the rate and efficiency of the silage fermentation in the eight trials (Tables 39.11 to 39.13). In general, the untreated-control alfalfa silages fermented much slower than was expected, and rate of pH drop and lactic acid production appeared to be influenced more by crop DM content than by numbers of LAB present on the crop or buffer capacity. With very few exceptions, end product-inoculated alfalfa silages had lower ($P<.05$) pH, acetic acid, ethanol, and ammonia-nitrogen values and higher ($P<.05$) lactic acid content than control silages.

In Trial 9, Medipharm Soluble provided the greatest number of LAB per gram of alfalfa (320,000) and produced the most rapid fermentation during the first 4 days. Biomate, which provided 100,000 per gram, gave the second lowest pH and highest lactic acid values, even though five inoculants provided greater numbers of bacteria.

Trials 14 to 20. The seven whole-plant corns were all low "response" crops, which underwent extremely rapid fermentations (Table 39.14). All 14 silages were at or below a pH of 4.2 by 24 hours and a pH of 4.0 by 48 hours post-filling. The three inoculants, Medipharm Soluble, Ecosyl, and Biomate, provided 10^5 to 10^6 LAB per gram of crop (i.e., 100,000 to 1,000,000 bacteria), but the pre-treated crops already contained from 5 x 10^5 to 1.5 x 10^7 per gram, which was up to 15 times more LAB than the number provided by the inoculants.

Trials 21 to 23 and 29 to 32. The three high moisture shelled corns ranged from 24.6 to 34.0% moisture, and the pre-treated grain had relatively high numbers of LAB (over 1,000,000 per gram). The wetter corns ensiled rapidly, with pH dropping below 5.0 by 48 hours (Table 39.15). Although Pioneer 1186 inoculant supplied 500,000 LAB per gram in Trial 22, it did not influence the rate of pH decline. The drier corn in Trial 23 fermented very slowly, with the untreated corn still above pH 5.4 after 7 days. The inoculated shelled corns had significantly lower pH values than the control, beginning at 48 hours post-filling for Medipharm Soluble and 4 days for Pioneer 1186.

The grain sorghum and sorghum and soybeans all had high LAB populations, ranging from 1.5 to 12 million bacteria per gram of pre-treated crop. In spite of the high LAB counts, Biomate increased the rate of pH decline during the first 4 days post-fillings (Table 39.15).

Trials 24 to 28. The five forage sorghums were generally low "response" crops, characterized by high LAB numbers on the pre-treated material. The sorghums did not ensile as rapidly as the whole-plant corns, likely because of cooler initial temperatures and higher buffer capacities for the sorghums. Five of the six inoculants used supplied at least 10^5 LAB per gram of crop and, in four of the five trials, inoculants gave lower pH and higher lactic acid values ($P<.05$) during the first 4 days post-filling (Table 39.16).

Our studies the previous two years indicated that if a silage crop had a high number of lactic acid bacteria present at harvest (500,000 or more per gram), adding more with an inoculant was unlikely to affect the ensiling rate (KAES, Report of Progress 514). The corn and sorghum crops ensiled in Trials 14 to 32 had an average initial LAB count of over 5,000,000 per gram, and, as expected, most untreated controls ensiled almost as rapidly as the inoculated crops. However, the hay crops ensiled in the first 13 trials also had an average initial LAB count of over 1,000,000 per gram, yet all untreated controls ensilied much slower than inoculated forages.

Knowing only the numbers of LAB present on the crop will not always predict the rate and efficiency of silage fermentation. It is essential that the microbial population be identified, that the ratio of homofermentative (single product fermentation) to heterofermentative (multiple product fermentation) bacteria be determined, and that the growth characteristics of the bacterial strains be differentiated in a silage environment. Other factors including crop characteristics (i.e., dry matter and fermentable carbohydrate content, buffer capacity, physical structure), silage management techniques (i.e., chopping length, packing density, sealing), and climatic conditions (i.e., growing season, air temperature, humidity) will play a role in silage fermentation and response to inoculants.

Table 39.1. List of the 14 Inoculants Evaluated in the 32 Trials, Their Manufacturer or Distributor, and Their Lactic Acid Bacteria Content

Inoculant	Manufacturer or Distributor	Lactic Acid Bacteria
AGMASTER® ALFALFA SILAGE INOCULANT (AgMaster)	Marschall Products Division of Miles Laboratories, Madison, Wisconsin	*Lactobacillus plantarum* and *Pediococcus acidilactici*
BIOMATE LAB CONCENTRATE (Biomate)	Chr. Hansen's Laboratory, Inc., Milwaukee, Wisconsin	*L. plantarum* and *P. cerevisiae*
BIOPOWER	BioTechniques Laboratories, Inc., Redmond, Washington	*Streptococcus faecium* and *L. plantarum*
BTA SILAGE INOCULANT (BTA)	BioTechnica Agriculture, Inc., Overland Park, Kansas	*L. plantarum* and *P. acidilactici*
DEL-N-SILE	Deltown Chemurgic, Fraser, New York	*L. plantarum* and *S. faecium*
ECOSYL	C-I-L Inc., London Ontario, Canada	*L. plantarum*
MEDIPHARM SOLUBLE (Medipharm)	Medipharm USA, Des Moines Iowa	*S. faecium* M-74, *L. acidophilus*, *Pediococcus sp.*, and *L. plantarum*
PIONEER BRAND 1186 HIGH MOISTURE CORN INOCULANT (1186)	Pioneer Hi-Bred International, Inc., Des Monies, Iowa	*L. plantarum* (multiple strains) and *S. faecium*
PIONEER BRAND 1174 WATER SOLUBLE SILAGE INOCULANT (1174)	Pioneer Hi-Bred International, Inc., Des Monies, Iowa	*L. plantarum* (multiple strains) and *S. faecium*
ROHACENT® (7057)	Rohm Tech, Inc., Malden, Massachusetts	*L. plantarum*
SILAGEST	InterBio, Inc., Naperville, Illinois	*L. plantarum*, *L. acidophilus*, *L. bulgaricus* *L. coryniformis* *S. thermophilus*, and *P. acidilactici*
SI CONCENTRATE 40 A/F	Great Lakes Biochemical Co., Inc., Milwaukee, Wisconsin	*L. plantarum*, *L. brevis*, *P. acidilactici*, *S. cremoris*, and *S. diacetylactis*
TRILAC	QualiTech, Inc., Chaska, Minnesota	*L. plantarum* and *P. cerevisiae*
XEROFERM	Xeroferm Laboratories, Portland, Oregon	*L. plantarum*, *S. faecium*, and *Pediococcus sp.*

Table 39.2. Description, Harvest Date, and Chemical Composition for the Crops Used in 32 Trials[1,2]

Trial No., Crop Description, Harvest Date (1987) and DM (%)	Chemical Composition			
	CP	ADF	BC	WSC
1. Newton wheat; flowering stage; May 15; 35.7	13.9	35.0	32.4	9.6
2. Arkan wheat; hard-dough stage June 4; 41.0	10.9	31.4	27.3	9.2
3. Bounty 205 hybrid wheat; soft-dough stage; June 4; 37.5	11.3	29.9	26.8	10.2
4. Trudan hybrid sudangrass; vegetative stage; July 23; 35.6	14.6	27.2	50.9	13.5
5. First cutting bromegrass; heading stage; June 5; 46.3	---	---	31.5	---
6. Second cutting alfalfa; June 19; 32.5	20.7	33.7	52.6	5.4
7. Second cutting alfalfa; July 6; 51.0	18.1	34.1	53.1	7.4
8. Third cutting alfalfa; July 10; 40.5	---	---	54.8	7.7
9. Third cutting alfalfa; July 31; 39.6	---	---	54.5	4.7
10. Fourth cutting alfalfa; Aug. 22; 42.5	23.6	23.7	42.6	---
11. Fifth cutting alfalfa; post-frost; Oct. 6; 53.3	23.3	22.8	60.1	9.6
12. Fifth cutting alfalfa; post-frost; Oct. 14; 41.4	24.4	18.7	68.6	11.1
13. Fifth cutting alfalfa; post-hard freeze; Nov. 11; 45.0	17.1	29.2	59.8	7.6
14. Hoegemeyer 2689 corn; early-dent stage; Aug. 6; 37.0	6.3	23.9	18.9	8.0
15. Hoegemeyer 2689 corn; early-dent stage; Aug. 7. 36.2	6.9	23.8	21.0	7.0
16. Hoegemeyer 2689 corn; early-dent stage; Aug. 8; 36.1	6.5	25.1	18.4	5.5
17. Ohlde 0-230 corn; mid-dent stage; Aug. 11; 39.0	6.3	24.6	19.8	7.7
18. Ohlde 0-230 corn; mid-dent stage; Aug. 12; 41.2	6.3	24.8	20.4	6.0

Table 39.2. con't.

Trial No., Crop Description, Harvest Date (1987) and DM (%)	Chemical Composition CP	ADF	BC	WSC
19. Pioneer 3183 corn; mid-dent stage; Aug. 19; 37.5	6.0	23.8	18.3	8.6
20. Pioneer 3183 corn; mid-dent stage; Aug. 20; 38.5	6.2	23.6	20.0	8.9
21. High moisture rolled shelled corn; Aug. 21; 34.0	---	---	---	---
22. High moisture rolled shelled corn, Aug. 22; 28.5	---	---	---	---
23. High moisture ground shelled corn; post-hard freeze; Sept. 30; 24.6.	9.8	---	---	---
24. DeKalb FS-5 forage sorghum Aug. 28; 28.8	---	---	26.6	---
25. Pioneer 947 forage sorghum; Sept. 4; 35.2	---	---	27.7	---
26. Funk's 102 F forage sorghum; Sept. 23; 30.5	7.0	28.0	26.5	12.4
27. DeKalb 25E forage sorghum; post-frost; Oct. 8; 32.8	6.0	30.0	23.3	---
28. DeKalb 25E forage sorghum post-frost; Oct. 13; 34.0	7.0	28.4	25.2	---
29. DeKalb 42Y grain sorghum (late-milk stage) and Pershing soybeans; drilled inter-seeding; Aug. 17; 34.9	12.8	---	29.0	---
30. DeKalb 42Y grain sorghum (late-dough stage) and Pershing soybeans; drilled inter-seeding; Aug. 23; 36.6	11.8	---	31.0	---
31. DeKalb 42Y grain sorghum (late-dough stage) and Pershing soybeans; 15-inch alternate row interseeding; Aug. 22; 34.4	16.9	---	25.2	---
32. DeKalb 42Y grain sorghum; late-dough stage; Aug. 22; 33.0	10.4	---	23.4	---

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[1] DM = Dry matter; CP = crude protein as a % of the crop DM; ADF = acid detergent fiber as a % of the crop DM; BC = buffer capacity as milliequivalents of NaOH/100g of crop DM; WSC = water soluble carbohydrates as a % of the crop dry matter.

[2] All forage sorghums in Trials 24 to 28 were harvested at the late-dough stage of maturity.

Table 39.3. Microorganism Profile of the Crop and Numbers of Lactic Acid Bacteria Supplied to the Pre-ensiled Crop by the Inoculants used in the Wheat, Sudangrass, and Bromegrass Trials

	Wheat			Sudangrass	Bromegrass
Item	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Microbes:	CFU[1]/gram of Crop				
Mesophilic	$1.4x10^{8}$	$2.7x10^{8}$	$2.7x10^{8}$	$5.7x10^{7}$	$7.4x10^{7}$
Lactic Acid Bacteria	$9.5x10^{5}$	$5.0x10^{6}$	$8.2x10^{5}$	$7.5x10^{6}$	$4.6x10^{6}$
Yeast and Mold	$1.0x10^{5}$	$5.1x10^{5}$	$4.4x10^{5}$	$7.5x10^{3}$	$5.0x10^{3}$
Inoculant:	CFU of LAB[2] supplied/gram of Crop				
AgMaster	$2.1x10^{5}$	---	---	---	---
Biomate	$1.6x10^{5}$	$1.1x10^{5}$	$1.1x10^{5}$	$1.5x10^{5}$	$1.4x10^{5}$
BioPower	$3.1x10^{5}$	---	---	---	---
1174	$1.4x10^{5}$	$6.3x10^{4}$	$6.3x10^{4}$	$1.4x10^{5}$	---
7057	$1.5x10^{5}$	---	---	---	---
SI Conc	$8.7x10^{4}$	$1.1x10^{5}$	$1.1x10^{5}$	$8.0x10^{4}$	---
Medipharm	$4.2x10^{5}$	---	---	---	---
Xeroferm	$5.4x10^{3}$	$2.3x10^{4}$	$2.3x10^{4}$	$1.7x10^{4}$	---

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[1] Colony-forming units.
[2] Lactic acid bacteria.

Table 39.4 Microorganism Profiles of the Pre-ensiled Crop and Numbers of Lactic Acid Bacteria Supplied to the Crop by the Inoculants Used in the Alfalfa Trials

Item	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10	Trial 11	Trial 12	Trial 13
Microbes:	CFU[1]/gram of Crop							
Mesophilic	$3.8x10^7$	$6.2x10^7$	$6.9x10^7$	$2.8x10^7$	---	$3.4x10^7$	$1.0x10^7$	$5.1x10^7$
Lactic Acid Bacteria	$6.2x10^5$	$5.6x10^6$	$4.0x10^6$	$8.6x10^5$	$4.0x10^3$	$9.0x10^5$	$9.0x10^5$	$1.0x10^5$
Yeast and Mold	$7.0x10^3$	$5.1x10^4$	$4.1x10^4$	$2.5x10^4$	---	$2.7x10^4$	$2.8x10^4$	$4.8x10^4$
Inoculant:	CFU of LAB[2] supplied/gram of Crop							
AgMaster	---	---	---	$1.8x10^5$	---	---	---	---
Biomate	---	---	---	$1.0x10^5$	$1.5x10^5$	---	---	---
BioPower	---	---	---	$2.5x10^5$	---	---	---	---
BTA	---	---	---	---	---	---	---	$2.8x10^5$
Del-N-Sile	$6.5x10^5$	---	---	---	---	---	---	---
Ecosyl	$2.9x10^5$	---	---	$2.2x10^5$	---	---	$1.1x10^6$	---
1174	---	---	---	$1.3x10^5$	---	---	---	---
SI Conc	---	$8.8x10^4$	$1.1x10^5$	$2.7x10^5$	---	$5.8x10^5$	---	---
Medipharm	---	---	---	$3.2x10^5$	---	---	---	---
TriLac	$2.9x10^5$	---	---	---	---	---	---	---
Xeroferm	---	$2.0x10^4$	---	$2.5x10^4$	---	---	---	---

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[1] Colony-forming units.

[2] Lactic acid bacteria.

Table 39.5. Microorganism Profile of the Pre-ensiled Crop and Numbers of Lactic Acid Bacteria Supplied to the Crop by the Inoculants Used in the Whole-crop Corn Trials

Item	Trial 14	Trial 15	Trial 16	Trial 17	Trial 18	Trial 19	Trial 20
Microbes:	---------------------------	-CFU[1]/gram of Crop-	---------------------------				
Mesophilic	$8.4x10^7$	$1.4x10^9$	$1.0x10^8$	$1.7x10^8$	$1.6x10^8$	---	---
Lactic Acid Bacteria	$9.4x10^6$	$8.4x10^6$	$1.5x10^7$	$1.2x10^7$	$9.0x10^6$	$5.0x10^5$	$5.8x10^6$
Yeast and Mold	$3.6x10^5$	$8.5x10^5$	$2.0x10^6$	$6.8x10^5$	$5.6x10^5$	$1.2x10^6$	---
Inoculant:	---------------------------	-CFU of LAB[2] supplied/gram of Crop-	---------------------------				
Biomate	---	---	---	---	---	$1.5x10^5$	$1.5x10^5$
Ecosyl	---	---	---	$1.0x10^5$	$1.5x10^5$	---	---
Medipharm	$5.0x10^5$	$5.2x10^5$	$1.5x10^6$	---	---	---	---

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[1] Colony-forming units.

[2] Lactic acid bacteria.

Table 39.6. Microorganism Profile of the Pre-ensiled Crop and Numbers of Lactic Acid Bacteria Supplied to the Crop by the Inoculants used in the High Moisture Shelled Corn and Forage Sorghum Trials

Item	High Moisture Corn			Forage Sorghum				
	Trial 21	Trial 22	Trial 23	Trial 24	Trial 25	Trial 26	Trial 27	Trial 28
Microbes:	CFU[1]/gram of Crop							
Mesophilic	$6.8x10^7$	$6.2x10^7$	$2.8x10^7$	$3.4x10^7$	$4.4x10^7$	$9.3x10^7$	$5.1x10^7$	$2.0x10^7$
Lactic Acid Bacteria	$3.2x10^6$	$1.4x10^6$	$9.0x10^6$	$4.4x10^5$	$5.8x10^6$	$4.3x10^6$	$1.4x10^5$	$1.5x10^6$
Yeast and Mold	$3.2x10^5$	$3.5x10^5$	$5.5x10^4$	$5.5x10^4$	$4.0x10^4$	$3.5x10^5$	$2.9x10^5$	$6.2x10^4$
Inoculants:	CFU of LAB[2] supplied/gram of Crop							
Biomate	---	---	---	$1.8x10^5$	$1.7x10^5$	---	---	$2.7x10^5$
Ecosyl	---	---	$4.4x10^4$	---	---	---	---	---
1174	---	---	---	$1.3x10^5$	---	---	---	$1.8x10^5$
1186	$2.4x10^5$	$5.0x10^5$	$2.4x10^5$	---	---	---	---	---
Silagest	---	---	---	---	---	---	$2.0x10^6$	---
SI Conc	---	---	---	$3.1x10^5$	---	---	---	$1.5x10^5$
Medipharm	---	---	$4.6x10^6$	---	---	---	---	---
TriLac	---	---	---	---	---	$4.6x10^5$	---	---
Xeroferm	---	---	---	$1.8x10^4$	---	---	---	$1.5x10^4$

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[1] Colony-forming units.

[2] Lactic acid bacteria.

Table 39.7. Lactic Acid Bacteria Profile of the Pre-ensiled Crop and Numbers of LAB supplied to the Pre-ensiled Crop by the Inoculants Used in the Grain Sorghum and Soybean Trials

Item	Grain Sorghum and Soybeans			Grain Sorghum
	Trial 29	Trial 30	Trial 31	Trial 32
	CFU[1]/gram of Crop			
Lactic Acid Bacteria	$1.2x10^7$	$4.5x10^6$	$8.1x10^6$	$7.6x10^6$
Inoculant:	CFU of LAB[2] supplied/gram of Crop			
Biomate	$1.6x10^5$	$1.5x10^5$	$1.7x10^5$	$1.6x10^5$

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[1] Colony-forming units.
[2] Lactic acid bacteria.

Table 39.8. pH and Chemical Composition over Time for the Wheat Silages in Trial 1

Time Post-filling and Item[1]		Control	AgMaster	Biomate	BioPower	1174	7057	SI Conc	Medipharm	Xeroferm
Initial:	pH	mean ≐ 6.42								
Hour 24:	pH*	6.14	5.88	5.47	5.94	5.85	6.06^{x}	6.14^{x}	5.07	6.09^{x}
	Lactic*	1.18	1.52	2.10	1.49^{x}	1.53	1.36	1.21	1.88	1.28
Hour 48:	pH*	6.04	4.85	4.66	5.10	4.62	4.91	5.83	4.39	5.59
	Lactic*	2.00	3.99	3.92	3.24	4.32	3.24	2.23^{x}	5.00	2.53
Day 4:	pH*	5.64	4.26	4.29	4.44	4.19	4.22	4.85	4.13	4.72
	Lactic*	2.77	7.24	5.83	6.49	7.79	5.08	4.36	6.85	4.82
Day 7:	pH*	5.08	4.12	4.14	4.27	4.09	4.10	4.48	4.07	4.36
	Lactic*	3.99	8.75	7.82	7.60	9.17	9.04	6.00	7.48	7.00
Day 42:	pH*	4.31	4.06	4.05	4.13	4.07	4.06	4.20	4.01	4.10
	Lactic*	6.85	9.53	9.64	8.24	9.64	10.05	8.03	9.79	9.88
	Acetic*	2.19	1.08	.89	1.01	.87	.97	1.15	.78	1.21
	Ethanol*	.320	.093	.096	.092	.087	.096	.084	.091	.107
	NH_3-N	.236	.201	.185	.172	.158	.166	.212^{x}	.173	.193

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[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

*Statistical analyses showed control vs. inoculant means differed ($P < .05$), unless the inoculant mean has a superscript(x).

Table 39.9. pH and Chemical Composition over Time for the Wheat Silages in Trials 2 and 3

		Trial 2					Trial 3				
Time Post-filling and Items[1]		Control	Biomate	1174	SI Conc	Xeroferm	Control	Biomate	1174	SI Conc	Xeroferm
Initial:	pH	mean = 6.41					mean = 6.39				
Hour 24:	pH*	5.76	4.72	5.10	5.06	5.11	5.61	4.70	4.98	4.98	5.04
	Lactic*	.90	2.24	1.51	1.62	1.47	1.34	2.43	1.77^{x}	2.25	1.99^{x}
Hour 48:	pH*	5.66	4.35	4.38	4.48	4.62	5.35	4.36	4.30	4.39	4.50
	Lactic*	1.79	4.36	4.22	3.53	3.57	1.87	5.27	4.91	4.37	3.93
Day 4:	pH*	5.10	4.13	4.10	4.16	4.22	4.77	4.06	4.01	4.10	4.14
	Lactic*	2.24	6.14	5.99	5.75	5.19	2.82	6.52	6.56	5.85	5.30
Day 7:	pH*	4.73	4.08	4.04	4.08	4.11	4.45	4.03	3.96	4.02	4.04
	Lactic*	3.44	6.27	6.01	5.85	6.12	4.22	6.57	6.93	6.57	7.06
Day 42:	pH*	4.23	4.10	4.06	4.11	4.09	4.18	4.02	4.00	4.04	4.03
	Lactic*	5.58	5.90	6.46	5.85	6.27	5.97	7.00	6.60	6.40	6.72
	Acetic*	1.40	.55	.66	.80	.81	1.72	.71	.62	.71	.67
	Ethanol*	.173	.055	.058	.048	.078	.165	.049	.050	.083	.068
	NH_3-N	.171	.158	.157	.157	.163	.184	.157	.171	.154	.156

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[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

*Statistical analyses showed control vs. inoculant means differed ($P < .05$) within a trial, unless the inoculant mean has a superscript(x).

Table 39.10. pH and Chemical Composition over Time for the Sudangrass and Bromegrass Silages in Trials 4 and 5

Time Post-filling and Item[1]		Trial 4: Sudangrass					Trial 5: Bromegrass	
		Control	Biomate	1174	SI Conc	Xeroferm	Control	Biomate
Initial:	pH*	5.87	5.86	5.85	5.87	5.85	5.94	5.95
Hour 12:	pH*	5.66	5.48	5.60	5.65^x	5.63^x	6.02	5.94
	Lactic*	.37	.52	.45	$.42^x$	$.40^x$	.25	.43
Hour 24:	pH*	5.26	4.49	4.65	4.87	4.79	6.02	5.34
	Lactic*	.88	1.97	1.76	1.50	1.61	.34	1.21
Hour 48:	pH*	5.02	4.24	4.31	4.34	4.48	5.57	4.41
	Lactic*	1.90	5.06	5.98	4.50	3.55	1.23	3.56
Day 4:	pH*	4.84	4.10	4.09	4.14	4.22	5.34	4.27
	Lactic*	2.87	7.27	7.82	7.24	6.40	1.82	5.03
Day 90:	pH*	4.47	4.08	4.06	4.12	4.10	4.75	4.12
	Lactic*	3.32	6.30	7.20	5.74	6.48	---	---
	Acetic*	1.40	.73	.92	.97	.73	---	---
	Ethanol*	.233	.198	$.219^x$	.196	.163	---	---
	NH_3-N	.105	.064	.058	.075	.079	---	---

[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

*Statistical analyses showed control vs. inoculant means differed ($P < .05$) within a trial, unless the inoculant mean has a superscript(x).

Table 39.11. pH and Chemical Composition over Time for the Alfalfa Silages in Trial 9

Time Post-filling and Item[1]		Control	Ag-Master	Biomate	Bio-Power	Ecosyl	1174	SI Conc	Medi-pharm	Xero-ferm
Initial:	pH	mean = 5.90								
Hour 12:	pH*	5.86	5.34	5.39	5.81^x	5.73^x	5.74^x	5.73^x	4.96	5.66^x
	Lactic*	.43	.72	1.08	.77	.52^x	.59^x	.54^x	1.40	.48^x
Hour 24:	pH*	5.66	4.98	4.94	5.20	4.97	5.03	5.10	4.83	5.04
	Lactic*	.60	2.46	2.61	2.44	1.91	2.88	1.75	3.46	1.65
Hour 48:	pH*	5.47	4.96	4.87	5.09	4.87	5.07	4.97	4.81	5.02
	Lactic*	1.34	3.75	4.06	3.71	3.39	3.64	3.17	4.32	3.24
Day 4:	pH*	5.40	5.00	4.92	5.08	4.94	5.01	5.05	4.80	5.04
	Lactic*	2.13	4.01	4.09	4.23	4.00	3.97	3.54	4.24	3.71
Day 90:	pH*	4.98	4.82	4.79	4.92	4.85	4.97^x	4.86	4.73	4.96^x
	Lactic*	4.47	4.45^x	5.12	5.20	5.21	4.98^x	4.57^x	5.38	4.64^x
	Acetic*	2.69	2.54^x	2.38	2.60^x	2.45	2.77^x	2.76^x	1.99	2.79^x
	Ethanol*	.243	.084	.089	.079	.083	.091	.117	.050	.091
	NH_3-N	.302	.301	.293	.303	.297	.308	.294	.251	.306

[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.
*Statistical analyses showed control vs. inoculant means differed ($P < .05$), unless the inoculant mean has a superscript(x).

Table 39.12. pH and Chemical Composition over Time for Selected Alfalfa Treatments in Trials 6, 7, 8, and 10.

Time Post-filling and Item[1]		Trial 6		Trial 7			Trial 8		Trial 10	
		Control	Del-N-Sile	Control	SI Conc	Xeroferm	Control	SI Conc	Control	Biomate
Initial:	pH	5.95	5.96	5.98	5.98	5.99	5.99	5.99	6.10	6.10
Hour 12:	pH*	5.53	5.28	6.01	6.00^x	6.01^x	5.97	5.93^x	6.08	6.07^x
	Lactic*	1.45	2.36	.19	.24^x	.27^x	.34	.39^x	.37	.25^x
Hour 24:	pH*	5.39	4.65	5.91	5.73	5.65	5.83	5.20	6.08	5.34
	Lactic*	1.71	5.64	.45	.67^x	.66^x	.58	1.23	.31	1.77
Hour 48:	pH*	5.09	4.58	5.81	5.36	5.24	5.62	4.61	6.01	5.11
	Lactic*	3.40	5.02	.86	2.13	2.22	.95	4.48	.60	3.64
Day 4:	pH*	4.92	4.55	5.54	4.62	4.81	5.36	4.53	---	---
	Lactic*	4.20	5.08	1.91	4.69	4.00	2.05	5.98	---	---
Day 7:	pH*	4.81	4.51	5.22	4.55	4.61	5.17	4.48	5.46	5.12
	Lactic*	5.27	6.83	2.56	5.09	5.28	2.81	6.72	3.19	4.96
Day 90:	pH*	4.58	4.43	4.67	4.38	4.41	4.70	4.47	5.34	5.09
	Lactic*	4.41	6.41	4.94	6.99	7.45	5.63	6.62	4.90	5.60
	Acetic*	3.23	2.22	1.79	1.32	1.40	2.41	1.53	2.75	2.72^x
	Ethanol*	.400	.190	.102	.048	.046	.235	.055	.136	.108
	NH_3-N*	.312	.203	.218	.172	.183	.265	.199	.380	.371^x

[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.
*Statistical analyses showed control vs. inoculant means differed ($P < .05$) within a trial, unless the inoculant mean has a superscript(x).

Table 39.13. pH and Lactic Acid over Time for Selected Alfalfa Treatments in Trials 11, 12, and 13

Time Post-filling and Item[1]		Trial 11		Trial 12		Trial 13	
		Control	SI Conc	Control	Ecosyl	Control	BTA
Initial:	pH	6.02	6.03	5.98	5.99	6.22	6.23
Hour 24:	pH	6.00	5.99^{x}	5.39	5.36^{x}	6.27	6.19^{x}
	Lactic	---	---	2.72	2.91^{x}	---	---
Hour 48:	pH*	5.99	5.99^{x}	5.20	5.07	5.74	5.20
	Lactic*	---	---	3.78	4.14	---	---
Day 4:	pH*	5.97	5.47	5.04	4.82	5.32	4.82
	Lactic*	---	---	7.58	9.49	---	---
Day 7:	pH*	5.91	4.96	4.90	4.71	5.18	4.74
	Lactic*	---	---	8.07	9.79	---	---
Day 90:	pH*	5.40	4.50	4.66	4.62^{x}	4.80	4.62

[1] Lactic acid is reported as a % of the silage dry matter.

*Statistical analyses showed control vs. inoculant means differed (P<.05) within a trial, unless the inoculant mean has a superscript(x).

Table 39.14. pH and Chemical Composition over Time for the Corn Silages in Trials 14 to 20

Time Post-filling and Item[1]		Trials 14, 15, & 16[A]		Trials 17 & 18[B]		Trials 19 & 20[B]	
		Control	Medipharm	Control	Ecosyl	Control	Biomate
Initial:	pH	5.80	5.80	5.79	5.76	5.98	5.98
Hour 6:	pH	5.16	5.06	5.02	5.02	5.55	5.52
	Lactic	.82	.88	---	---	---	---
Hour 12:	pH	4.34	4.25	4.58	4.54	4.72	4.66
	Lactic	1.91	2.13	---	---	---	---
Hour 24:	pH	4.14	4.12	4.24	4.22	4.24	4.19
	Lactic	2.93	3.30	---	---	---	---
Hour 48:	pH	3.91	3.90	4.03	4.01	3.94	3.92
	Lactic	4.56	4.71	---	---	--	---
Day 90:	pH	3.92	3.91	3.92	3.88	3.86	3.85
	Lactic	6.01	6.29	---	---	---	---
	Acetic	1.07	1.06	.97	1.00	---	---
	Ethanol	.83	.59	1.17	.93	---	---

[1] Acids, ethanol, and NH$_3$ are reported as a % of the silage dry matter.

[A] Values reported were averaged across the three trials.

[B] Values reported were averaged across the two trials.

Table 39.15. pH over Time for Selected High Moisture Shelled Corn, Grain Sorghum and Soybeans, and Grain Sorghum Silages in Trials 22, 23, 29, 31, and 32

	High Moisture Corn					Grain Sorghum and Soybeans				Grain Sorghum	
	Trial 22		Trial 23			Trial 29		Trial 31		Trial 32	
Time Post-filling[1]	Control	1186	Control	1186	Medi-pharm	Control	Bio-mate	Control	Bio-mate	Control	Bio-mate
	-----	-----	-----	-----	-----	pH	-----	-----	-----	-----	-----
Initial:	6.10	6.12	6.10	6.12	6.09	---	---	---	---	---	---
Hour 12*	5.36	5.37^{x}	---	---	---	4.80	4.67	5.91	5.86^{x}	5.23	5.19^{x}
Hour 24*	5.06	5.08^{x}	6.16	6.06^{x}	6.06^{x}	4.65	4.40	4.92	4.45	4.77	4.60
Hour 48*	4.87	4.87^{x}	6.00	5.91^{x}	5.84	4.49	4.24	4.21	4.11	4.38	4.27
Day 4*	4.78	4.79^{x}	5.73	5.51	5.36	4.22	4.08	4.17	4.06	4.15	4.09^{x}
Day 7*	4.54	4.58^{x}	5.46	5.15	4.97	---	---	---	---	---	---
Day 42*	4.26	4.31^{x}	4.76	4.39	4.35	4.06	4.06^{x}	4.09	4.06^{x}	4.11	4.06^{x}

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[1] In Trials 29, 31, and 32 the 12, 24, and 48 hour times were actually 10, 20, and 40 hours, respectively.

*Statistical analyses showed control vs. inoculant means differed ($P < .05$) within a trial, unless the inoculant mean has a superscript(x).

Table 39.16. pH and Lactic Acid over Time for Selected Forage Sorghum Treatments in Trials 24 to 28

		Trial 24			Trial 25		Trial 26		Trial 27		Trial 28		
Time Post-filling and Item		Control	Bio-mate	1174	Control	Bio-mate	Control	Tri-Lac	Control	Sila-gest	Control	Bio-mate	1174
Initial:	pH	5.92	5.91	5.92	5.93	5.93	5.98	5.96	5.89	5.90	5.94	5.94	5.95
Hour 6:	pH*	---	---	---	5.26	5.21	5.80	5.68	5.78	5.76^{x}	5.88	5.86^{x}	5.86^{x}
Hour 12:	pH*	4.93	4.74	4.86^{x}	4.75	4.73^{x}	4.78	4.66	5.71	5.69^{x}	4.73	4.66	4.70^{x}
	Lactic*	.94	1.26	1.21	1.04	1.38	---	---	---	---	---	---	---
Hour 24:	pH*	4.40	4.24	4.31	4.65	4.60	4.44	4.34	4.48	4.40	4.40	4.30	4.34
	Lactic*	1.52	2.19	1.81	1.87	1.97^{x}	1.12	1.40	---	---	---	---	---
Hour 48	pH*	4.14	4.03	4.04	4.41	4.36	4.11	4.07^{x}	4.24	4.20^{x}	4.21	4.11	4.11
	Lactic*	3.02	4.11	3.63^{x}	3.67	3.88^{x}	3.90	4.18^{x}	---	---	---	---	---
Day 4:	pH*	3.92	3.88	3.86^{x}	4.22	4.19^{x}	3.96	3.95^{x}	4.07	4.01	4.03	3.97^{x}	3.91
	Lactic*	5.41	5.71^{x}	6.60	4.80	5.47	5.79	5.92^{x}	---	---	---	---	---
Day 90:	pH*	3.86	3.84^{x}	3.83^{x}	4.11	4.09^{x}	3.93	3.90^{x}	3.92	3.90^{x}	^{3}.98	3.96^{x}	3.90
	Lactic	---	---	---	---	---	6.33	6.56^{x}	---	---	---	---	---

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[1] Lactic acid is reported as a % of the silage dry matter.

*Statistical analyses showed control vs. inoculant means differed ($P < .05$) within a trial, unless the inoculant mean has a superscript(x).

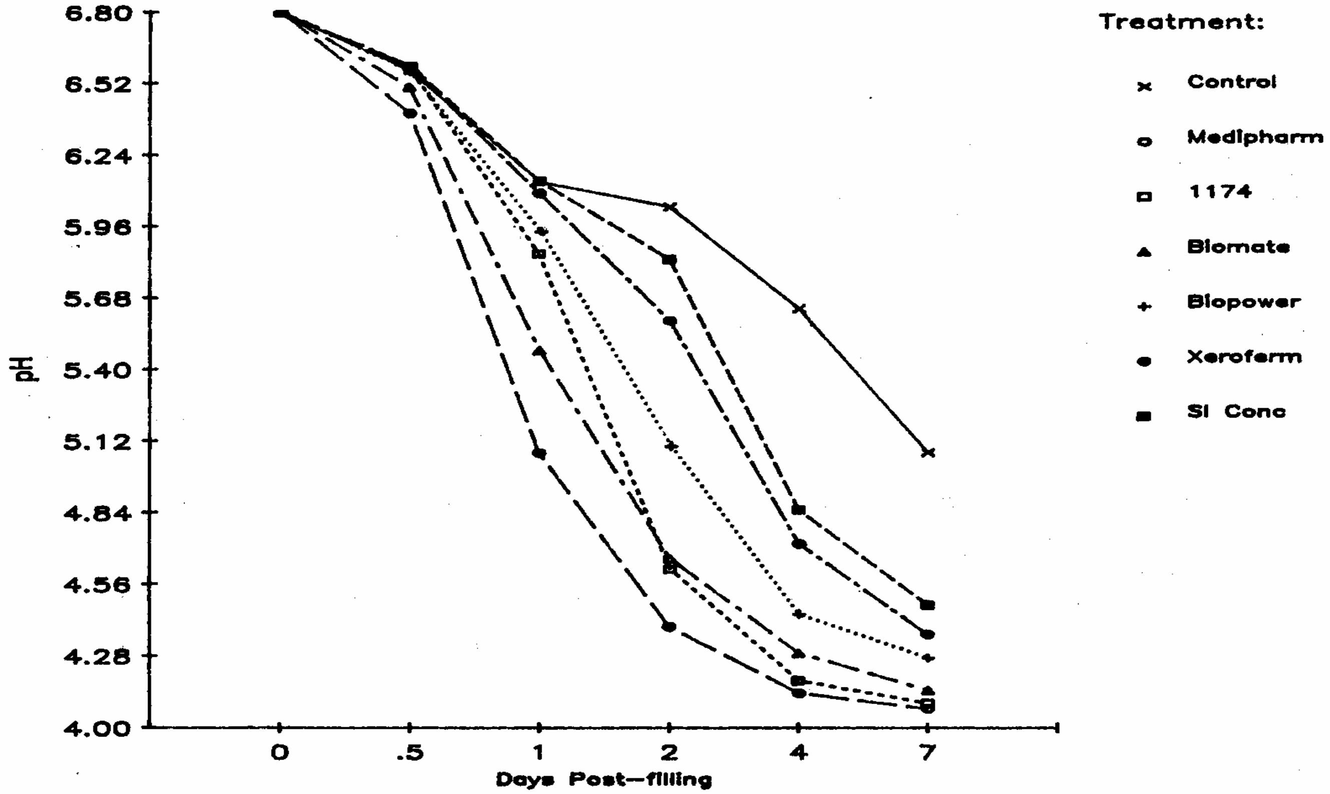

Figure 39.1. pH over Time for the Wheat Silages in Trial 1

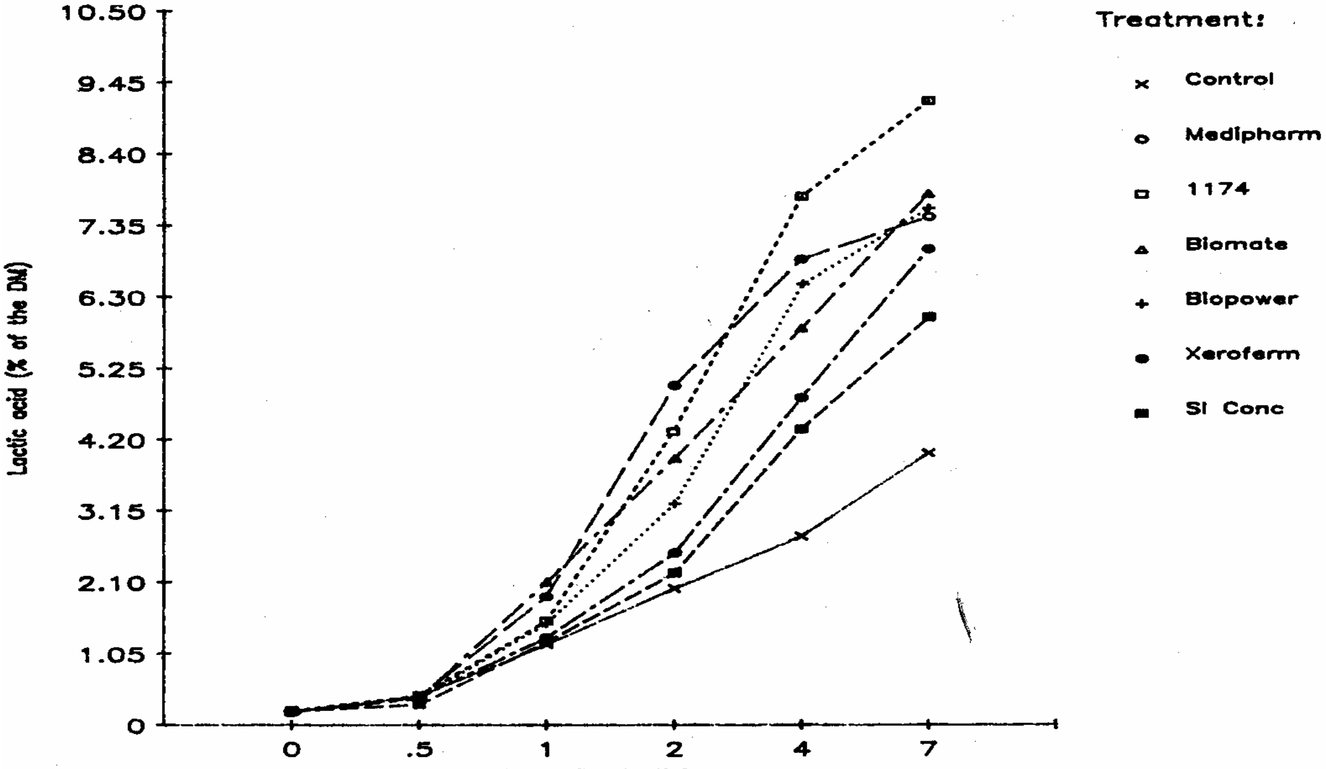

Figure 39.2. Lactic Acid over Time for the Wheat Silages in Trial 1

Effect of Environmental Temperature and Inoculants on the Fermentation of Alfalfa and Forage Sorghum Silages[1]

Keith Bolsen, Ahmed Laytimi,
Lesa Nuzback, and Renee Hart

Summary

The inoculants, TriLac® and Ecosyl® increased the rate and efficiency of the ensiling process in both high (50%) and low (32.5%) dry matter alfalfa, regardless of temperature. In both alfalfa trials, the inoculated silages had significantly lower pH, acetic acid, ethanol, and ammonia-nitrogen values and higher lactic acid values than their control counterparts. The inoculants worked equally well when fermentation was at 60 or 90 F. Although similar effects were obtained with forage sorghum, the differences were not as pronounced as those for the alfalfa silages.

Introduction

Silage-making in Kansas begins in May with crops like alfalfa and winter cereals and ends in November with late-season forage sorghums. During these 7 months, minimum and maximum daytime temperatures will range from less than 32 F to over 100 F. How do the air temperature and the temperature of harvested forage as it enters the silo affect the ensiling process? Results from the last 2 years using alfalfa and forage sorghum (KAES Reports of Progress 494 and 514) indicated that initial fermentation was delayed by a cool temperature and that a warm initial temperature produced silages with lower pH values and higher acid contents. In addition, a silage inoculant generally increased the fermentation rate, particularly with alfalfa when the fermentation temperature was cool.

Our objective was to further document the effect of fermentation temperatures and inoculants on the rate and efficiency of fermentation in alfalfa and forage sorghum.

Experimental Procedures

The PVC laboratory silo used in these trials, the treatment methods, and the silo-filling techniques were similar to those described in the article on page 137 of this report. The inoculants were applied in liquid form. TriLac contains *Lactobacillus plantarum* and *Pedicoccus cerevisiae* and supplied 2.54×10^5, 2.86×10^5, and 2.90×10^5 colony-forming units. (CFU) of bacteria per gram of crop in Trials 1, 2, and 3, respectively. Ecosyl contains *Lactobacillus plantarum* and supplied 2.90×10^5 CFU per gram of crop in Trial 3. Chemical composition and microorganism profile of the pre-ensiled crops are presented in Table 40.1.

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[1] Partial financial assistance was provided by Quali-Tech, Inc., Chaska, Minnesota and C-I-L, Inc., London, Ontario, Canada.

Trial 1. Silages was made from late-dough stage, post-frost, hybrid forage sorghum (DeKalb 25E) on October 8, 1986. The direct-cut material contained 29.0% dry matter (DM) and was approximately 70 to 75 F when ensiled. Four treatments were compared: (1) control (no inoculant), with the laboratory silos stored at 60 F (control-60); (2) control, with silos stored at 90 F (control-90); (3) TriLac-treated, with silos stored at 60 F (TriLac-60); and (4) TriLac-treated, with silos stored at 90 F (TriLac-90). Eighteen laboratory silos were filled for each treatment, with three silos per treatment opened at 12, 24, and 48 hours and 4, 7, and 90 days post-filling.

Trial 2. Silage was made from fifth cutting, post-frost alfalfa on October 16, 1986. The 24-hr wilted material contained 51.0% DM and was 75 F when ensiled. The treatments and opening times were the same as those described in Trial 1.

Trial 3. Silage was made from second cutting alfalfa on June 19, 1987. The 3- to 4-hr wilted material contained 34.0% DM and was 80 F when ensiled. Both TriLac and Ecosyl were included as treatments at 60 and 90 F.

Results and Discussion

Presented in Figures 40.1 to 40.6 are temperature and inoculant effects on silage fermentation dynamics during the first 7 days post-filling in the three trials. Silage fermentation results for the 90-day silages is shown in Table 40.2.

In Trial 1, both 90 F forage sorghum silages had sharply lower pH values and higher lactic acid contents at 24 hours than the two 60 F silages (Figures 40.1 and 40.2). Beginning at 4 days post-filling, the TriLac-60 silage had lower pH and higher lactic acid values than the control-90 silage. The 90-day, Trilac-90 and TriLac-60 silages had lower pH, acetic acid, ethanol, and ammonia-nitrogen and higher lactic acid values ($P<.05$) than the control-90 and control-60 silages (Table 40.2).

In Trial 2, the control-90 and control-60 alfalfas fermented very slowly and were still above pH 5.40 and below 3.2% lactic acid at 7 days post-filling (Figures 40.3 and 40.4). In contrast, the inoculated silages had significantly lower pH and higher lactic acid values than the control-90 silage, beginning at 48 hours for TriLac-90 and 7 days for TriLac-60 silages. The 90-day, TriLac-90 and TriLac-60 silages had significantly lower pH, acetic acid, ethanol, and ammonia-nitrogen and higher lactic acid values than the two control silages (Table 40.2).

The temperature and inoculant effects on fermentation dynamics and 90-day chemical composition of the alfalfa silages in Trial 3 were nearly identical to those obtained in Trial 2 (Figures 40.5 and 40.6 and Table 40.2). Both inoculants, TriLac and Ecosyl, increased the rate and efficiency of silage fermentation over the control.

Table 40.1. Chemical Composition and Microorganism Profile of the Pre-ensiled Crops in Trials 1, 2, and 3

	DeKalb 25E	Alfalfa	
	Trial 1	Trial 2	Trial 3
Item	1986	1986	1987
Dry Matter, %	29.0	51.0	32.5
pH	5.85	6.1	5.95
Water Soluble Carbohydrates[1]	7.25	6.2	5.4
Crude Protein[1]	7.2	22.0	20.7
Buffer Capacity[2]	20.2	59.5	52.6
Mesophilic Bacteria[3]	8.9×10^{7}	7.2×10^{7}	3.8×10^{7}
Lactic Acid Bacteria[3]	6.0×10^{4}	6.8×10^{4}	6.2×10^{5}
Yeasts and Molds[3]	1.3×10^{4}	3.4×10^{3}	7.0×10^{3}

[1] Expressed as a % of the crop dry matter.

[2] Milliequivalents NaOH per 100 grams of crop DM required to raise the pH of the fresh material to 6.0.

[3] Colony-forming units per gram of crop.

Table 40.2. Chemical Analyses of the 90-day Silages in the Three Trials

Crop, and Treatment	Dry Matter	pH	Lactic Acid	Acetic Acid	Ethanol	NH_3-N
	%		-------% of the Silage DM-------			
Trial 1: Forage Sorghum						
Control-60	28.5	3.92^{b}	5.66^{b}	1.45^{b}	$.304^{b}$	.043
TriLac-60	28.8	3.87^{a}	6.42^{a}	$.96^{a}$	$.231^{a}$	.029
Control-90	28.5	3.98^{c}	4.99^{a}	1.34^{b}	$.345^{c}$	.050
TriLac-90	28.5	3.88^{a}	6.53^{a}	$.76^{a}$	$.270^{a}$	.032
Trial 2: Alfalfa						
Control-60	49.2	4.82^{b}	6.55^{b}	1.94^{c}	$.272^{c}$	$.205^{b}$
TriLac-60	49.8	4.34^{a}	9.31^{a}	1.12^{a}	$.095^{a}$	$.133^{a}$
Control-90	50.1	4.97^{c}	6.05^{b}	1.41^{b}	$.170^{b}$	$.217^{b}$
TriLac-90	50.5	4.43^{a}	9.99^{a}	1.00^{a}	$.089^{a}$	$.130^{a}$
Trial 3: Alfalfa						
Control-60	33.1	4.59^{c}	3.54^{b}	3.78^{d}	$.322^{b}$	$.269^{ab}$
TriLac-60	34.1	4.32^{a}	6.44^{a}	2.08^{a}	$.104^{a}$	$.192^{a}$
Ecosyl-60	33.6	4.38^{a}	6.23^{a}	2.71^{b}	$.126^{a}$	$.200^{a}$
Control-90	33.4	4.58^{a}	4.41^{b}	3.23^{c}	$.400^{b}$	$.312^{b}$
TriLac-90	34.1	4.45^{b}	6.43^{a}	2.11^{a}	$.116^{a}$	$.245^{ab}$
Ecosyl-90	33.0	4.46^{b}	6.25^{a}	2.64^{b}	$.171^{a}$	$.234^{ab}$

[a b c d] Values in the same column within a trial with different superscripts differ ($P<.05$).

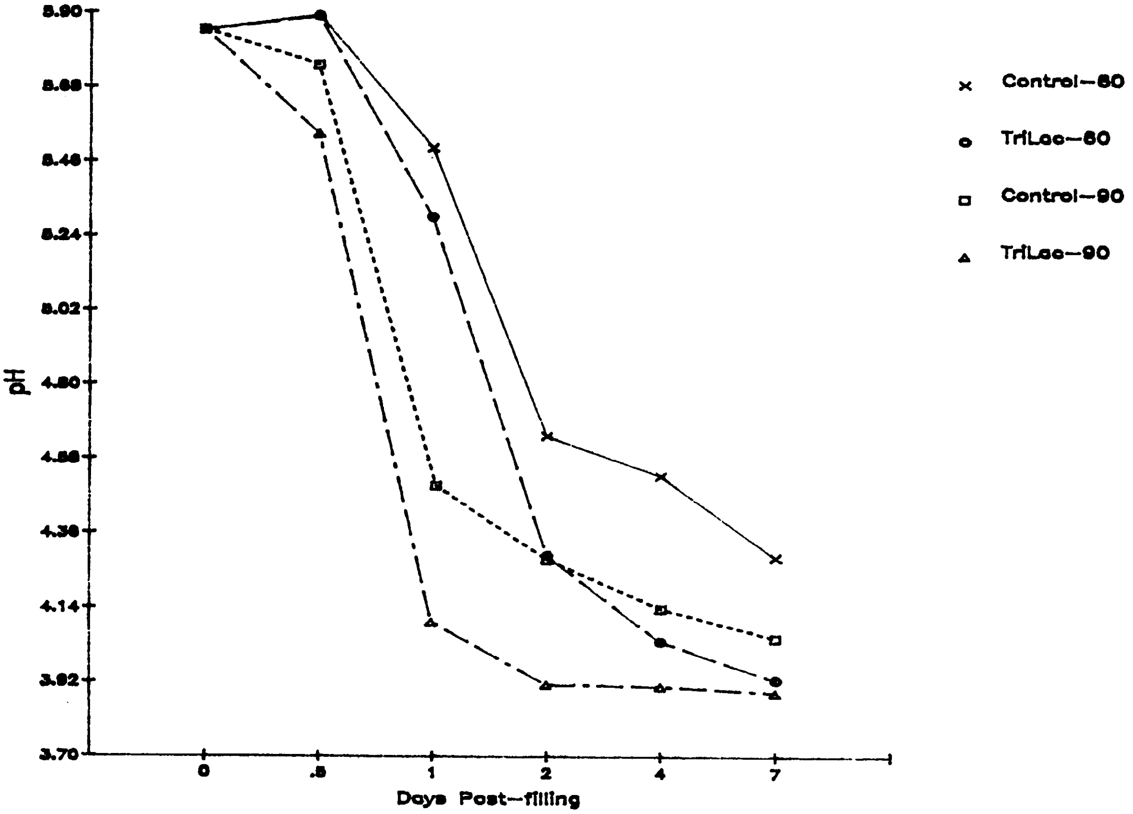

Figure 40.1. pH over Time for the Forage Sorghum Silages in Trial 1

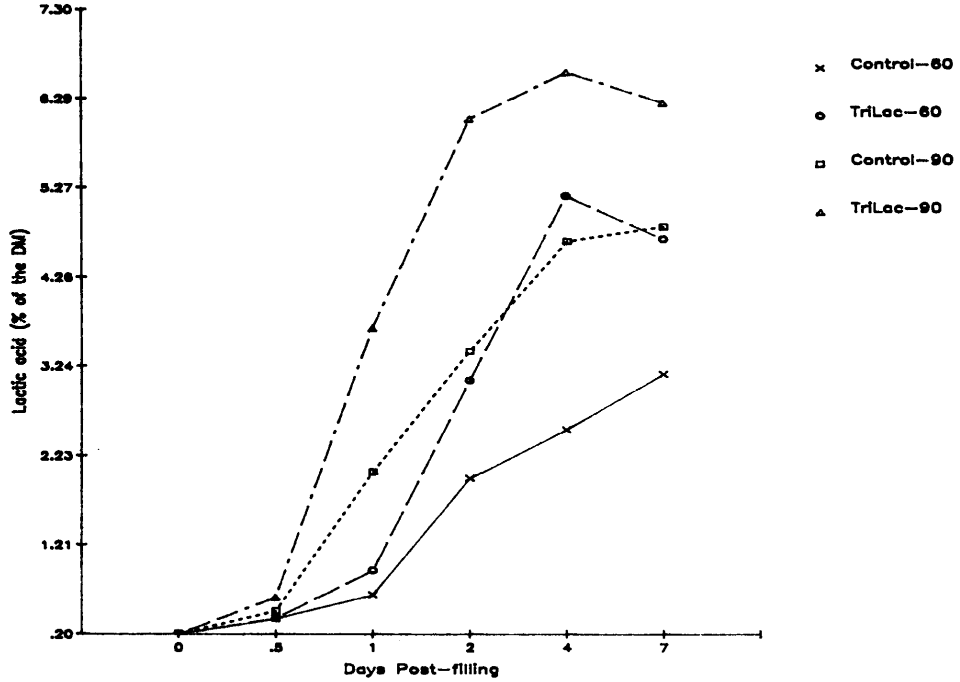

Figure 40.2. Lactic Acid over Time for the Forage Sorghum Silages in Trial 1

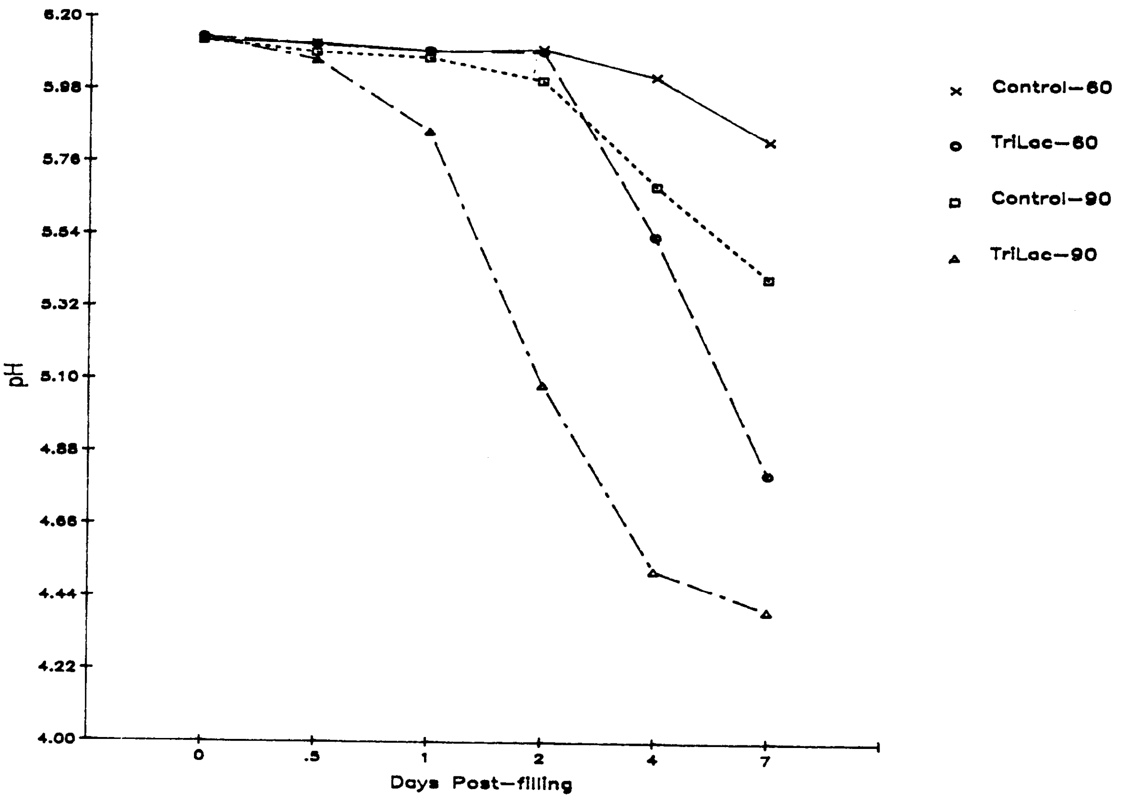

Figure 40.3. pH over Time for the Alfalfa Silages in Trial 2

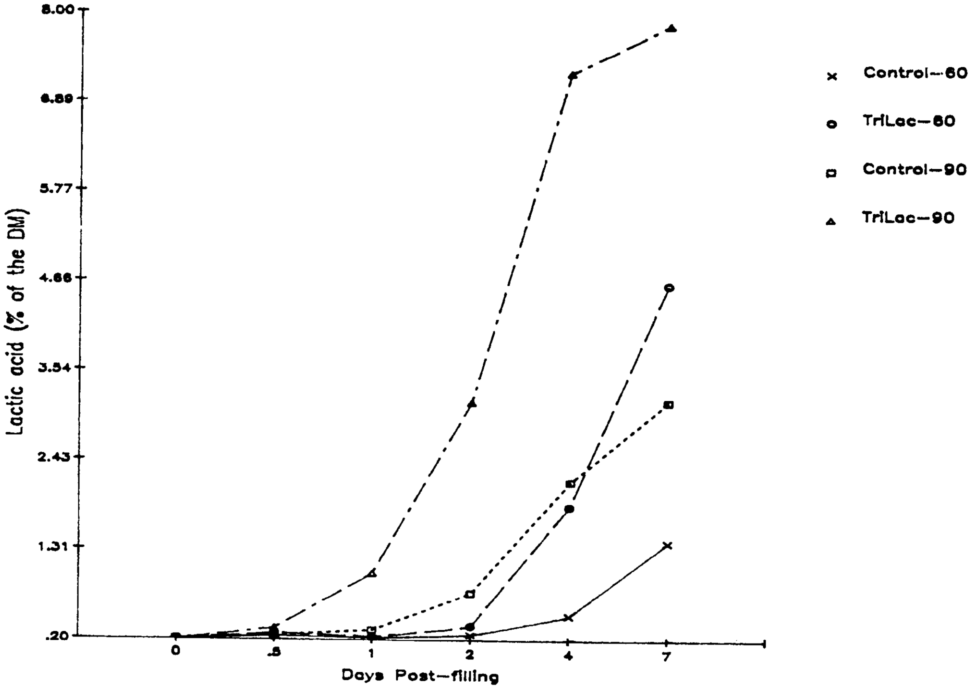

Figure 40.4. Lactic Acid over Time for the Alfalfa Silages in Trial 2

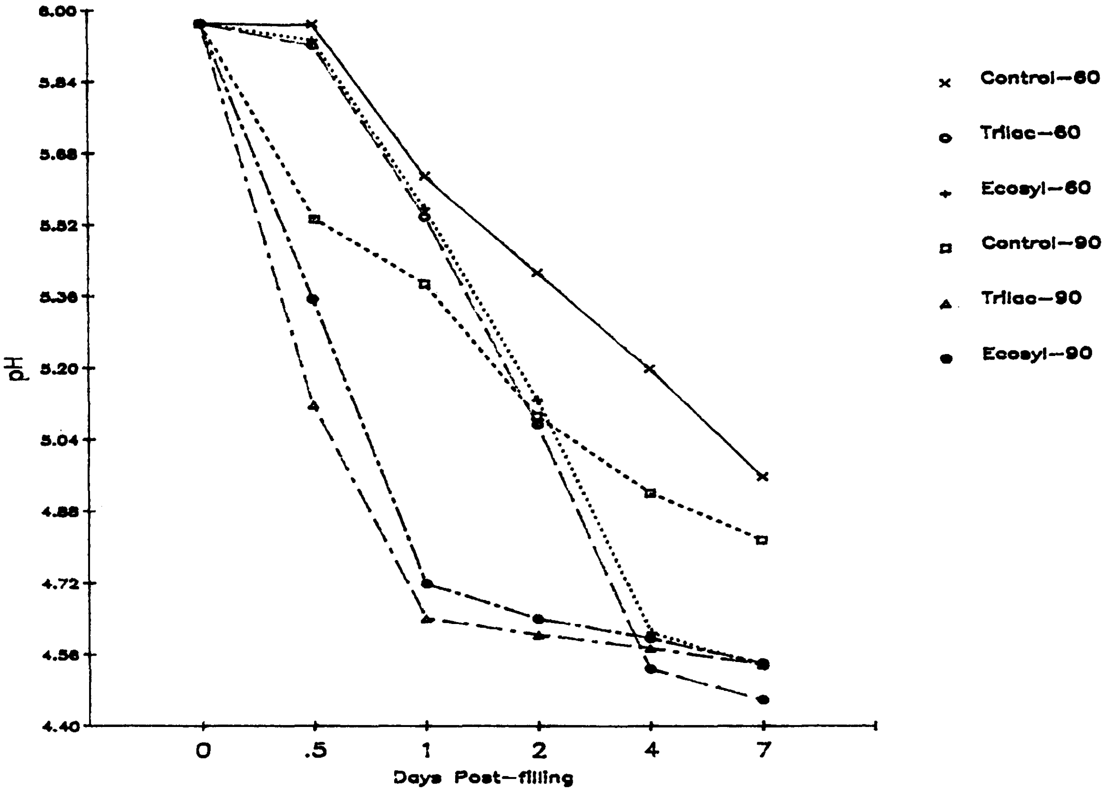

Figure 40.5. pH over Time for the Alfalfa Silages in Trial 3

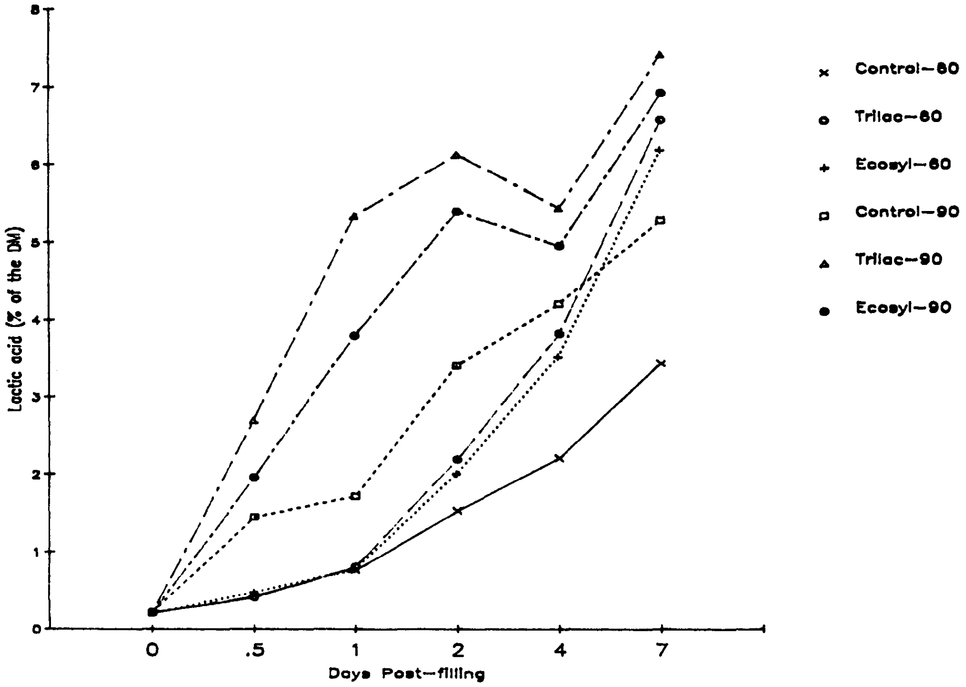

Figure 40.6. Lactic Acid over Time for the Alfalfa Silages in Trial 3

Inoculant-treated Corn Silages for Growing Cattle[1,2,3,4]

Keith Bolsen, Brett Kirch, Ahmed
Laytimi, Jim Hoover and Harvey Ilg

Summary

Whole-plant corn silages were treated with Ecosyl® in one trial and Biomate® or Silagest® in a second trial. In both trials, the silages were well preserved and moderately stable in air during the feed-out period. Inoculated silages had slightly lower ensiling temperatures than control silages. Laboratory silo results indicated that all silages fermented extremely fast, but inoculated silages did have slightly lower pH and higher lactic acid values during the first 4 days post-filling. Calves fed inoculated silage rations tended to gain faster and more efficiently than those fed control silages. Gain per ton of crop ensiled also favored the inoculated silages.

Experimental Procedures

Trial 1. Whole-plant corn was treated with Ecosyl inoculant at the time of ensiling and compared to untreated (control) silage. Both silages were made by the alternate load method in 10 x 50 ft concrete stave silos on August 18 and 20, 1986 from Pioneer 3471 corn harvested in the mid to full-dent stage at 36.0% dry matter (DM). Ecosyl was applied at the blower as a liquid and supplied an average of 1.0×10^5 colony-forming units (CFU) of lactic acid bacteria (LAB) per gram of crop. The corn, as harvested, contained an average of 2.1×10^5 CFU of LAB per gram.

Each silo was partitioned vertically into thirds as it was filled, with approximately 15 tons per third. The partitions were separated by plastic mesh fencing. Two thermocouple wires and three nylon bags filled with 4.5 to 5.0 lb of fresh crop, were placed in the vertical center of each third. Ensiling temperatures were monitored for the first 6 weeks of storage. Twice during the filling of the stave silos, fresh forage was removed from randomly selected loads and control and Ecosyl-treated material was ensiled in PVC laboratory silos, 18 silos each. Triplicate silos were opened at 6, 12, 24 and 48 hours and 4 and 90 days post-filling. The farm-scale silos were opened on December 5, 1986 and emptied at a uniform rate

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[1] Ecosyl® contains *Lactobacillus plantarum* and is a product of C-I-L, Inc. London, Ontario, Canada.

[2] Biomate® contains *Lactobacillus plantarum* and *Pediococcus cerevisiae* and is a product of Chr. Hansen's Laboratory, Inc. Milwaukee, Wisconsin.

[3] Silagest® contains multiple strains of lactic acid bacteria and is a product of InterBio, Inc. Naperville, Illinois.

[4] C-I-L, Inc., Chr. Hansen's Laboratory, Inc., and InterBio, Inc. all provided partial financial assistance.

during the following 12 weeks. Samples were taken twice weekly for DM recovery calculations and chemical analyses. Each silage was fed to 16 steer and heifer calves (four pens of four calves per silage) in an 80-day growing trial, which began on December 6, 1986. Rations were full-fed and all contained 87.6% silage and 12.4% supplement on a DM basis. Rations were formulated to provide 12.0% crude protein (DM basis), 200 mg of Rumensin® per animal daily, required amounts of calcium and phosphorus, and vitamins A, D, and E. Supplements were top-dressed and partially mixed with the silages in the bunk. Feed offered was recorded daily for each pen and the quantity of silage fed was adjusted daily to assure that fresh feed was always available. Feed not consumed was removed, weighed, and discarded every 7 days or as necessary.

For 3 days before the start of the feeding trail, all cattle were limit-fed a forage sorghum silage ration to provide a DM intake of 2.0% of body weight. Cattle were then weighed individually on 2 consecutive days after 16 hr without feed or water. For 2 days before the final weighing, the cattle were fed their respective silage rations at a restricted intake of 2.0% of body weight.

Trial 2. Three whole-plant corn silages were compared: (1) control (no additive), (2) Biomate, and (3) Silagest. Both additives were applied at the blower and at the manufacturers' recommended rate. Biomate supplied an average of 2.1×10^5 CFU of LAB per gram of crop and Silagest supplied 6.6×10^4 per gram. The corn, as harvested, contained an average of 3.3×10^6 CFU of LAB per gram. The silages were made by the alternate load method in 10 x 50 ft concrete stave silos on August 25, 1986 from Pioneer 3475 corn harvested in the full-dent stage at 38 to 40% dry matter. Each silo was partitioned vertically into thirds as it was filled, with approximatley 14 tons per third. All other procedures for filling and emptying the silos and the cattle growing trial were identical to those described in Trial 1.

Results and Discussion

Ensiling temperatures for the two trials are shown in Table 41.1. In Trial 1, the initial forage temperatures were 82.7 F for control and 81.5 F for Ecosyl. Change from initial temperature was consistently 1 to 2 F lower for the inoculated corn silage during the first 4 weeks. In Trial 2, the initial forages were between 92.0 and 92.3 F and reflected the very warm air temperatures on the day the silages were made. Biomate silage had a 1 to 5 F lower temperature than control silage during the first 4 weeks; however Silagest silage was not consistently cooler than the control until day 10 post-filling.

Silage fermentation dynamics during the first 4 days post-filling for the five silages in the two trials are shown in Table 41.2. All silages fermented extremely fast, reaching a pH of 4.0 or below within the first 48 hours post-filling. In spite of the rapid pH drop in the two untreated silages, inoculated silages still had lower pH ($P<.05$) and higher lactic acid values ($P<.05$) at a few of the opening times.

Shown in Tables 41.3 and 41.4 are DM losses and fermentation end-products for control and inoculated silages. In both trials, all silages had low pH values, intermediate levels of total fermentation acids (predominately lactic acid), and low ammonia-nitrogen contents --- all characteristics of well preserved corn silage. In

Trial 1, silages from the concrete stave silos, buried bags, and PVC silos had similar fermentation profiles, although acetic acid content was lowest in PVC silos. Silage DM losses were consistently lower for the Ecosyl-treated corn silage. In Trial 2, silage from all three treatments had nearly identical fermentation end-products except DM loss and acetic acid values were slightly lower for Biomate and Silagest-treated silages.

Performance by cattle during the two 80-day growing trials is presented in Table 41.5. Mild weather and the high grain content of the silages combined to produce exceptional rates and efficiencies of gain. Although cattle fed Ecosyl-treated silage in Trial 1 made 8.7% faster gains and had 5.5% greater intake, these differences were not statistically significant. When the data for farm-scale silage recoveries were combined with cattle performance, the Ecosyl-treated corn silage produced 6.3 lb more gain per ton of crop ensiled than the control silage.

In Trial 2 the only significant improvement in cattle performance was a better feed conversion for those fed Silagest-treated silage, although cattle fed the Biomate and Silagest silages had 5.4% faster daily gains, on average, than those fed control corn silage. Cattle gains per ton of crop ensiled were 2.6 and 9.2 lb higher for Biomate and Silagest silages, respectively, than with control corn silage.

Table 41.1. Ensiling Temperatures as Change From Initial Temperature for Control and Incolated Corn Silages in Trials 1 and 2

Days Post-filling	Trial 1		Trial 2		
	Control	Ecosyl	Control	Biomate	Silagest
--------------- Inital Forage Temperature, F ---------------					
	81.5	82.7	92.3	92.3	92.0
----------- Change from Initial Temperature, F ----------					
1	+9.9	+9.3	+8.4	+7.6	+9.1
2	+12.7	+12.1	+9.3	+8.3	+10.0
3	+13.7	+13.2	+9.6	+8.7	+10.4
4	+14.1	+13.4	+9.5	+8.6	+10.5
5	+16.2	+14.7	+10.5	+9.1	+10.8
6	+16.0	+14.2	+11.0	+9.6	+11.0
7	+15.9	+13.8	+11.4	+9.4	+9.7
10	+15.0	+13.5	+10.7	+8.0	+9.7
14	+14.3	+12.9	+9.5	+5.9	+8.0
21	+12.0	+10.3	+8.8	+4.5	+5.7
28	+8.7	+7.8	+6.3	+1.2	+3.3

Table 41.2. pH and Lactic Acid during the First Four Days Post-filling for Control and Inoculated Corn Silages in Trials 1 and 2

Time Post-filling and Item[1]		Trial 1[A]		Trial 2[B]		
		Control	Ecosyl	Control	Biomate	Silagest
Initial:	pH	5.90	5.89	5.92	5.93	5.93
6 hrs:	pH*	5.62	5.59	5.44	5.29	5.40
	Lactic*	.30	.28	.36	.43	.37
12 hrs:	pH*	5.24	5.16	4.33	4.19	4.24^{x}
	Lactic	.50	$.49^{x}$	.92	1.23	$.84^{x}$
24 hrs:	pH*	4.07	4.04^{x}	4.02	3.92	3.93
	Lactic	1.89	2.22	2.33	2.69	2.59
48 hrs:	pH	3.85	3.85	3.78	3.77	3.78
	Lactic	3.84	4.20	3.39	3.49	3.46
4 days:	pH	3.78	3.71	3.71	3.77	3.70
	Lactic*	4.42	4.69^{x}	3.94	4.53	4.11^{x}

[1] Lactic acid as a % of the silage dry matter.

[A] Each value is the mean of six laboratory silos.

[B] Each value is the mean of four laboratory silos.

*Statistical analyses showed control vs. inoculant means differed ($P<.05$), within a Trial, unless the inoculant mean has a superscript (x).

Table 41.3. Dry Matter Losses and Fermentation End-Products for the Control and Ecosyl Corn Silages from the Concrete Stave Silos, Buried Bags, and PVC Silos in Trial 1

Treatment and Location in the Silo or Days Post-filling		DM, %	DM loss[1]	pH	Fermentation Acids				
					Lactic	Acetic	Total	Ethanol	NH_3-N
					% of the Silage DM				
Concrete Stave Silos									
Control:	Top	39.4	14.67	3.76	6.27	1.60	7.92	.34	.009
	Middle	37.5	9.04	3.57	8.57	1.77	10.44	.29	.109
	Bottom	37.1	4.49	3.58	9.96	2.13	12.24	.30	.122
	Avg.	38.0	9.48	3.64	8.26	1.83	10.20	.31	.108
Ecosyl:	Top	39.2	10.08	3.71	6.70	1.48	8.22	.34	.095
	Middle	37.5	8.99	3.55	9.47	1.49	11.08	.36	.116
	Bottom	37.5	2.40	3.62	9.14	2.48	11.75	.30	.129
	Avg.	38.1	7.14	3.63	8.44	1.82	10.35	.33	.113
Buried Bags									
Control:	Top	37.6	5.33	3.62	7.59	---	---	---	.091
	Middle	35.7	7.17	3.59	5.79	---	---	---	.112
	Bottom	36.3	6.25	3.56	8.44	2.33	10.85	.27	.093
	Avg.	36.5	6.25	3.59	7.27	---	---	---	.097
Ecosyl:	Top	36.0	5.51	3.61	7.90	---	---	---	.088
	Middle	35.0	6.74	3.63	6.58	---	---	---	.117
	Bottom	37.0	4.19	3.60	8.33	2.56	11.04	.31	.110
	Avg.	36.0	5.48	3.61	7.60	---	---	---	.105
PVC Silos									
Control:	90 Days	36.2	---	3.76	6.38	1.05	7.47	.47	.076
Ecosyl:	90 Days	36.9	---	3.71	7.30	.99	8.33	.37	.070

[1] Percent of the DM ensiled.

Table 41.4. Dry Matter Losses and Fermentation End-Products for Control, Biomate, and Silagest Corn Silages from the Concrete Stave and PVC silos in Trial 2

Treatment and Location in the Silo or Days Post-filling		DM, %	DM loss[1]	pH	Fermentation Acids				
					Lactic	Acetic	Total	Ethanol	NH_3-N
					----------% of the Silage DM----------				
		Concrete Stave Silos							
Control:	Top	39.0	10.71	3.87	4.42	1.28	5.75	1.38	.089
	Middle	39.0	4.35	3.74	5.88	2.88	8.86	.25	.122
	Bottom	38.7	6.10	3.78	5.54	3.42	9.11	.30	.132
	Avg.	38.9	7.00	3.80	5.28	2.53	7.91	.64	.115
Biomate:	Top	37.9	12.57	3.83	4.75	1.73	6.53	1.39	.101
	Middle	39.8	3.94	3.75	5.53	2.26	7.59	.31	.111
	Bottom	38.2	3.41	3.75	6.11	2.48	8.59	.34	.113
	Avg.	38.6	6.20	3.78	5.46	2.16	7.57	.68	.108
Silagest:	Top	39.1	10.74	3.84	4.31	1.30	5.65	1.19	.086
	Middle	37.9	3.98	3.78	5.00	2.97	8.09	.21	.121
	Bottom	36.4	3.82	3.76	6.26	2.92	9.33	.28	.119
	Avg.	37.8	6.10	3.79	5.20	2.39	7.69	.56	.109
		PVC Silos							
Control:	90 Days	37.6	---	3.76	6.36	1.33	7.74	1.31	.077
Biomate:	90 Days	37.2	---	3.77	6.62	1.11	7.77	1.30	.075
Silagest:	90 Days	38.2	---	3.78	6.46	1.19	7.70	1.31	.076

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[1] Percent of the DM ensiled.

Table 41.5. Performance by Cattle Fed Control and Inoculated Corn Silages in Trials 1 and 2

Item	Trial 1[1] Control	Trial 1[1] Ecosyl	SE	Trial 2[1] Control	Trial 2[1] Biomate	Trial 2[1] Silagest	SE
No. of Cattle	16	16		16	16	16	
Initial Wt., lb	561	569		569	567	564	
Final Wt., lb	763	789		771	773	781	
Avg. Daily Gain, lb	2.54	2.76	.14	2.53	2.62	2.71	.09
Daily Feed Intake, lb[2]	16.26	17.16	.44	17.03	17.35	16.98	.32
Feed/lb of Gain, lb[2]	6.46	6.26	.26	6.77^{b}	6.62^{ab}	6.30^{a}	.16
Silage DM Recovery, % of the DM Ensiled	90.5	92.8		93.0	93.8	93.9	
Silage Fed, lb/Ton Ensiled[3]	1810	1857		1860	1876	1878	
Silage/lb of Gain, lb[3]	16.02	15.56		16.81	16.56	15.68	
Cattle Gain/Ton of Crop Ensiled, lb[3]	113.0	119.3		110.6	113.2	119.8	

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[1] December 6, 1986 to March 2, 1987 (80 days).

[ab] Values in Trial 2 in the same row with different superscripts differ ($P<.10$).

[2] 100% dry matter basis.

[3] Adjusted to 35% dry matter.

Whole-plant Forage and Grain Sorghums and Corn Silages for Growing Cattle

Brett Kirch, Susan Hamma, Keith Bolsen,
Jack Riley, and Jim Hoover

Summary

Two trials were conducted to determine the feeding value of whole-plant forage sorghum, grain sorghum, and corn silages, with and without 25% rolled grain sorghum added to the ration. In general, growing cattle fed corn or grain sorghum silages out-performed those fed forage sorghum silages. Only forage sorghums with moderate grain yields supported gains approaching those from grain sorghum silages. With the addition of 25% rolled grain sorghum, cattle performance from the low and medium grain-yielding forage sorghum silages was improved greatly (gains by 20 to 44%, dry matter intake by 12 to 17%, feed conversion by 4 to 25%). Adding 25% grain to the moderate grain-yielding forage sorghum hybrid rations increased cattle gains to a level comparable to those from grain sorghum silages. These studies indicate that the grain content of a corn or sorghum silage ration is the major determinant of cattle performance, and that whole-plant corn and grain sorghums should produce the fastest and most efficient gains in growing programs.

Introduction

Grain sorghum silages generally have the following advantages over their forage sorghum counterparts: (1) higher grain content, which leads to faster daily gains; (2) more crude protein, which lowers supplementation costs; and (3) earlier forage maturity and improved dry-down characteristics, both of which lead to better silage preservation and increased silage intake. Our objectives were to continue our comparisons of forage and grain sorghum and corn silages and to document the performance of growing cattle fed these silages when grain is added to the ration.

Experimental Procedures

Summarized in Table 42.1 are harvest dates, dry matters (DM), and chemical compositions at harvest for the forage sorghum, grain sorghum, and corn hybrids used in the 1985-86 and 1986-87 trials.

In both years, all hybrids were direct-cut using a Field Queen harvester. Forage and grain sorghums were in the late-dough stage of kernel development, and the corn was dented. All silages were made in either 10 x 50 ft and 14 x 60 ft concrete stave silos or 8 x 75 ft Ag Bags®.

In the 1985-86 trial, whole-plant silages were made from four forage sorghum and three grain sorghum hybrids. Each silage was fed to 16 crossbred steer and heifer calves (four pens of three steers and one heifer per ration, with an initial avg. wt. of 538 lb). Two pens received 87.6% silage and 12.4% supplement (DM basis), whereas the remaining two pens received rations containing 62.6% silage, 12.4% supplement, and 25% rolled sorghum grain. Each ration provided 12% CP (DM basis); 200 mg of Rumensin® per calf daily; and calcium, phosphorus, and vitamin A to meet NRC (1984) requirements. The supplements used were soybean meal-based, with 2.5% urea and rolled grain sorghum as the carrier. The rations were fed for 70 days; December 6, 1985 to February 14, 1986.

In the 1986-87 trial, whole-plant silages were made from three grain sorghums, one forage sorghum, and one corn hybrid. Each silage was fed to 16 crossbred steers and heifer calves (four pens of three steers and one heifer per ration, with an initial avg. wt. of 563 lb). The ration and supplement ingredients and percentages were the same as described for the 1985-86 trial. The rations were fed for 80 days; December 12, 1986 to March 1, 1987.

In both trials, calves were weighed on two consecutive days at the beginning and end of the trial, after 16 hr without feed or water. To minimize fill effects, all calves were fed a forage sorghum silage ration at 1.75% of body weight (DM basis) for 1 week before each trial began.

Samples of each silage were taken twice weekly. Feed intake was recorded daily for each pen and the quantity of complete-mixed ration was adjusted daily to assure that fresh feed was always in the bunks. Feed not consumed was removed, weighed, and discarded as necessary.

Results and Discussion

1985-86: Trial 1. The three grain sorghum hybrids (Funk's 550, NK 2778, DeKalb 42Y) produced the highest daily gains (Table 42.2). The moderate grain-yielding forage sorghum hybrids (Buffalo Canex, Acco 351, and Pioneer 947) produced respectable gains of over 2 lb per day. The low-grain yielding forage sorghum hybrid (DeKalb 25E) produced the poorest gain.

With the addition of 25% rolled grain sorghum, the most dramatic improvements in cattle performance were with the forage sorghums. Daily gain of calves fed DeKalb 25E and added grain improved by .61 lb/day, which is a 44% improvement. Calves fed the three moderate grain-yielding forage sorghum hybrids also showed significant increases in daily gains (Buffalo Canex, 31%; Acco 351, 24%; and Pioneer 947, 21% improvements). Calves fed the three moderate grain-yielding forage sorghums had gains and feed conversions comparable to those of calves fed the grain sorghum silages without added grain. Adding grain to the grain sorghum silages had little effect on calf performance.

Calves consumed more of the grain sorghum silage rations than the forage sorghum silage rations and the intake of the low grain-yielding hybrid was quite low (only 2.0% of body wt.). Even after the addition of 25% grain, calves still consumed more of the grain sorghum silage rations, but the largest increases in intake occurred with the forage sorghums. Buffalo Canex and DeKalb 25E showed about 17% improvements, whereas Pioneer 947 and Acco 351 improved by 15 and 12%, respectively. Only calves receiving NK 2778 silage demonstrated any significant improvement in intake among the grain sorghums as a result of grain addition.

Efficiency of gain was virtually the same for all hybrids with the exception of DeKalb 25E silage, which produced the least efficient gains. However, DeKalb 25E was also the only hybrid to give a significant improvement (24%) in efficiency of gain as a result of adding grain. However, after the improvement, the efficiency of gain was still inferior to the other hybrids.

1986-87: Trial 2. The corn silage (Pioneer 3475) and two of the grain sorghum silages (Funk's G-522 and NC+174) produced the fastest cattle gains ($P<.05$), whereas DeKalb 41Y produced a respectable gain of 2.15 lb/day. The moderate grain-yielding forage sorghum hybrid (DeKalb FS-5) produced the slowest ($P<.05$) gain. With the addition of 25% rolled grain sorghum, only calves fed DeKalb 41Y and DeKalb FS-5 showed any improvement in gains (5 and 14%, respectively) but neither was statistically significant.

Calves consumed significantly more of the corn and grain sorghum silage rations than the forage sorghum silage, but the intake of the DeKalb FS-5 was still acceptable (2.44% of body wt.). After the addition of 25% grain, only NC+174 and DeKalb FS-5 silages resulted in a significant increase in consumption; the forage sorghum silage was still consumed at a lower level than either the corn or grain sorghum silage rations.

Efficiency of gain was best with the corn and two of the grain sorghum silages (Funk's G-522 and NC+174). With the addition of 25% grain, only DeKalb 41Y produced an improvement (8%) in feed efficiency. The efficiency of gain of calves fed corn silage actually decreased by 6 percent.

Results from these two trials indicate that grain sorghum silages can produce gains comparable to corn silage and superior to forage sorghum silages. Only forage sorghums with moderate grain-yielding potential can compare favorably to grain sorghums when evaluated on the basis of growing cattle performance. Low grain-yielding forage sorghums, especially without grain added to the ration, may have limited use in growing cattle rations.

The addition of 25% rolled grain sorghum resulted in the greatest improvements of cattle performance with the forage sorghum hybrids. Adding grain to low grain-yielding forage sorghums gave acceptable cattle performance. Grain sorghum and corn silage rations benefitted very little from the addition of 25% rolled grain sorghum and, in some instances, performance was actually decreased. It should be noted that because of wet field conditions, the DeKalb 41Y in the 1986-87 trial was harvested about 10 days to 2 weeks later than intended, and the grain was nearly mature.

A decrease in digestibility of the grain portion of the DeKalb 41Y silage likely explains the lower performance and benefit of additional rolled grain sorghum when compared to the other two grain sorghum silages. In a previous trial, DeKalb 41Y silage produced gains comparable to those with both Funk's G-522 and NC+174 silages.

Table 42.1. Hybrid Types, Harvest Dates, and Dry Matter and Chemical Analyses at Harvest[1]

Year, Trial and Hybrid	Hybrid Type	Harvest Date	DM	CP	NDF	ADF
			%	-% of	the crop	DM-
1985-86: Trial 1						
Buffalo Canex	Forage[3]	Sept. 16	28.0	8.5	54.1	28.9
Acco Paymaster 351	Forage[3]	Sept. 26-27	32.6	8.8	61.3	32.5
Pioneer 947	Forage[3]	Sept. 27	37.0	8.3	54.1	32.6
DeKalb 25E	Forage[2]	Oct. 31	30.4	7.0	58.6	37.8
Funk's 550	Grain	Sept. 16	38.0	11.5	43.5	20.7
Northrup King 2778	Grain	Sept. 19	39.0	10.3	40.4	20.4
DeKalb 42Y	Grain	Oct. 7	44.0	10.3	36.9	19.1
1986-87: Trial 2						
DeKalb FS-5	Forage[3]	Sept. 21-22	29.0	7.8	---	---
Funk's G-522	Grain	Aug. 29	34.9	9.8	---	---
NC+174	Grain	Sept. 3	36.0	8.8	---	---
DeKalb 41Y	Grain	Sept. 22	40.1	8.8	---	---
Pioneer 3475	Corn	Aug. 18-20	35.9	7.9	---	---

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[1] DM = dry matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[2] Low grain-yielding forage sorghum.

[3] Moderate to high grain-yielding forage sorghum.

Table 42.2. Performance by Cattle Fed the Forage, Grain Sorghum, and Corn Silage Rations in 1985-86: Trial 1

	Forage Sorghum Hybrid				Grain Sorghum Hybrid		
Item	DeKalb 25E	Buffalo Canex	Acco 351	Pioneer 947	Funk's 550	NK 2778	DeKalb 42Y
Avg. Daily Gain, lb	1.34^{d}	2.09^{c}	2.15^{bc}	2.03^{c}	2.53^{a}	2.46^{ab}	2.45^{ab}
(w/25% Grain)	1.94*	2.72*	2.66*	2.44*	2.75	2.92*	2.76
Avg. Daily Feed, lb[1]	12.7^{c}	14.4^{b}	15.0^{b}	14.6^{b}	17.7^{a}	17.8^{a}	18.1^{a}
(w/25% Grain)	14.9*	16.6*	16.8*	16.8*	18.6	19.3*	18.6
Feed/Gain, lb[1]	9.6^{b}	6.9^{a}	7.0^{a}	7.2^{a}	7.0^{a}	7.2^{a}	7.5^{a}
(w/25% Grain)	7.7*	6.1	6.3	6.9	6.7	6.6	6.7

[1] 100% dry matter basis.

[abc] Means differ within a row (P<.05).

*Means differ from the respective base ration (P<.05).

Table 42.3. Performance by Cattle Fed the Forage, Grain Sorghum, and Corn Silage Rations in 1986-87: Trial 2

	Forage Sorghum Hybrid	Grain Sorghum Hybrid			Corn Hybrid
Item	DeKalb FS-5	DeKalb 41Y	Funk's G-522	NC + 174	Pioneer 3475
Avg. Daily Gain, lb	1.69^{c}	2.15^{b}	2.60^{a}	2.68^{a}	2.70^{a}
(w/25% Grain)	1.92	2.26	2.61	2.69	2.70
Avg. Daily Feed, lb	15.4^{c}	19.8^{a}	19.1^{a}	18.7^{a}	17.1^{b}
(w/25% Grain)	17.0*	19.3	20.3	20.7*	18.4
Feed Gain, lb[1]	9.08^{b}	9.25^{b}	7.34^{a}	7.00^{a}	6.40^{a}
(w/25% Grain)	8.87	8.60	7.81	7.66	6.77

[1] 100% dry matter basis.

[abc] Means differ within a row (P<.05).

*Means differ from the respective base ration by (P<.05).

Relationship between Agronomic and Silage Quality Traits of Forage Sorghum Cultivars

Jim White, Keith Bolsen, and Brett Kirch

Summary

Results from two trials evaluating 11 forage sorghums as silage crops indicated that silage quality traits of voluntary intake, digestibility, and crude protein content were linearly associated with the agronomic characteristics of days to half bloom and plant height. Intake was negatively associated with plant height (r = -.49); digestibility was negatively associated with days to half bloom (r = -.39) and plant height (r = -.49); and crude protein was negatively associated with days to half bloom (r = -.51) and plant height (r = -.71). Within the same cultivar, but between years, voluntary intake varied by as much as 30 percent, digestibility by 13 percent, and protein content by 12.5 percent. Forage sorghums were also compared to grain sorghum and corn hybrids.

Introduction

Historically, Kansas has been the leading state in the production of forage sorghum. Producers who grow their own forage sorghum tend to select cultivars based upon agronomic traits, such as tonnage yield or resistance to lodging. The feeding value of these silages depends upon the management of the crop when ensiled and silage quality factors, such as voluntary intake, digestibility, and crude protein and fiber content. The objectives of this study were (1) to determine the associations between selected agronomic and silage quality traits of forage sorghums and (2) to identify those cultivar characteristics that are associated with superior silage. Grain sorghum and corn hybrids were included for comparison.

Experimental Procedures

Trial 1: 1986. Seven forage sorghum and five grain sorghum cultivars were grown in 1986. The forage sorghum cultivars included two early season (Buffalo Canex and Pioneer 956), three mid season (Atlas, DeKalb FS-5, and Pioneer 947), and two late season (Golden Acres T-E Silomaker and DeKalb 25E). The grain sorghums included Funk's G-522, Pioneer 8493, Asgrow Topaz, NC+ 174, and DeKalb 41Y. Cultivars were selected to represent a cross section of plant height, season length, and grain to forage ratios.

The sorghums were grown under dryland conditions on a silt loam soil near the Kansas State University campus in Manhattan. The plots were planted on May 31. One month earlier, 100 lb/acre of anhydrous ammonia was applied. Soil tests indicated that phosphorus and potassium were adequate. Furdan 15G® insecticide was applied in the furrows at planting, and the following day, Ramrod® was used as the pre-emergence herbicide. In July, Cygon 400® was used to control greenbugs. The sorghums were randomly assigned to plots in a block design, each with three replicates. Each plot had six rows 30 inches apart and 200 ft long. All plots were harvested when the kernels were in the late-dough stage of maturity. Previous research at Kansas State University (KAES Reports of Progress 494 and 514) has indicated that harvest at that stage optimizes both silage yield and nutritive value of sorghum silages.

Agronomic data collected for each plot included days to half bloom, plant height, and whole-plant DM and grain yields. Days to half bloom (number of days between planting and the date when half of the main heads exhibited some florets) was used to measure season length. Plant height was measured to the tallest point of the head immediately prior to harvest. Lodging score is the number of plants lodged divided by the number of plants in a row. Lodged plants are those with broken stalks or plants inclined less than 45 degrees from the soil surface. Silage yield was determined by harvesting three inside rows of each plot with a Field Queen forage harvester. After harvest, the chopped material was inoculated with Biomate® and ensiled in plastic lined, 55 gallon pilot silos. The silos were stored at ambient temperature for approximately 100 days prior to the intake and digestion trial. The two outside rows were left as borders, and heads were clipped from the remaining row from a random 60 ft to determine grain yield. The heads were dried and threshed with a stationary thresher.

Thirty-six crossbred wether lambs (avg. wt. of 113 lb) were randomly assigned to each silage (three per silage) in a two-period voluntary intake and digestion trial. Each period had a 10-day preliminary phase, a 7-day voluntary intake phase, a 2-day adjustment to 90% of voluntary intake, and a 7-day collection phase. The rations were 90% silage and 10% supplement on a DM basis. All were formulated to 11.5% protein and met NRC requirements for vitamins and minerals. Between the two periods, the lambs were randomly reassigned to the silages.

Trial 2: 1987. Ten forage sorghum cultivars, one grain sorghum hybrid (DeKalb 42Y), and one corn hybrid (Pioneer 3183) were grown at the same field location and under similar practices as the cultivars in Trial 1. The forage sorghums included Pioneer 956 and 947, DeKalb FS-5 and 25E, PAG 455, Funk's G 102F, Golden Acres T-E Silomaker, NK 300, Cargill 200F, and Atlas. The corn plots were planted on May 6, and all sorghum plots were planted on June 3. All agronomic and silage data were collected by methods used in Trial 1. A voluntary intake and digestion trial was carried out following the same procedures as described in Trial 1; however, only the results from the first period are reported.

Results and Discussion

In both Trials the silages appeared to be well preserved, with no off odors or indications of clostridial fermentation. During the feed-out periods, there were no indications that the silages were deteriorating from exposure to air.

Results from Trial 1 are shown in Table 43.1. The grain sorghums consistently yielded less silage DM per acre than did the forage sorghums. However, the grain sorghums had higher crude protein values, voluntary intakes, and DM digestibilities. Within the grain sorghums, there were no statistical differences in voluntary intakes or digestibilities. This is not surprising, considering that commercial grain sorghum hybrids have been developed almost exclusively using a cytoplasmic male sterile system, with Milo cytoplasm and Kafir restoring genes. At the outset it was anticipated that substantial differences within the grain sorghum hybrids would be found because grain sorghum has not been ruthlessly selected for silage quality criteria. However, because of the consistency found in Trial 1, it was decided that only one grain sorghum would be included as a relative standard with the forage sorghum cultivars in Trial 2.

Results from Trial 2 are shown in Table 43.2 and are preliminary. Data from only one period of the digestion trial are available at this time. The corn silage had disappointingly low grain yield, silage yield, crude protein, and voluntary intake. These results support earlier research indicating that corn silage was superior to sorghum silage only when the environment favored corn production.

The grain sorghum silage in Trial 2 again had higher intake, digestibility, and crude protein than the forage sorghums. Within the forage sorghums, similar extensive variations was found in Trial 2 as had been observed in Trial 1, and the cultivars were influenced by year. The 1986 growing season favored early season cultivars, but 1987 favored late season hybrids. There were also substantial variations in silage quality traits between years. Within a cultivar, intake varied by as much as 30% between years, digestibility by as much as 13%, and protein by as much as 12.5 percent.

Considering the limitations of making and evaluating large numbers of silages, if agronomic traits could be used to predict subsequent silage quality of a cultivar, the selection process would be facilitated. Listed in Table 43.3 are correlations (linear associations) of agronomic traits and silage quality traits.

The results show intake to be negatively correlated (r = -.49) with plant height (i.e., as plant height decreases, intake increases). Dry matter digestibility was negatively correlated to both days to half bloom (r = -.39) and plant height (r = -.49). Crude protein content was negatively correlated with both days to half bloom r =-.51) and plant height (r = -.74). Results indicate that silage DM yield was not statistically correlated with silage quality traits. Hence, to select for improved silage quality, these data suggest starting with short, early season cultivars.

Table 43.1. Agronomic and Silage Quality Traits of the 12 Forage and Grain Sorghum Cultivars in Trial 1

Cultivar	Harvest Date	DHB[1]	Plant Height	Whole-plant[2]			Grain Yield[3]	Vol. Intake[4]	DM Dig.[5]
				DM Yield	DM	CP			
	1986		Inches	Ton/A.	%	%	Bu/A.		%
<u>Forage Sorghum</u>									
Canex	Aug. 20	57	108	5.5	25.3	7.8	51	66.5^{abcd}	58.7^{bcd}
Pioneer 956	Aug. 20	57	105	6.0	30.5	7.6	93	57.6^{cd}	58.0^{cd}
Pioneer 947	Sept. 4	61	108	7.3	34.4	7.4	105	61.5^{bcd}	58.6^{bcd}
DeKalb FS-5	Aug. 30	60	106	6.6	27.9	7.3	87	70.5^{ab}	57.7^{cd}
DeKalb 25E	Oct. 6	87	131	7.0	27.9	6.6	68	53.3^{c}	53.7^{e}
Silomaker	Oct. 6	85	112	8.2	30.0	7.4	98	55.9^{d}	52.3^{e}
Atlas	Sept. 4	64	103	6.9	27.5	7.2	52	54.4^{d}	56.8^{d}
<u>Grain Sorghum</u>									
Funk's G-522	Aug. 21	51	59	5.6	33.7	9.0	106	68.1^{abcd}	60.7^{ab}
Pioneer 8493	Aug. 21	51	54	5.2	35.1	9.8	99	69.5^{ab}	61.5^{ab}
NC + 174	Aug. 23	52	62	5.6	34.0	9.8	106	74.5^{ab}	61.4^{ab}
Asgrow Topaz	Aug. 26	53	55	5.5	33.6	9.2	113	72.0^{ab}	63.8^{a}
DeKalb 41Y	Aug. 29	55	51	5.7	33.6	9.2	110	72.5^{ab}	61.4^{ab}

[1] DHB = days to half bloom.

[2] DM = dry matter and CP = crude protein on a DM basis.

[3] Adjusted to 12.5% moisture.

[4] Voluntary intake expressed as grams of DM per kg of metabolic body weight $(kg^{.75})$.

[5] DM Dig. = dry matter digestibility.

[abcd] Means in a column with different superscripts differ ($P<.05$).

Table 43.2. Agronomic and Silage Quality Traits of the 12 Forage Sorghum, Grain Sorghum and Corn Cultivars in Trial 2

Cultivar	Harvest Date	DHB[1]	Plant Height	Whole-plant[2] DM Yield	Whole-plant[2] DM	Whole-plant[2] CP	Grain Yield[3]	Vol. Intake[4]	DM Dig.[5]
	1987		Inches	Ton/A	%	%	Bu/A.		%
Forage Sorghum									
Cargill 200F	Aug. 25	59	73	4.9	41.4	8.3	75	63.8	62.8
Pioneer 956	Aug. 25	58	77	4.5	38.1	8.6	72	64.1	56.5
Pioneer 947	Sept. 3	65	75	5.1	33.0	9.4	72	64.7	59.8
DeKalb FS-5	Aug. 28	61	77	4.8	29.4	8.3	69	66.1	59.0
DeKalb 25E	Sept.29	78	88	7.3	30.3	7.5	90	54.6	58.0
Silomaker	Sept 21	77	73	6.3	32.0	8.1	76	79.8	60.1
Atlas	Sept 2	66	73	4.3	27.0	7.9	35	60.9	58.8
Funk’s 102F	Sept 24	77	77	6.6	30.7	8.5	92	57.8	59.1
NK 300	Sept 19	71	59	6.0	34.1	8.4	92	72.6	60.8
PAG 455	Sept 24	77	65	7.0	33.4	7.7	94	71.8	59.0
Grain Sorghum									
DeKalb 42Y	Aug 28	59	41	3.8	37.2	9.7	78	74.8	63.9
Corn									
Pioneer 3183	Aug 7	--	81	4.7	35.4	7.7	66	58.0	67.5

[1] DHB = days to half bloom.

[2] DM = dry matter and CP = crude protein on a DM basis.

[3] Adjusted to 12.5% moisture.

[4] Voluntary intake expressed as grams of DM per kg of metabolic body weight ($kg^{.75}$).

[5] DM Dig.= dry matter digestibility.

[a b c d] Means in a column with different superscripts differ ($P<.05$).

Table 43.3. Linear Associations[1] of Agronomic and Silage Quality Traits in the Two Trials

Silage Trait	Agronomic Trait: Day to Half Bloom	Plant Height	Whole-plant DM Yield	Whole-plant DM	Whole-plant CP	Grain Yield
Voluntary Intake	NS	-. 49	NS	NS	NS	NS
DM Digestibility	-.39	-.49	NS	NS	NS	NS
CP Content	-.51	-.74	NS	NS	NS	NS

[1] Correlations significant at $P<.05$ and NS is not significant.

Selecting Forage Sorghum Cultivars for Silage

Jim White, Keith Bolsen,
Brett Kirch, and Lyle Pfaff

Summary

Eighty forage sorghum cultivars were compared in 1986 for agronomic and silage quality traits. Silage yield ranged from 5.3 to 10.0 tons (t) of dry matter (DM) per acre (mean, 7.4 t); grain yield, from 13 to 113 bushels (bu) per acre (mean, 66 bu). Percent lodging was extremely high, with a mean of 51% and only one cultivar free of lodging. Pre-ensiled DM content ranged from 22.2 to 35.4% (mean, 27.4%) and plant height from 85 to 180 inches (mean, 121 inches). Silage quality results showed that in vitro DM digestibility ranged from 44.6 to 62.1% (mean, 53%); crude protein from 4.5 to 8.2% (mean, 6.8%); neutral detergent fiber from 48.3 to 71.9% (mean, 58.4%); and acid detergent fiber from 27.1 to 49.8% (mean, 35.7%).

From the 80 cultivars in 1986, 60 were selected for the 1987 trial. When compared to 1986, the 1987 means showed slightly lower silage (7.0 t) and grain (63 bu) yields and much shorter plants (93 inches). Lodging scores were dramatically lower in 1987 (10%), and DM content was higher (29.1%). The year to year effect influenced all of the agronomic traits measured. The 1986 growing season favored the early maturing forage sorghums, whereas 1987 favored the late maturing cultivars.

Introduction

Results of a 1986 Kansas State University survey of sorghum seed dealers indicated that there were more than 100 forage sorghum cultivars available in Kansas.

Prior to the interest in hybrid sorghum in the late 1950's, nearly all commercially grown forage sorghum could be traced to less than 20 introductions. Improved cultivars have been developed from a rather narrow germplasm base, with 50 to 60% of the sorghum currently grown in the United States having similar germplasm. Although two forage sorghum cultivars might have similar germplasm and appearance, their value as silage crops could be distinctly different.

Often cultivar recommendations and/or selections are made primarily on the basis of agronomic traits (i.e., silage yield, lodging score). Although silage yield is an important criterion, it is only a part of the silage resource, and it may not be the most important. A producer could be most interested in maximum silage yield for over-wintering cows. However, for backgrounding cattle, a producer would be interested in the most economical feed cost per pound of gain and, thus, silage quality would also be an essential criterion. Choice of a forage sorghum cultivar should be based upon a number of traits, including yield potential of forage and grain, adaptation, handling and ensiling characteristics, and feeding value of the silage.

Within the forage sorghum complex there is tremendous biological variation. Our objective was to provide documentation for the agronomic and silage quality traits of many of the forage sorghum cultivars available in 1986 and 1987.

Experimental Procedures

Trial 1: 1986. From the available forage sorghum cultivars identified in the 1986 survey, 80 were selected for use in Trial 1. The selections represented a broad range of agronomic characteristics.

The cultivars were grown under dryland conditions on a silt loam soil near the Kansas State University campus in Manhattan. The plots were planted on June 4. One month earlier, 100 lb/acre of anhydrous ammonia was applied. A soil test indicated that phosphorus and potassium were adequate. Furdan 15G® insecticide was applied in the furrow at planting, and the following day Ramrod® was used as the pre-emergence herbicide. In July, Cygon 400® was used to control greenbugs.

The cultivars were randomly assigned in a block design, each with three replicates. Each plot was 30 ft long and four 30-inch rows wide. All grain-producing cultivars were harvested at the late-dough stage of kernel maturity. The sterile hybrids were harvested when the kernels in the unbagged heads reached the late-dough stage. Nonheading hybrids were harvested on the first frost date (Oct. 15). Before harvest, all plots were reduced to 20 ft in length, and one of the two inside rows was harvested with a modified one-row forage harvester to determine silage yield. The heads from the other inside row were hand-cut, dried, and threshed to measure grain yield. The chopped forage was ensiled in 5-gallon plastic laboratory silos. Silos were opened after 90 days, and samples taken for chemical analyses.

Agronomic data collected for each plot included days to half bloom, plant height, lodging score, silage yield, and grain yield. Silage quality traits measured for each plot included dry matter (DM), crude protein (CP), in vitro DM digestibility (IVDMD), neutral detergent fiber (NDF), and acid detergent fiber (ADF).

Trial 2: 1987. From the 80 cultivars used in Trial 1, 60 were selected to use in a similar study in 1987. The plots were planted six rows wide (rather than four) and silage yield was measured by harvesting two inside rows (rather than one). All agronomic and silage data were collected by the methods used in Trial 1.

Results and Discussion

Presented in Table 44.1 are the agronomic and silage quality results of Trial 1 and agronomic results of Trial 2. For certain categories, five cultivars are identified as being extreme high and low observations.

Trial 1: 1986. Silage DM yield ranged from 5.2 to 10.0 tons per acre, with an average of 7.4 tons. The cultivar with the highest yield was Funk's G 1990; the lowest was the variety, Ellis. Other high yielding cultivars were PAG 55F (9.9 t), Golden Harvest (GH) SI Gro 3 (9.6 t), Garrison Sile-all (9.3 t), and DeKalb FSla+ (9.2

t). Low yielding cultivars were Casterline Suline (6.0 t), Warner Sweet Bee Sterile (6.0 t), Ketgen KFS-2 (5.7 t), and Triumph SSll (5.6 t).

Grain yield (not determined for the 11 sterile or nonheading hybrids) ranged from 12 to 113 bu per acre, with an average of 66 bushels. The highest yielding cultivar was Golden Acres (GA)-TE Silomaker; the lowest was Northrup King (NK) Sucrosorgo 405. Other high yielding cultivars were Cargill 200F (106 bu), DeKalb FS-5 (92 bu), Pioneer 947 (89 bu), and Pioneer 927 (89 bu). Other low yielding cultivars were PAG 466 (35 bu), Oro Red Top Kandy (30 bu), and Hoegemeyer 615F (27 bu).

Days to half bloom ranged from 53 to 106, with an average of 71 days. The earliest cultivar was Buffalo Canex; the latest was NK Sucrosorgo 405. Five cultivars bloomed in 55 days or less, and five bloomed after 85 days. Lodging score ranged from 0 to 100%, with an average of 51 percent. Only one hybrid, McCurdy F65, did not have any lodged plants, whereas GA-TE Milkmaker, GA-TE Silomaker, and NK 326 were 100% lodged. Some plots (replicates) were so badly lodged that they were judged to be unharvestable (i e., rep 1 of Hoegemeyer 615F and rep 2 of Terra Ho-K). Plant height ranged from 85 to 180 inches, with an average of 121 inches. The shortest were DeKalb FSla+ and the variety, Rox Orange; the tallest was Pioneer 931. Other short cultivars were McCurdy XF65, NK 300, and PAG 455. Other tall cultivars were NK Sucrosorgo 405, Funk’s G 1990, Oro Red Top Kandy, and Sokota 320F. Pre-ensiled DM content ranged from 22.2 and 35.4%, with an average of 27.4 percent. The wettest cultiver was Hoegemeyer 615F; the driest was Asgrow H8551. Only seven cultivars contained over 30% DM, and nine contained under 25% DM at harvest.

In vitro DM disappearance ranged from 44.6 to 62.1%, with an average of 53 percent. The hybrid with the highest IVDMD was Cargill 250S (a sterile); the lowest was NK Sucrosorgo 405, which also had the lowest grain yield. Only two other cultivars were 60% digestible or above; Early Sumac and Buffalo Canex; 20 cultivars were less than 50% digestible. Crude protein ranged from 4.5 to 8.2%, with an average of 6.8 percent. The NDF fraction ranged from 48.3 to 71.9%, with an average of 58.4 percent. The ADF fraction ranged from 27.1 to 49.4%, with an average of 35.7 percent. Buffalo Canex had the lowest NDF and second lowest ADF, whereas Pioneer 931 had the highest NDF and ADF fractions.

Results from Trial 1 indicated that the late maturing, nonheading cultivars had the highest silage yields. However, these high yielding cultivars (i.e., Pioneer 931 and Funk’s G 1990) tended to have low IVDMD, low protein, and high fiber fractions.

Trial 2: 1987. Silage DM yield ranged from 4.2 to 10.2 tons per acre, with an average of 7.0 tons. The highest yielding cultivar was DeKalb 25E; the lowest was Pioneer 956. Other high yielding cultivars were Funk’s G 1990 (9.8 t), GH SI Gro 3 (9.5 t), Pioneer 931 (9.5 t), and Terra Ho-K (9.4 t). Low yielding cultivars were NK Sucrosorgo 301 (5.1 t), Early Sumac (5.0 t), PAG Mor-Cane (4.8 t), and Cargill 200F (4.6 t).

Grain yield ranged from 35 to 112 bushels per acre, with an average of 63 bushels. The highest yielding cultivar was McCurdy XF65; the lowest was the variety, Atlas. Other high grain-yielding cultivars were McCurdy F75A (102 bu), DeKalb 25E (100 bu), Garst 333 (100 bu), and PAG 55F (100 bu). Low grain-yielding cultivars were Rox Orange (55 bu), NC + 935 (54 bu), Warner 2 Way DR (50 bu), and GH SI Gro 2 (42 bu).

Days to half bloom ranged from 56 to 106 days, with an average of 73 days. The earliest cultivar was NK Sucrosorgo 301; the latest was NK Sucrosorgo 405. Five cultivars bloomed in 59 days or less, and five bloomed on or after 85 days. Lodging score ranged from 0 to 61%, with an average of 10 percent. Several cultivars had no lodged plants, including Atlas, DeKalb FS-5, Funk's G 1990, Keltgen KFS, McCurdy XF65, NK 300, PAG 455, Pioneer 947, and Pioneer 931. The cultivar with the most lodged plants was NK Sucrosorgo 301. Other badly lodged cultivars were Rox Orange (31%), Keltgen (KFS-1 (34%), Hoegemeyer 610F (39%), and Sokota 320F (43%). Plant height ranged from 67 to 143 inches with an average of 93 inches. The shortest was DeKalb FSla+; the tallest was Pioneer 931. Other short cultivars were NK 300, McCurdy XF65, Keltgen KFS-2, and PAG 55F. Tall cultivars were GH SI Gro 3, Oro Red Top Kandy, Funk's G 1990, and NK Sucrosorgo 405. Pre-ensiled DM content ranged from 24 to 34.8%, with an average of 29.2 percent. The wettest cultivar was PAG Mor-Cane; the driest was Cargill 200F. In contrast to Trial 1, 20 cultivars contained over 30% DM and only two contained under 25% DM at harvest.

Differences Between Years. The 1986 growing season favored early maturing forage sorghums, whereas 1987 favored the late maturing cultivars. In 1987, all cultivars tended to be a few days later in reaching half bloom; however, they matured to the late-dough stage and were harvested earlier than in 1986 (Table 44.2). The last harvest date in 1986 was October 15; in 1987 it was October 7. The average plant height in 1987 was over 2 ft shorter than in 1986 (93 vs. 121 inches). In 1986, the forage sorghums had higher averages for silage yield (7.4 vs. 7.0 t), grain yield (66 vs. 63 bu), and lodging score (51 vs. 10%).

Across years, the late maturing, nonheading cultivars tended to have the highest silage yields; however, they also tended to have the lowest IVDMD, lowest protein, and highest fiber fractions.

Table 44.1. Agronomic and Silage Quality Traits for the 80 Cultivars in Trial 1 and Agronomic Traits for the 60 Cultivars in Trial 2

Cultivar[2]	Days to Half Bloom		Plant Ht., Inches		Silage Yield, Tons DM/A.		Grain Yield, Bu/A.		Pre-ensiled DM, %		Lodging Score, %		Silage Quality Traits[1]			
													IVDMD, %	CP	NDF	ADF
														(% of Silage DM)		
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986			
Agripro 380F	56	60	116	91	7.7	6.2	78	67	27.6	28.5	14	18	59.0	5.7	54.4	31.3
Agripro 905F	79	85	133	104	7.5	7.2	56	74	26.2	32.4	90	8	51.9	6.1	56.4	37.3
Asgrow H8551	0	--	123	--	6.4	--	0	--	35.4	--	80	--	52.9	6.7	61.6	35.9
Atlas	65	64	115	90	6.8	6.0	36	35	26.7	28.8	9	0	54.0	7.0	54.7	32.8
Buffalo Canex	53	57	103	90	6.3	5.3	64	60	25.5	26.9	16	2	60.0	7.9	48.3	27.8
Cargill 200F	56	59	99	79	7.0	4.6	106	73	34.1	34.8	10	14	55.9	7.0	52.9	31.2
Cargill 250S	0	0	100	93	6.1	5.2	0	0	25.7	24.9	33	8	62.1	7.6	57.5	33.1
Cargill SS100	55	--	109	--	7.2	--	66	--	28.0	--	17	--	56.5	7.0	59.9	31.5
Cargill SS110	55	--	110	--	6.3	--	69	--	29.1	--	12	--	51.1	7.3	53.2	33.6
Casterline Silo Plus	80	82	137	102	7.3	7.0	52	78	25.7	32.3	67	7	49.4	5.5	60.1	39.8
Casterline SuCane	57	--	113	--	6.0	--	70	--	25.4	--	85	--	54.3	6.9	56.2	32.5
Casterline SuCane 2	61	62	99	75	6.8	5.7	83	65	27.8	26.8	81	4	55.9	6.0	51.3	28.7
DeKalb 25E	84	79	141	105	7.8	10.2	57	100	25.5	28.5	73	3	47.9	7.5	64.9	40.5
DeKalb FS-1a+	76	65	85	67	9.2	6.2	68	64	29.5	30.2	21	1	52.7	6.9	58.1	34.8
DeKalb FS-5	57	61	111	90	7.9	5.9	92	71	27.7	27.0	1	0	58.1	7.1	53.8	31.6
Early Sumac	58	60	90	79	6.5	5.0	51	57	28.5	26.0	40	16	61.4	7.4	51.1	27.9
Ellis	57	--	96	--	5.3	--	37	--	29.0	--	15	--	59.5	7.5	55.0	30.1
Fontanelle G-307	56	59	113	95	6.3	5.8	63	74	26.6	26.5	35	18	54.6	7.1	52.8	31.5
Funk's FP 4	56	60	111	79	7.0	5.6	68	65	26.7	28.2	8	17	49.8	8.0	56.8	35.2
Funk's G 102F	73	76	111	93	7.4	8.0	86	89	25.6	26.5	91	5	47.3	6.2	62.8	38.1
Funk's G 1990	0	0	161	141	10.0	9.8	0	0	29.6	28.5	4	0	45.8	4.7	66.5	46.2
Funk's 83F	55	--	115	--	6.9	--	49	--	26.3	--	49	--	52.1	8.2	57.2	35.8
GA T-E Goldmaker	0	0	111	93	6.9	6.0	0	0	25.7	27.4	11	9	56.0	7.3	60.3	37.0
GA T-E Milkmaker	85	--	138	--	6.7	--	24	--	23.9	--	100	--	48.2	5.8	62.2	41.7
GA T-E Silomaker	83	75	115	87	9.2	7.9	113	89	26.8	28.1	100	2	48.4	6.3	68.2	37.3
GA T-E Yieldmaker	82	87	108	97	7.9	8.0	75	82	25.6	28.9	99	5	49.7	6.8	62.2	40.6
GH Regro II	55	--	112	--	6.6	--	62	--	28.6	--	4	--	53.1	7.5	56.8	34.3
GH SI Gro 1	59	60	99	92	6.5	6.4	83	75	27.6	27.7	10	13	57.8	7.0	53.8	29.1
GH SI Gro 2	83	84	125	83	7.0	5.9	71	42	28.3	32.6	78	5	50.8	6.2	57.8	37.9
GH SI Gro 3	81	82	133	115	9.6	9.5	46	96	28.6	33.0	98	26	53.6	5.3	63.5	43.9
Garrison Sile-all	86	78	137	105	9.3	8.2	83	96	25.4	28.0	96	6	50.0	5.7	61.0	37.8
Garst 333	86	81	123	85	8.3	8.0	83	100	27.9	31.5	69	1	51.6	6.2	59.0	39.3
Grower's 1586F	81	81	108	100	7.5	8.6	72	70	28.5	27.0	84	15	47.6	5.9	64.9	40.6
Hoegemeyer 610F	55	58	108	92	6.7	6.0	77	73	24.9	27.9	79	39	55.6	8.0	58.5	30.4
Hoegemeyer 612F	0	0	104	87	6.6	5.4	0	0	26.6	26.9	5	2	54.6	7.5	60.2	35.5
Hoegemeyer 615F	81	--	124	--	7.3	--	27	--	22.2	--	97	--	45.1	5.1	63.6	39.5
Hoegemeyer 618F	87	77	140	107	8.6	8.4	58	80	27.2	26.7	95	28	50.4	4.8	39.2	37.7
Horizon F12	58	61	111	90	7.7	5.5	81	63	28.8	28.8	19	2	--	7.7	50.3	28.0
Keltgen KFS	80	76	120	83	7.5	7.0	64	63	27.8	28.5	77	0	45.8	6.0	59.7	40.0
Keltgen KFS1	55	57	112	101	7.0	6.5	87	83	26.7	29.7	71	34	53.6	7.0	56.2	32.7
Keltgen KFS2	0	--	103	--	5.7	--	0	--	26.5	--	12	--	55.3	6.2	56.5	35.3
McCurdy F75A	82	73	113	97	8.3	8.0	84	102	27.4	28.3	93	9	51.4	6.3	64.6	40.9
McCurdy F65	80	69	86	69	7.1	7.5	82	112	29.2	32.6	0	0	47.8	7.2	54.9	35.4
McCurdy F69	87	84	121	86	7.7	5.9	71	57	29.0	30.2	66	3	52.1	5.1	58.9	37.4
McCurdy F79	81	--	135	--	7.4	--	36	--	27.5	--	92	--	51.3	5.9	59.6	39.8
NB 305F	59	60	102	85	8.0	7.0	79	83	28.5	30.9	5	7	59.4	7.1	50.0	29.4
NC+ 935	60	63	117	97	7.9	6.1	81	54	27.8	25.9	78	1	57.9	6.3	55.2	33.0
NC+ 965	78	--	137	--	8.5	--	66	--	27.0	--	79	--	--	--	--	--
NK 300	81	71	86	68	8.0	7.0	82	79	30.9	32.2	2	0	46.2	6.3	64.7	37.4
NK 326	77	--	120	--	6.7	--	43	--	24.9	--	100	--	57.4	5.1	61.2	39.6
NK Sucrosorgo 301	53	56	108	92	6.3	5.1	76	81	25.6	29.7	58	61	56.5	7.2	57.6	29.7
NK Sucrosorgo 405	106	106	169	141	7.0	8.8	0	0	28.1	29.1	40	1	44.6	5.1	65.7	42.3
Oro Kandy Kane	58	61	102	89	7.5	6.5	71	73	28.1	29.4	19	6	61.8	7.2	50.8	28.1
Oro Red Top Kandy	84	83	148	119	7.0	7.6	30	76	24.0	29.1	86	1	51.8	6.1	62.6	40.8
PAG 55F	82	84	112	75	9.9	8.9	74	100	28.9	33.8	49	3	51.9	8.1	56.2	37.0
PAG 455	84	77	95	78	8.6	7.8	87	78	27.6	29.9	64	0	45.7	6.9	63.7	37.6
PAG 466	86	--	142	--	7.6	--	35	--	26.9	--	84	--	49.7	6.6	61.2	40.4
PAG Mor-Cane	0	0	101	84	6.2	4.8	0	0	25.3	24.0	11	13	58.2	7.7	54.0	32.2
Pioneer 927	83	84	105	78	8.9	6.3	89	62	26.8	31.8	78	14	53.5	6.2	60.8	37.6
Pioneer 931	0	0	180	144	8.9	9.5	0	0	31.4	33.2	24	0	45.5	5.0	71.9	49.4
Pioneer 947	59	63	116	85	7.6	6.4	89	68	34.4	33.7	28	0	57.2	8.0	50.4	29.0
Pioneer 956	55	59	99	83	6.3	4.2	86	69	30.9	32.7	70	17	60.0	7.2	57.7	31.0
Rox Orange	58	60	85	79	6.4	5.5	72	55	27.6	26.8	21	31	57.5	7.0	52.9	27.1
Seed Tech Hi-Ton	61	62	115	98	6.8	6.8	67	59	28.2	30.2	27	5	57.7	7.3	54.1	30.3
Seed Tech Hi-Energy2	80	80	108	107	7.5	8.8	55	62	26.9	29.9	32	8	50.1	5.9	55.4	38.1
Sokota 320F	93	89	146	103	8.0	7.4	61	66	25.1	30.7	92	43	46.9	5.1	56.8	39.8
Sokota 325F	80	83	145	110	8.3	9.2	55	65	27.0	28.7	77	6	49.3	6.2	52.2	34.8
Sokota 330F	0	--	101	--	6.2	--	0	--	24.5	--	26	--	57.2	7.4	57.7	35.2
Stauffer 333F	79	79	137	97	8.0	7.7	68	70	27.6	33.4	78	4	52.7	6.3	54.8	37.2
Sugar Drip	67	--	118	--	6.7	--	45	--	25.0	--	87	--	54.5	7.2	57.7	36.2
Terra HO-K	84	78	145	104	8.3	9.4	44	65	27.3	28.9	56	3	50.5	4.5	62.0	39.5
Terra Sterile Honey	0	--	102	--	6.0	--	0	--	24.8	--	4	--	57.6	7.3	57.7	34.6
Triumph SS11	55	--	100	--	5.6	--	--	--	27.4	--	32	--	51.0	7.7	61.1	35.4
Triumph Supersile 20	79	76	137	110	8.5	7.9	58	66	27.2	28.2	43	11	49.3	5.4	65.1	39.8
Triumph Supersile 10	56	--	108	--	6.3	--	37	--	27.7	--	7	--	55.1	7.2	59.5	33.6
Warner 2-WayDR	81	76	123	107	8.3	7.8	80	50	28.1	25.3	74	8	50.0	5.8	65.9	37.4
Warner Sweet Bee	57	76	119	89	6.4	5.3	78	75	24.9	25.3	74	3	55.6	6.2	53.8	32.0
Warner Sweet Bee Ster.	0	0	107	90	6.0	5.5	0	0	23.3	25.1	28	1	55.8	6.9	60.1	37.5
Wilson Forage King	80	75	119	83	8.6	8.7	85	100	27.7	30.7	96	5	51.0	5.8	66.7	38.6
Wilson Green SuS	55	--	127	--	7.1	--	66	--	31.0	---	12	--	51.2	7.3	60.9	37.4

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[1] IVDMD = in vitro dry matter digestibility, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[2] GA = Golden Acres, GH = Golden Harvest, NK = Northrup King.

Table 44.2. Minimum, Maximum, Mean, and Standard Deviation for the Data in Trials 1 and 2

Item	Days to Half Bloom		Plant Ht., Inches		Silage Yield, Tons DM/A		Grain Yield, Bu/A.		Pre-ensiled DM, %		Lodging Score, %		Silage Quality Traits[1] IVDMD, %	CP (% of Silage DM)	NDF (% of Silage DM)	ADF (% of Silage DM)
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	- - - - 1 9 8 6 - - -		
Minimum	53	56	85	67	5.3	4.1	13	35	22.2	24.0	0	0	44.6	4.5	48.3	27.1
Maximum	106	106	180	143	10.0	10.2	113	112	35.4	34.8	100	61	62.1	8.2	71.9	49.4
Mean	71	73	121	93	7.4	7.0	66	63	27.4	29.2	51	10	53.0	6.8	58.4	35.7
Std. Dev.	14	12	17	17	1.0	1.5	20	29	2.0	2.5	35	12	4.4	1.6	4.8	4.5

[1] IVDMD = in vitro dry matter digestibility, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

Small experimental forage harvester used for harvesting forage plots and measuring their production.

Evaluation of Interseeded Grain Sorghum and Soybeans as a Silage Crop

**Salah H.M. Esmail, Keith Bolsen,
Seyed Azimi, and John Shirley**

Summary

Interseeded grain sorghum and soybeans were harvested at late-boot, milk, and late-dough maturity stages of the sorghum (62, 77, and 91 days post-planting, respectively). Maximum dry matter yield occurred at the late-dough stage and interseeded silages had higher crude protein contents than the control, late-dough, grain sorghum silage. All silages underwent normal homolactic fermentations and were well preserved. Cellulose and acid detergent fiber contents were also higher in the mixtures than in the control silage, but fiber values decreased as maturity advanced. Digestibilities of most nutrients were similar in the rations, but when considered with chemical composition and yield data, late-dough harvest maximized utilization of the interseeded sorghum-soybean silage. Response to the silage inoculant Biomate® was determined in laboratory silos, and the greatest benefit occurred in the milk stage silage. Cattle fed the late-dough stage grain sorghum control silage had faster ($P<.05$) gains and higher intakes than those fed the late-dough sorghum-soybean silage. Adding grain improved gain and intake only for cattle fed the interseeded silage. In a subsequent trial, seeding grain sorghum and soybeans in alternating 15-inch rows increased the proportion of soybean plants and crude protein in the mixture at the late-dough harvest, with similar dry matter yields.

Introduction

Interseeded combinations of grain sorghum and soybeans have been used as silage for dairy and beef cattle for many years. More recently, this practice has received attention because of favorable economic factors.

Under good management, selected hybrids of grain sorghum and soybeans have produced as much dry matter (DM) per acre as corn silage. Since the silage is higher in protein and minerals, less supplement is needed to balance rations.

Further studies involving digestibility and animal performance at various stages of maturity are needed to ascertain the best time to harvest the interseeded silage crop.

Experimental Procedures

Trial 1: 1986-87. Field plots were established near the KSU Beef Research Unit. Grain sorghum and soybeans were interseeded in four replications on May 22, 1986, by a grain drill with 6-inch row spacing. Planting rates were 18 lb of DeKalb 41Y grain sorghum and 95 lb of Pershing soybeans per acre. Plots of DeKalb 41Y were also established, using a 30-inch row planter and a 5.5 lb per acre seeding rate.

Anhydrous ammonia at 90 lb per acre was followed by 80 lbs of ammonium phosphate per acre. Lasso® herbicide was applied at .53 liters diluted in 12.4 liters of water per acre.

At each harvest (grain sorghum at late-boot, milk, and late-dough kernel maturities), the mixture was cut with a swather conditioner, wilted to approximately 30% DM, and chopped with a Field Queen forage harvester. The DeKalb 41Y control silage was direct-cut in the late-dough stage. Prior to each harvest, the ratio of grain sorghum to soybean plants was estimated by the square meter quadrant technique. The quadrant was randomly assigned to three locations in each replication. Both crops within the quadrant were cut, separated, placed into large paper bags, and dried at 48 to 50 C. The dried crops were then ground for chemical analyses.

About 4.5 to 5.0 tons of material from each harvest were inoculated with Biomate® silage inoculant and ensiled in 3.9 x 3.9 x 7.8 ft rectangular, plastic lined, pilot silos (three silos per treatment) and stored for 3 months. Eight individually penned Angus and Angus x Hereford heifers were assigned to each silage to determine voluntary intakes and nutrient digestibilities. Chromic oxide was included in each ration at about 20 grams/head/day as a non-digestible marker. There was a 12-day adaptation period followed by a 7-day fecal collection period. Supplements (12.4% of the ration on a DM basis) were fed to balance for crude protein, calcium, and phosphorus. Silages and supplements were fed ad lib twice daily during the first 9 days of the adaptation period, then fed at 90% of the ad lib intake until the end of the trial. Fecal samples were collected twice daily. Composite feed and fecal samples were made for each heifer to obtain apparent digestibility values for DM, crude protein, starch, acid detergent fiber (ADF), and cellulose.

Silage fermentation responses of each of the four silages to Biomate were determined using PVC laboratory silos by procedures described on page 137 of this report. Three silos per treatment were opened at 10, 20, and 40 hours and 4, 14, and 90 days post-filling. At each opening, samples were taken for the measurement of pH, lactic acid, volatile fatty acids, ethanol, and ammonia-nitrogen.

Trial 2: 1986-87. On May 23, an additional 20 acres of the grain sorghum and soybean mixture and 10 acres of DeKalb 41Y were seeded. Each was harvested when the sorghum kernels reached the late-dough stage. The mixture was wilted for approximately 24 hours to 46 to 48 % DM and ensiled in a 14 x 40 ft Harvestore®; the DeKalb 41Y was direct-cut at 42 to 44 % DM and ensiled in an AgBag®. Each silage was full-fed, with or without an additional 25% dry-rolled grain sorghum, to 16 crossbred steer and heifer calves with an initial avg. wt. of 563 pounds. The four rations and other procedures for the 80-day growing trial are described on page 168 of this report.

Trial 3: 1987-88. Field plots were planted in four replications on June 1, 1987. Grain sorghum and soybeans were interseeded in alternate rows with a 15-inch row spacing (Figure 45.1). The mixture was harvested at the late-dough stage of the grain sorghum. The three other treatments were drilled sorghum-soybeans harvested in either the milk or late-dough stages, and the control grain sorghum. Planting rates, fertilizer, and herbicide were similar to those in Trial 1. Procedures for harvesting, ensiling, and estimating the grain sorghum to soybean ratios were the same as those used in Trial 1.

Results and Discussion

Trial 1. Effects of the stage of maturity at harvest on DM yield and chemical composition of the four pre-ensiled crops are shown in Table 45.1. As maturity advanced, the DM yield of the mixture increased and the ratio of grain sorghum to soybeans decreased. Protein content was higher at all stages of maturity in the mixture than in the control grain sorghum ($P<.05$). There was also a slight but nonsignificant decrease in protein content from the late-boot stage through the late-dough stage. This decrease does not correlate well with the increase in the ratio of soybean plants to grain sorghum plants as maturity advanced. It should be noted that the sorghum plants severly shaded the soybeans. Cellulose and ADF contents decreased ($P<.05$) as maturity advanced. Grain sorghum silage had the lowest ADF and cellulose content. Lignin content was higher in the mixture silages, particularly at the milk stage of the grain sorghum.

Table 45.2 shows the effects of the stage of maturity on the composition and fermentation characteristics of the silages. Generally, the silages made at all stages of maturity were well preserved. Lactic acid was predominant, and the pH values were normal. Lactic acid contents were higher ($P<.05$) in the sorghum-soybean silages than in the control grain sorghum silage. Acetic acid and ammonia contents also differed but were within the range found in normal silages. Silage composition values were in accordance with those obtained on the pre-ensiled crops.

Voluntary intakes and apparent nutrient digestibilities are shown in Table 45.3. Digestibility of DM, CP, and cellulose were not affected by the stage of maturity. Further, digestibilities of these nutrients were all similar to those in the grain sorghum silage. Starch and ADF digestibilities decreased as the maturity advanced, and were lowest for the grain sorghum silage. However, digestibility did not differ significantly from the late-boot to the milk stage for starch, and from the milk stage to the late-dough stage for ADF. The amounts of digestible nutrients per acre are also shown in Table 45.3. The amount of digestible DM was significantly higher at the late-dough stage as compared to all the other treatments. The amount of digestible crude protein did not differ at the late-boot, milk, or late-dough stages, but was significantly greater in the sorghum-soybean silage than in the control sorghum silage. Considering the increase in digestible dry matter, harvest at the late-dough stage appears to provide for maximum utilization of the sorghum-soybean mixture.

Response of sorghum-soybean silages at different maturity stages to the inoculant is shown in Table 45.4. The inoculant increased the rate of pH drop ($P<.05$) over the control silage only during the first 4 days post-filling. This response was greater for the milk stage than for the other silages. Lactic acid also differed among the four silages ($P<.05$) and also greater for the milk stage sorghum-soybean silage. Increased lactic acid production, however, was a function of both maturity and time post-filling rather than just the inoculant. It may have been due to the greater amount of water soluble carbohydrates and lactic acid bacteria in the fresh crop at the milk stage (Table 45.1).

Trial 2. Chemical composition and fermentation characteristics of the sorghum-soybean and grain sorghum silages are shown in Table 45.5. Although values for most of the fermentation characteristics differed ($P<.05$), all were within the range expected for well-preserved silages.

Dry matter intake was greater ($P<.05$) for the two grain sorghum silage rations than for the two sorghum-soybean rations. Cattle fed the mixture silage without grain made the slowest ($P<.05$) gains, but feed conversions were similar for the two silages. When considered with DM yield in Trial 1 (13,130 lb/acre for sorghum-soybean silage and 11,400 lb/acre for grain sorghum silage), gain per acre was 139 lb higher for the sorghum-soybean silage than for the grain sorghum silage.

Adding grain increased ($P<.05$) gain and intake of cattle fed the sorghum-soybean silage but not of cattle fed the grain sorghum silage. Feed efficiency was not affected by the grain addition in either silage.

Trial 3. Shown in Table 45.6. are DM yield and crude protein contents of the crops that were ensiled in Trial 3. When grain sorghum and soybeans were interseeded in alternate 15-inch rows, DM yield, crude protein content, and proportion of soybeans increased as compared with the drilled mixture. Planting in alternate rows likely minimized the shading effect of sorghum plants on soybeans.

Figure 45.1. Grain Sorghum and Soybeans Planted in Alternate 15-inch Rows

Table 45.1. Yield and Pre-ensiled Chemical Composition of the Sorghum-Soybean and Grain Sorghum Forages in Trial 1

	Sorghum-Soybean			
Item	Late-boot	Milk	Late-dough	Grain Sorghum
Harvest Date, 1986	July 23	Aug. 7	Aug. 21	Sept. 10
Dry Matter, %	30.8	28.0	30.4	35.4
DM Yield, lb/Acre	10,820	11,490	13,130	11,400
Sorghum : Soybean Whole-plant Ratio	4.9:1	3.5:1	3.4:1	---
	--------------------% of the Forage DM------------------			
Crude Protein	14.14	13.60	13.05	9.23
Water Soluble Carbohydrate	6.3	9.5	5.1	4.3
Starch	5.0	6.2	9.4	33.4
Lactic Acid Bacteria, Colony-forming units/ gram	$6.9\text{x}10^4$	$8.6\text{x}10^4$	$4.8\text{x}10^4$	$1.8\text{x}10^4$

Table 45.2. Chemical Composition and Fermentation Characteristics of the Four Silages in Trial 1

	Sorghum-Soybean			
Item	Late-boot	Milk	Late-dough	Grain Sorghum
Dry Matter, %	29.6^b	26.7^c	27.8^c	34.5^a
pH	4.23^b	4.00^d	4.30^a	4.09^c
	-----------------% of the Silage DM-----------------------			
Crude Protein	13.67^a	14.05^a	13.98^a	9.70^b
Cellulose	28.4^a	24.9^b	24.5^b	16.7^c
Acid Detergent Fiber	37.6^a	33.5^b	35.0^b	24.8^c
Lactic Acid	6.30^b	8.27^a	8.24^a	5.52^c
Acetic Acid	1.83^c	2.25^b	3.48^a	1.40^d
Ammonia-N	$.18^b$	$.17^b$	$.28^a$	$.12^c$
DM Recovery, % of the DM Ensiled	97.5	87.0	87.0	92.8

^{abc}Means on the same line with different superscripts differ (P<.05).

Table 45.3. Voluntary Intake and Apparent Nutrient Digestibilities of the Four Silage Rations and Yield of Digestible Nutrients per Acre in Trial 1

Item	Sorghum-Soybean Late-boot	Sorghum-Soybean Milk	Sorghum-Soybean Late-dough	Grain Sorghum
No. of Heifers	8	8	8	8
Initial Wt., lb	703	701	704	704
Daily DM Intake, lb	12.06^{b}	11.57^{b}	12.31^{b}	15.51^{a}
	---Digestibility, %---			
Dry Matter	66.5	68.4	65.9	65.5
Crude protein	68.9	71.3	67.5	66.3
Starch	93.7	90.9	88.1	74.2
Acid Detergent Fiber	58.2	54.8	50.1	52.3
Cellulose	69.0	67.6	62.9	65.2
	---lb per Acre---			
Digestible DM	7,090	7,695	8,665	7,110
Digestible CP	1,055	1,250	1,156	698
Ruminal pH[1]	7.2^{a}	7.1^{a}	7.2^{a}	6.9^{b}

[ab] Means on the same line with different superscripts differ ($P<.05$).

[1] Means of five measurements taken at 1, 2, 4, 6, and 12 hours post-feeding.

Table 45.4. pH and Lactic Acid Content over Time for the Control and Inoculated Silages in Trial 1

		Sorghum-Soybean							
		Late-boot		Milk		Late-dough		Grain Sorghum	
Time Post- filling		Control	Biomate	Control	Biomate	Control	Biomate	Control	Biomate
Hour 10:	pH	5.53	5.33	5.01	4.86	4.94	4.94	4.86	4.70
	Lactic Acid[1]	.63	.59	1.60	1.95	1.38	1.34	.58	.55
Hour 20:	pH	4.52	4.34	4.40	4.18	4.43	4.40	4.52	4.44
	Lactic Acid	1.24	2.14	3.81	4.52	3.14	3.44	1.35	1.50
Hour 40:	pH	4.50	4.25	4.39	4.04	4.21	4.22	4.28	4.24
	Lactic Acid	3.17	3.91	4.89	7.26	5.44	5.48	2.88	2.67
Day 4:	pH	4.28	4.10	4.12	3.89	4.11	4.14	4.16	4.16
	Lactic Acid	4.57	5.69	6.36	9.22	6.08	5.72	4.07	3.76
Day 14:	pH	4.19	4.10	3.95	3.87	4.04	4.05	4.05	4.05
	Lactic Acid	5.65	6.18	7.34	6.51	7.59	6.86	---	---
Day 90:	pH	4.18	4.07	3.88	3.88	4.15	4.18	4.03	4.04
	Lactic Acid	6.36	6.68	10.59	8.42	6.93	6.87	6.95	6.57

[1] Values are as a % of the silage dry matter.

Table 45.5. Performance by Calves Fed the Four Silage Rations in Trial 2

Item	Sorghum-Soybean[1]		Grain Sorghum[1]	
	w/o	w	w/o	w
No. of Calves	8	8	8	8
Initial Wt., lb	563	563	563	563
Final Wt., lb	699	729	727	752
Avg. Daily Gain, lb	1.70^b	2.08^a	2.13^a	2.28^a
Daily Feed Intake, lb[2]	14.8^c	17.5^b	19.8^a	19.3^a
Feed/lb of Gain, lb[2]	8.74	8.45	9.29	8.56
Silage Analyses:				
DM, %	46.6		42.7	
pH	4.61		4.16	
	--------------------% of the Silage DM--------------------			
Crude Protein	9.1		8.8	
Lactic Acid	5.77		4.46	
Acetic Acid	2.52		1.57	
Ethanol	.20		.39	
Ammonia-N	.31		.10	
Acid Detergent Fiber	36.4		23.6	

[abc] Means on the same line with different superscripts differ ($P<.05$).

[1] w/o = 87.6% silage and 12.4% supplement; w = 62.6% silage, 25.0% dry-rolled grain sorghum, and 12.4% supplement.

[2] 100% dry matter basis.

Table 45.6. Yield, Protein Content, and the Grain Sorghum to Soybean Whole-Plant Ratio in Trial 3

Item	Sorghum-Soybean			Grain Sorghum
	Milk (drilled)	Late-dough (drilled)	Late-dough (15" rows)	
DM Yield, lb/Acre	7,475	8,045	8,955	9,865
Crude Protein, % of the DM	12.8	11.8	16.9	10.4
Sorghum: Soybean Whole-plant Ratio	3.1:1	5.3:1	2.2:1	---

Yield, Chemical Composition, and Feeding Value of Winter Cereal Silages and Hays: A 3 Year Study[1]

Seyed Azimi, Keith Bolsen, Ahmed Laytimi,
Salah H.M. Esmail, Jim Hoover, and Q.K. Ye[2]

Summary

Three trials were conducted to compare silage and hay yields and feeding values of winter cereal forages harvested in the boot and dough stages of maturity. Included were triticale; common rye; Kanby barley; and Centurk, Arkan, and Bounty 205 wheats. As expected, forage dry matter (DM) yields were higher at the dough stage than boot stage, and silage yields tended to be higher than those for hay. In Trials 1 (1983-84) and 2 (1985-86), wheat and triticale had similar forage yields, and in Trials 2 and 3 (1986-87), barley and rye forage yields were lower than wheat yields. In all three years, wet weather conditions made hay-making difficult.

In Trial 1, cattle performance from dough stage wheat (Centurk) and triticale, both silages and hays, was very poor, with daily gains from .9 to 1.2 lb and DM intakes below 2.0% of body weight. Triticale and Centurk wheat forages were high in fiber, and their dough silages had low intakes and digestibilities. Digestion trial results indicated that Arkan and Bounty wheats, Kanby barley, and rye generally had higher feeding values at the boot stage than at the dough stage, and that how well the silage or hay was preserved was a major factor influencing final feeding values.

Introduction

In the 1970's, our research showed the potential and possible limitations of whole-plant wheat, barley, and oat silages for growing cattle (KAES, Bulletin 613R). In the fall of 1983, a series of studies was begun to further document the effect of stage of maturity on yield and nutritive value of winter cereals. At that point,we introduced triticale and common rye into the comparisons, and included both silage and hay as methods of forage conservation.

Experimental Procedures

Trial 1: 1983-84. Triticale (Jenkins) and hard red winter wheat (Centurk 78) were sown in the fall of 1983 (approximately 15 acres per crop). Each crop was harvested from a single plot for both silage and hay in the boot and soft-dough stages of maturity, except that rainy weather prevented the successful baling of the triticale boot hay.

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[1] Triticale for Trials 1 and 2, and partial financial assistance were provided by Arco Seed Company, Woodland, California.

[2] Visiting researcher from the Agriculture University, Beijing, Peoples Republic of China.

The boot forages were field-wilted to about 65 to 70% moisture prior to ensiling; the soft-dough forages were direct-cut at about 65% moisture. All silages were made in 55-gallon capacity, plastic lined, pilot silos; the dough silages were also made in 10 x 50 ft concrete stave silos and in large round bales (balage: 1,200 lb avg. wt.). All hays were baled in conventional (60 to 80 lb) and large round (700 to 800 lb) bales, except the triticale hay, which was made in round bales only. Dry matter yield was determined for each crop at each harvest.

The control, whole-plant, irrigated corn (Pioneer 3183), was harvested in the early-dent stage and contained about 67% moisture. It was ensiled in a 10 x 50 ft concrete stave silo.

The stave silos were opened on November 15, 1984 and emptied at a uniform rate over a 13-week period. Samples of silages and hay were taken twice weekly and all bale silages were core-sampled prior to feeding.

Twenty-four crossbred wether lambs (avg. wt., 101 lb) were allotted by weight to the following six hays and silages in a two-period, voluntary intake and digestion study: wheat boot stage hay (1) and silage (2); wheat dough stage hay (3) and silage (4); triticale boot stage silage (5); and triticale dough stage silage (6). The wheat hays were in conventional bales and were ground prior to feeding. The silages were from the pilot silos. There were four lambs per forage in each period, which consisted of 10-day forage adaptation, 5-day voluntary intake, 2-day forage intake adjustment, and 7-day fecal collection phases. During the intake adjustment and collection phases, all lamb received 90% of their previously established ad libitum intake. At the end of period one, all lambs were weighed and randomly reassigned to the six forages. All rations were 82.5% of the appropriate forage, 2.5% cane molasses, and 15% supplement on a dry matter (DM) basis. Liquid molasses was mixed with the hays prior to feeding and dry molasses was added to the supplements for the silage rations. All rations were formulated to 11.5% crude protein (CP); .5% calcium; .35 phosphorus; and supplied equal amounts of trace minerals, vitamins (A, D, and E), and aureomycin (20 mg/per/lamb day).

The stave silo wheat and triticale dough silages, large round bale wheat and triticale dough hays, balage, and corn silage were each fed to steer and heifer calves (472 lb initial wt.) in four pens for four calves per forage. The 84-day growing trial began on November 16, 1984. Silages and hays were full-fed and all calves received 2.0 lb of supplement daily. Rations were formulated to provide 12.25% crude protein (DM basis); 200 mg of Rumensin® per calf daily; and required amounts of calcium, phosphorus, and vitanins A, D, and E. Supplements were top-dressed and partially mixed with the silage or hay in the bunk. Supplement for the calves fed balage was premixed twice daily with 8.0 lb of wheat silage per pen prior to feeding.

Balage was fed free-choice and the bales were cut in half before they were placed in the feed bunks. The hays were stored outside and tub-ground prior to feeding. Feed offered was recorded daily for each pen, and the quantity of forage fed was adjusted daily to assure that fresh feed was always available. Feed not consumed was removed, weighed, and discarded every 7 days or as necessary. All calves were weighed individually on 2 consecutive days at the start and at the end of the trial. Intermediate weights were taken at 28 and 56 days. Because the balage was in short supply, it was fed for the first 56 days only.

Trial 2: 1985-86. Winter cereals compared were hard red winter wheats (Arkan and Cargill Bounty 205), Kanby barley, and triticale (Trical®). The cereals were all seeded in three replicated plots, which strengthened the yield data over that collected in Trial 1. Silages and hays were harvested by procedures similar to those in Trial 1, but rainy weather in May made baling the boot stage hays impossible and harvesting of the silages at the intended DM content (30 to 35%) difficult. None of the dough stage hays received more than .25 inches of rainfall between cutting and baling.

Thirty-six wether lambs were allotted by weight to the 12 forages in a two-period, voluntary intake and digestion study. All rations were 90% forage and 10% supplement on a DM basis and formulated to a minimum of 11% crude protein; all supplied NRC required amounts of minerals and vitamins. All other procedures were similar to those described in the digestion study in Trial 1.

Trial 3: 1986-87. Winter cereals compared were Arkan and Bounty 205 wheats, Kanby barley, and common rye. The cereals were all seeded in four replicated plots. Silages and hays were harvested by procedures similar to those in Trial 1, but rainy weather in late May and early June made baling the Arkan and Kanby hays impossible. Forty-two wether lambs were used in a two-period, voluntary intake and digestion study with the 14 forages fed in 90% forage and 10% supplement rations. All other procedures were similar to those described in the digestion study in Trial 1.

Results and Discussion

Trial 1: Cattle Growing Study. Performance by cattle fed the six rations in Trial 1 are presented in Table 46.1. All five winter cereals resulted in very poor performance throughout the feeding period. Cattle fed corn silage made excellent gains overall (2.29 lb/day) and significantly out-performed those fed wheat or triticale. In general, there was little difference in feeding value among the five winter cereals. Wheat silage and balage supported similar gains for the first 56 days. The poorer efficiency of cattle fed balage reflects higher feed refusals, since only 71% of each bale was consumed, on average. Overall DM intakes were extremely low, ranging from 1.75% of body wt. for cattle fed wheat and triticale silages to 2.0% for those fed wheat hay.

Chemical analyses of the six silages and hays fed in the cattle study are shown in Table 46.2. All five winter cereals had very high acid detergent fiber (ADF) contents and low crude protein (CP) values. The triticale had very poor grain development, and the kernels never reached full size. As a result, the triticale might have been a few days beyond the "dough stage" when swathed for silage and hay. The wheat kernels developed normally and the crop did not appear to be past the mid-dough stage when swathed. These poor results, particularly with the Centurk wheat, were completely unexpected, since our research in the 1970's indicated much higher feeding values for dough silages (KAES, Bulletin 613R).

Trial 1: Lamb Digestion Study. Summarized in Table 46.3 are results of the digestion study in Trial 1. Boot stage silages and hays had higher (P<.05) voluntary intakes (about 24%) and higher ($P<.05$) digestibility for all nutrients (except protein) when compared with the dough stage forages. Triticale forages yielded feeding values similar to wheat, and silage had feeding values similar to hay. Forage DM yields for the boot stage silages were somewhat lower than expected for both triticale and wheat. Yields for dough stage silages were acceptable; the equivalent of 9 to 10 tons of 67% moisture silage per acre.

All four silages in the digestion study were well preserved and had lactic and acetic acid, ethanol, and ammonia-nitrogen contents within a normal range. The wheat hays had slightly lower CP and higher ADF values than their silage counterparts.

Trial 2. Summarized in Table 46.4. are results from Trial 2. Forage DM yield for all four cereals was lower at the boot than dough stage, and at the dough stage, yields were higher for the silages than for hays. Triticale had the highest boot stage yield; and barley had the lowest. Arkan and Bounty 205 wheats had the highest dough stage yields.

In the digestion study, boot stage triticale and Bounty 205 silages supported higher intakes than dough silages, and intakes of dough stage hays were lower than those of dough silages for all four cereals. The DM digestibilities for triticale and the two wheats were highest for the boot stage silages, but DM digestibility of the barley silages was not affected by stage of maturity. Dough stage hays tended to have lower DM and CP digestibilities than their silage counterparts, except for Arkan. Triticale consistently had lower DM, CP, and NDF digestibilities than the two wheats or barley.

As expected, all dough stage silages and hays had lower CP values than boot stage silages. Triticale forages had the highest ADF content, and Arkan wheat and barley forages had slightly lower ADF values than Bounty 205. Silage fermentation results showed that the dough stage silages were more efficiently preserved than their boot stage counterparts, with dough silages having lower pH, ethanol, and ammonia-nitrogen values and higher lactic acid contents. All four boot stage silages had a high pH (ranging from 4.7 to 5.5) and a very high ammonia-nitrogen content (ranging from 22 to 38% of the total nitrogen).

Trial 3. Summarized in Table 46.5 are results from Trial 3. Forage DM yield for all four cereals was lower at the boot stage vs. the dough, and boot stage hay had a lower yield than boot stage silage, except for the barley. Rye and Bounty 205 dough stage silages had higher DM yields than their counterpart hays. Bounty 205 had the highest DM yields at both maturities; rye had the lowest yields.

In the digestion study, lambs fed rye boot stage hay had a DM intake that was 38 to 60% higher than those fed the other boot hays, but intake of the rye dough stage hay was 32% lower then that of the Bounty 205 dough hay. The DM digestibilities did not show a consistent trend when compared by winter cereal, stage of maturity, or method of harvest. Digestibilities of the three barley forages were similar; digestibilities of the boot and dough silages of Bounty 205 were higher than those of the two hays. Arkan boot silage digestibility was higher than its boot hay or dough silage. The rye boot hay had the highest digestibility of the 14 forages, but the rye dough hay and silages had the lowest digestibilities.

Chemical analyses of the 14 forages showed that all boot stage silages and hays had higher CP values than the dough stage material. The ADF and NDF values for rye boot forage were lower than for rye dough forages, but fiber values for the other forages were not affected by maturity or method of harvest. Preliminary silage fermentation results indicate that all silages were well preserved, except the barley boot silage, which had extensive clostridial activity as evidenced by a pH of 7.5. Both DM intake and digestibility of the barley boot silage were lower when compared to the other three boot silages.

Table 46.1. Performance of Steers and Heifers Fed the Six Silage and Hay Rations in Trial 1 (56 Days: November 16, 1984 to January 11, 1985 and 84 Days: to February 8, 1985)

	Corn	Triticale		Wheat		
Item	silage	Hay	Silage	Hay	Silage	Balage
No. of Cattle	16	16	16	16	16	16
Initial Wt., lb	471	473	473	469	472	476
	------0 to 56 Days------					
56-day Wt., lb	609	525	543	552	543	535
Avg. Daily Gain, lb	2.46^{a}	$.93^{c}$	1.25^{bc}	1.48^{b}	1.27^{bc}	1.04^{c}
Daily Feed Intake, lb[1]	13.86^{a}	10.29^{bc}	9.79^{c}	11.80^{b}	10.28^{bc}	10.31^{bc}
Silage	12.06	8.49	7.99	10.00	8.48	8.51[2]
Supplement	1.80	1.80	1.80	1.80	1.80	1.80
Feed/lb of Gain, lb[1]	5.71^{a}	11.43^{c}	7.78^{b}	7.85^{b}	8.14^{b}	10.18^{c}
	------0 to 84 Days------					
84-day Wt., lb	664	548	559	571	555	---
Avg. Daily Gain, lb	2.29^{a}	$.89^{c}$	1.03^{bc}	1.21^{b}	1.00^{bc}	---
Daily Feed Intake, lb[1]	14.67^{a}	10.89^{c}	10.51^{c}	12.44^{b}	10.47^{bc}	---
Silage	12.87	9.09	8.79	10.64	8.67	---
Supplement	1.80	1.80	1.80	1.80	1.80	---
Feed/lb of Gain, lb[1]	6.43	12.23^{c}	10.27^{b}	10.30^{b}	10.53^{b}	---

[abc] Values in the same row with different superscripts differ ($P<.05$).

[1] 100% dry matter basis.

[2] The 8.51 lb of silage DM intake included 6.45 lb of balage and 2.06 lb of wheat silage from the stave silo.

Table 46.2. Harvest Date, Yield, and Chemical Composition of the 12 Triticale, Wheat, and Corn Silages and Hays in Trial 1

	Lamb Digestion Study						Cattle Growing Study					
	Triticale Silage		Wheat Silage		Wheat Hay		Triticale		Wheat		Wheat	Corn
Item	Boot	Dough	Boot	Dough	Boot	Dough	Silage	Hay	Silage	Hay	Balage	Silage
Harvest Date, 1984	May 24	June 18	May 21	June 12	May 24	June 14	June 19	June 22	June 12	June 14	June 12	Aug 25
Dry Matter Yield, Ton/Acres	2.12	3.33	2.34	2.91	2.24	2.83	---	---	---	---	---	5.95
Dry Matter, %	38.4	42.1	37.0	37.4	91.5	91.3	38.6	86.2	38.1	87.3	43.2	32.0
pH	4.76	4.20	4.75	3.99	---	---	4.40	---	4.12	---	---	3.73
	--% of the Forage DM--											
Lactic Acid	10.1	5.6	6.8	5.2	---	---	4.4	---	4.3	---	3.9	6.5
Acetic Acid	1.7	1.6	2.3	1.7	---	---	3.1	---	2.3	---	2.4	2.9
Ethanol	.83	.60	.93	.98	---	---	.95	---	.92	---	1.02	1.53
Ammonia-N	.30	.14	.28	.14	---	---	.23	---	.22	---	.28	.11
Crude Protein	11.4	8.3	11.4	7.6	11.0	6.2	7.5	7.8	7.4	8.3	7.9	8.1
Neutral Detergent Fiber	64.2	68.3	58.9	63.6	68.2	69.8	67.5	72.7	62.2	72.4	63.8	40.4
Acid Detergent Fiber	40.8	45.2	39.0	41.6	43.6	46.0	46.0	52.0	41.0	46.8	41.6	22.3
Lignin	4.5	6.6	4.7	6.5	5.5	6.4	6.8	7.2	6.3	6.8	6.5	4.9
Ash	10.2	7.5	9.8	7.5	10.2	7.6	7.9	9.5	7.4	8.5	7.2	5.3

Table 46.3. Voluntary Intake and Nutrient Digestibilities of the Six Triticale and Wheat Forage Rations in Trial 1

Forage	VI[1]	Digestibility, %[1]			
	lb DM/Day	DM	CP	ADF	NDF
Triticale Silages					
Boot	2.49^{a}	63^{a}	70^{a}	59^{ab}	60^{a}
Dough	1.74^{bc}	56^{c}	69^{a}	46^{c}	42^{b}
Wheat Silages					
Boot	1.83^{bc}	65^{a}	68^{ab}	59^{cd}	56^{ab}
Dough	2.03^{b}	56^{c}	64^{b}	42^{c}	40^{c}
Wheat Hays					
Boot	2.38^{a}	62^{ab}	34^{c}	56^{a}	64^{a}
Dough	1.56^{c}	59^{bc}	64^{b}	56^{b}	50^{b}

[1] VI = Voluntary intake, DM = dry matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[abcd] Values in the same column with different superscripts differ ($P<.05$).

Table 46.4. Harvest Date, Forage and Grain Yields, Chemical Composition, and Voluntary Intake and Digestibility of the Triticale, Wheat, and Barley Forages in Trial 2

Forage[1]	Harvest Date	Forage DM Yield	Chemical Composition[2]								VI[2]	Digestibility, %			
			DM	LA	NH_3-N	ETOH	CP	NDF	ADF	pH	lb DM/Day	DM	CP	NDF	ADF
	1986	Tons/ Acre	%	---------% of the DM-------------											
Triticale															
Boot Silage	May 22	2.84	25.1	2.1	.78	.20	14.7	56.2	40.1	5.2	1.67^{bc}	54.7^{c}	65.9^{b}	55.0^{cd}	55.8^{c}
Dough Silage	June 13	4.23	36.3	7.1	.26	.03	11.0	59.5	40.5	4.1	1.21^{cd}	52.2^{c}	56.6^{cd}	52.3^{d}	49.3^{d}
Dough Hay	June 16	3.70	76.5	---	---	---	10.9	63.0	41.2	---	$.97^{d}$	48.5^{d}	52.4^{de}	50.2^{d}	45.8^{de}
Arkan Wheat (64)															
Boot Silage	May 6	2.42	32.1	4.6	.57	.15	16.4	59.4	33.8	4.7	1.72^{bc}	65.9^{a}	74.1^{a}	69.0^{a}	65.9^{a}
Dough Silage	June 2	4.71	39.8	7.6	.20	.27	11.0	53.3	33.2	3.9	1.81^{ab}	53.9^{c}	56.4^{cd}	53.1^{d}	47.2^{d}
Dough Hay	June 4	4.22	82.5	---	---	---	10.4	58.8	31.5	---	1.39^{c}	55.4^{c}	61.2^{bc}	59.2^{bc}	41.3^{e}
Bounty 205 Wheat (59)															
Boot Silage	May 12	2.48	22.0	5.0	.95	.22	15.6	54.4	36.9	5.0	2.03^{a}	59.8^{b}	66.4^{b}	60.4^{b}	60.3^{b}
Dough Silage	June 6	4.69	37.2	7.2	.19	.08	11.1	53.1	34.3	4.0	1.56^{c}	53.8^{c}	56.9^{cd}	48.4^{e}	42.7^{e}
Dough Hay	June 8	4.55	81.0	---	---	---	10.5	57.9	33.0	---	1.21^{cd}	52.9^{c}	50.9^{e}	52.3^{d}	43.3^{e}
Barley (56)															
Boot Silage	May 5	2.22	29.8	3.7	.89	.15	16.6	56.9	33.8	5.5	1.98^{a}	62.6^{ab}	68.8^{ab}	63.7^{ab}	65.0^{a}
Dough Silage	May 30	3.64	28.7	9.9	.20	.15	11.9	57.5	32.0	3.9	2.00^{a}	61.0^{b}	63.1^{bc}	63.2^{ab}	54.2^{c}
Dough Hay	June 4	3.06	77.5	---	---	---	12.4	61.4	30.0	---	1.90^{ab}	54.8^{c}	60.2^{c}	55.9^{cd}	43.1^{e}

[1] Grain yield in bushels per acre (adjusted to 12.5% moisture) is shown in parenthesis. Extensive lodging made it impossible to harvest the triticale grain.

[2] VI = voluntary intake, DM = dry matter, LA = lactic acid, ETOH = ethanol,CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[abcde] Values in the same column with different superscripts differ (P<.05).

Table 46.5. Harvest Date, Forage and Grain Yields, Chemical Composition, and Voluntary Intake and Digestibility of the Rye, Wheat, and Barley Forages in Trial 3

Forage	Harvest Date	Forage DM Yield	Chemical Composition[1]				VI[1]	DM Digestibility
			DM	CP	NDF	ADF	lb DM/Day	
	1987	Tons/ Acre	%	--% of the DM----				%
Common Rye								
Boot Silage	Apr 25	2.10	25.1	22.1	51.3	26.8	2.18	62.9
Boot Hay	Apr 28	1.83	84.0	21.2	56.3	30.9	2.58	70.9
Dough Silage	May 16	2.64	36.3	12.1	60.9	37.4	1.10	53.4
Dough Hay	May 19	2.40	76.5	11.5	63.3	38.4	.86	54.2
Arkan Wheat								
Boot Silage	May 9	2.40	36.8	15.5	60.4	33.6	2.12	66.5
Boot Hay	May 11	2.15	71.1	15.5	60.2	31.9	1.61	56.5
Dough Silage	June 2	3.56	35.7	10.7	58.3	31.5	.99	57.3
Dough Hay[2]		---	---	---	---	---	---	---
Bounty 205 Wheat								
Boot Silage	May 8	2.55	29.5	17.8	58.4	33.2	2.07	65.5
Boot Hay	May 11	2.36	67.2	16.5	60.9	34.1	1.67	57.3
Dough Silage	May 29	3.75	34.5	12.0	59.1	34.4	.82	64.3
Dough Hay	June 1	3.43	73.6	11.5	65.6	37.6	1.26	58.4
Barley								
Boot Silage	May 3	2.25	26.1	14.9	63.4	35.8	1.54	57.9
Boot Hay	May 5	2.30	83.1	15.7	66.5	35.4	1.87	57.3
Dough Silage	May 30	3.38	31.1	10.3	68.3	36.3	1.81	59.3
Dough Hay[2]		---	---	---	---	---	---	---

[1] VI = voluntary intake, DM = dry matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[2] Not baled due to rainy weather.

Effect of Enzyme and Inoculant Additives on Preservation and Feeding Value of Wheat and Forage Sorghum Silages[1,2,3]

Ahmed Laytimi, Keith Bolsen, Joe Schurhammer,
and Brett Kirch

Summary

Enzyme and inoculant additives produced more efficiently preserved wheat and forage sorghum silages and improved their feeding value. In general, treated silages had lower pH, acetic acid, and ammonia-nitrogen values and higher lactic acid and lactic to acetic acid ratios than untreated silages. In two of the three trials, cell wall and acid detergent fiber fractions were lower in treated than untreated silages. In Trial 2, the treated sorghum silages were extremely unstable in air and cattle performance was similar for control and treated silages. In Trial 3, gains and feed conversions in steers were improved for those fed treated forage sorghum silages.

Introduction

Kansas is the leading state in wheat production and one of the leaders in forage sorghum production. Silage made from these two crops has often been associated with high ensiling losses, low intakes, and low digestibilities, particularly when harvested in the dough stage. Our objective was to evaluate the effect of enzymes and bacterial inoculants on the preservation and feeding value of whole-plant wheat and forage sorghum silages.

Experimental Procedures

Trial 1. Four whole-plant, soft-dough stage, Centurk wheat silages were compared: 1) control (no additive), 2) Clampzyme experimental (X)-treated, 3) SI Concentrate 40 A/F (SI Conc) inoculant-treated, and 4) Clampzyme X + SI Conc-treated. Clampzyme X was applied in liquid form at .4 liters per ton and SI Conc at 4 grams of product diluted in 1.0 liter of water per ton. The wheat was swathed on May 24, 1985 and chopped immediately with a Field Queen forage harvester.

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[1] Enzymes and partial financial assistance were provided by Finnish Sugar Co., Inc., Shamburg, Illinois; Espoo, Finland; and Redhill, England.

[2] Clampzyme ® (experimental) and Clampzyme ® contain cellulases, hemicellulases, and glucose oxidase.

[3] SI Concentrate 40 A/F ® silage inoculant contains *L. plantarum*, *L. brevis*, *P. acidilactici*, *S. cremoris*, and *P. diacetylactis* and was provided by Great Lakes Biochemical Co., Inc., Milwaukee, Wisconsin.

Silages were made in 55-gallon capacity, plastic lined, pilot silos and stored at ambient temperature for approximately 120 days. Each silage was fed to four wether sheep in a three-period voluntary intake and digestion trial. Rations were 90% of the appropriate silage and 10% supplement on a DM basis and other procedures were similar to those described on page ## of this report.

Trial 2. Four, whole-plant, hybrid forage sorghum silages were compared: 1) control (no additive), 2) Clampzyme X-treated, and 3) Clampzyme X + SI Cone inoculant-treated silages from DeKalb 25E, and 4) a control (no additive) silage from Pioneer 947. The silages were made in 8 x 50 ft Ag Bags® and were harvested in the late-dough stage (30 to 32% DM for DeKalb 25E on October 31 and 34% DM for Pioneer 947 on September 24, 1985). The silos were opened on December 6, 1985 and emptied at a uniform rate during the following 12 weeks.

Each silage was fed to 16 steer and heifer calves (four pens of calves per silage) in a 70-day growing trial. Two pens on each silage received a ration containing 87.6% silage and 12.4% supplement; the other two pens received 62.6% silage, 25.0% rolled grain sorghum, and 12.4% supplement (DM basis). Rations were formulated to provide 12.0% crude protein (DM basis), 200 mg of Rumensin® per calf daily, and required amounts of calcium, phosphorus, and vitamin A. All calves received hormonal implants at the start of the trial.

For 1 week before the growing trial, all calves were limit-fed a grass hay and grain ration to provide a DM intake of 1.75% of body weight. Calves were weighed individually on two consecutive days after 16 hr without feed or water at the start and end of the trial. For 2 days before the final weighing, the calves were fed their respective silage ration at a restricted intake of 1.75% of body weight.

Samples of each silage were taken twice weekly. Feed intake was recorded daily for each of the 16 pens, and the quantity of silage fed was adjusted daily to assure that fresh feed was always in the bunks. Feed not consumed was removed, weighed, and discarded as necessary.

During the filling of the DeKalb 25E Ag Bags, fresh forage was removed from a randomly selected load and the following treatments were prepared and ensiled in PVC laboratory silos: 1) control (no additive), 2) Clampzyme X-treated, 3) SI Conc-treated, and 4) Clampzyme X + SI Conc-treated. Duplicate silos were opened at 12 and 24 hours and 4, 14, and 90 days post-filling for each treatment.

Trial 3. Three whole-plant, DeKaIb 25E silages were compared: 1) control (no additive), 2) Clampzyme-treated, and 3) Clampzyme + SI Conc inoculant-treated. Clampzyme was applied at .2 liters per ton and SI Conc at 4 grams per ton. The silages were made in 10 x 50 ft concrete stave silos and the crop was harvested in the late-dough stage at 28 to 29% DM on October 17 and 18, 1986. The silos were opened on March 27, 1987 and emptied at a uniform rate during the following 10 weeks.

Each silage was fed to 16 yearling steers (four pens of four steers per silage) in a 65-day growing trial. Rations, implants, pre-trial feeding, and beginning and ending cattle weight procedures were identical to those of Trial 2.

During the filling of the concrete silos, fresh forage was removed from a randomly selected load on each of the two days and the following treatments were prepared and ensiled in PVC laboratory silos from each: 1) control (no additive); 2) Clampzyme; 3) SI Conc; and 4) Clampzyme + SI Conc. Duplicate silos were opened at 12, 24, and 48 hours and 4, 14, and 90 days post-filling for each treatment.

During the cattle growing trial, silage from each of the three silos was fed to eight mature wether sheep in a two period, total collection digestion trial. Period one consisted of 7-day silage adaption, 5-day voluntary intake, and 7-day fecal collection phases. Period two consisted of a 7-day silage adaption and 7-day fecal collection phases. Rations were 90% of the appropriate silage and 10% supplement on a DM basis.

Results and Discussion

Trial 1. Voluntary intake, nutrient digestibility, and chemical composition of the four wheat silage rations are shown in Table 47.1. Although intake and DM digestibility tended to be higher in treated silages, none of the values was statistically different. However, NDF and ADF values for the Clampzyme X-treated silages were lower than the values for control silage. Clampzyme X-treated silages also had higher lactic acid and lower ammonia-nitrogen contents than control. SI Conc-treated silage had lower acetic acid, ethanol, and ammonia-nitrogen values than control silage. These data indicate that Clampzyme X decreased cell wall concentrations in the wheat silage and SI Conc improved the efficiency of the ensiling process. The data also indicate that the effects of the two additives were complementary.

Trial 2. Performance by calves fed the eight silage rations in Trial 2 and silage analyses are shown in Table 47.2. Calves fed Pioneer 947 silage had faster gains, higher DM intakes, and better feed conversions than those fed DeKalb 25E silages. Grain addition improved calf performance from all four forage sorghum silages.

The two additive treatments, Clampzyme X or Clampzyme X + SI Conc, did not affect gain, intake, or efficiency, regardless of grain addition treatment. One possible explanation could be the extremely unstable nature of the treated silages which heated within 24 to 48 hrs after exposure to air. It was difficult to keep the exposed silage surfaces from heating prior to feeding.

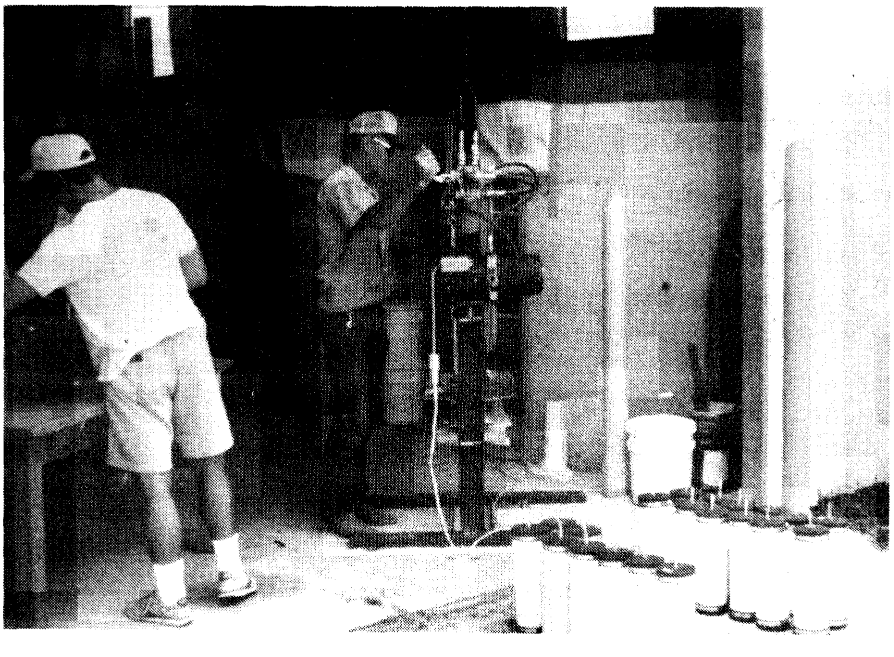
Chemical composition of the silages actually fed to the cattle from the two treated silage Ag Bags showed higher pH and lower lactic acid values compared to silage from the control Ag Bag. In contrast, analyses of silages from the PVC laboratory silos showed just the opposite, with treated silages having lower pH and higher lactic acid values than control silage.

Trial 3. Performance by steers fed the six silage rations in Trial 3 and silage fermentation-results are shown in Table 47.3. Steers fed each of the three silages with 25% additional grain had faster gains, higher DM intakes, and better feed conversions, which is consistent with results in Trial 2 and results of similar trials contained on pages ## and ## of this report.

Both of the silage additive treatments improved steer performance, with steers fed Clampzyme silage gaining faster (P<.05) and more efficiently (P<.05) than those fed control silage. In contrast to results in Trial 2, all three silages from the stave silos were stable in air, even during the mild spring weather. When compared to control silage, treated silages had lower pH, lower acetic acid and ammonia-nitrogen contents, and higher lactic acid contents --all characteristics of more efficiently preserved silage.

Results of the digestion trial and chemical composition of the three silages are shown in Table 47.4. Lambs fed Clampzyme-treated silage had a higher DM intake than those fed control silage. In general, there were only small differences in nutrient digestibilities, although values for treated silages tended to be slightly higher than those for control silage.

Silage analyses results clearly indicate that Clampzyme decreased cell wall fiber, because both treated silages had lower NDF and ADF values than control. This explains, at least in part, the improved feed conversions by steers fed the treated silage rations. Silage fermentation results from both the digestion trial and PVC silos (Table 47.5) were consistent with results from silages fed in the cattle trial -- lower pH, acetic acid, and ammonia-nitrogen and higher lactic acid values for the two treated silages.



Small laboratory silos (lower right) are a valuable research tool for following silage fermentation dynamics. Here, silage is uniformly packed into the laboratory silos using a hydraulic press.

Table 47.1. Voluntary Intake, Nutrient Digestibility, and Chemical Composition of the Four Wheat Silage Rations in Trial 1

Item[1]	Control	Clampzyme X	SI Conc	Clampzyme X + SI Conc
D ,%	30.7	31.7	31.0	31.1
VI[2]	35.5	37.3	38.3	44.4
<u>Digestibility</u>	--------------------------	%	------------------------	
DM	51.9	51.5	53.3	53.9
CP	64.8	63.7	62.8	63.4
NDF	48.5	47.7	47.3	48.7
ADF	48.2	45.6	47.5	45.6
Cellulose	59.5	58.4	59.8	57.8
Hemicellulose	49.0	52.5	50.2	54.6
<u>Silage Analyses</u>	----------------- % of the Silage DM -----------------			
CP	12.1	12.1	12.1	12.1
NDF	62.1	59.6	60.8	58.9
ADF	42.5	40.1	40.8	39.7
Cellulose	30.8	29.0	29.6	27.9
Hemicellulose	19.6	19.4	20.0	19.8
Lactic Acid	8.27	10.25	8.25	10.26
Acetic Acid	3.54	3.47	2.59	2.57
Ethanol	.62	.62	.45	.37
Ammonia-N	.34	.25	.23	.22
pH	4.07	3.87	4.00	3.86

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[1] DM = dry matter, VI = voluntary intake, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[2] Kg of dry matter per kg of body wt.$^{.75}$

Table 47.2. Performance by Calves Fed the Four Forage Sorghum Silages with and without Additional Grain and Chemical Composition of the Silages in Trial 2

	DeKalb 25E**							
Silage* :	Control		Clampzyme X		Clampzyme X + SI Conc		Pioneer 947	
Item Grain*:	w/o	w	w/o	w	w/o	w	w/o	w
No. of Calves	8	8	8	8	8	8	8	8
Initial Wt., lb	543	539	543	531	544	530	536	537
Avg. Daily Gain, lb	1.34	1.95	1.22	2.13	1.25	1.93	2.04	2.44
	1.65		1.68		1.59		2.24	
Daily Feed Intake, lb[1]	12.71	14.92	11.98	15.47	11.79	14.64	14.62	16.79
	13.8		13.7		13.2		15.7	
Feed/lb of Gain, lb[1]	9.6	7.7	9.8	7.4	9.5	7.6	7.2	6.9
	8.7		8.6		8.5		7.0	
Silage Analyses								
Dry Matter, %	32.4		32.6		33.0		37.0	
pH	4.04		4.11		4.12		---	
Aerobic Stability, hrs	120		37		46		---	
	-------------------% of the Silage DM----------------------							
Lactic Acid	4.87		4.51		4.62		---	
Acetic Acid	2.15		1.61		1.59		---	
Ethanol	.84		.92		1.00		---	
Ammonia-N	.054		.038		.039		---	
Acid Detergent Fiber	37.8		38.1		37.8		32.6	

[1] 100% dry matter basis.

*Statistical analyses showed that both main effects, hybrid (25E vs. 947) and grain addition (w/o vs. w), influenced ($P<.05$) gain, feed intake, and feed/gain.

**Silage treatments within DeKalb 25E (control vs. Clampzyme X vs. Clampzyme X + SI Conc) did not significantly influence calf performance.

Table 47.3. Performance by Steers Fed the Three DeKalb 25E Silages with and without Additional Grain in Trial 3 and Chemical Composition of the Silages

Item	Silage[1]	Control		Clampzyme		Clampzyme + SI Conc	
	Grain :	w/o	w	w/o	w	w/o	w
No. of Steers		8	8	8	8	8	8
Initial Wt., lb		607	609	611	612	607	606
Avg. Daily Gain, 1		1.38^{b}	2.01^{z}	1.50^{a}	2.29^{x}	1.43^{ab}	2.15^{y}
		1.69		1.89		1.79	
Daily Feed Intake, lb[2]		13.67	16.19	13.77	16.86	13.20	16.86
		14.9		15.3		15.0	
Feed/lb of Gain, lb[2]		10.0^{b}	8.1^{y}	9.2^{a}	7.4^{x}	9.3^{a}	7.9^{y}
		9.0		8.3		8.6	
Silage Analyses							
pH		4.14		3.92		3.97	
		------------------ % of the Silage DM ----------					
Lactic Acid		3.55		5.13		5.48	
Acetic Acid		2.37		1.71		2.27	
Ethanol		.317		.354		.319	
Ammonia-N		.087		.060		.062	

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[1] Statistical analyses showed that both main effects, silage (control vs. Clampzyme vs. Clampzyme + SI Conc) and grain addition (w/o vs. w), influenced gain and feed/gain; only grain addition influenced feed intake.

[2] 100% dry matter basis.

[a b] Silage treatments (w/o grain) differ (P<.05).

[xyz] Silage treatments (w grain) differ (P<.05).

Table 47.4. Voluntary Intake, Nutrient Digestibility, and Chemical Composition of the Three DeKalb 25E Silage Rations in Trial 3

Item	Control	Clampzyme	Clampzyme + SI Conc
VI, kg DM/Day	1.59^{b}	1.83^{a}	1.69^{ab}
Digestibility		%	
DM	54.2	55.1	54.3
OM	55.1	56.7	55.6
CP	59.7	60.8	60.3
NDF	34.9^{b}	37.7^{a}	35.2^{b}
ADF	31.0	33.6	31.3
Cellulose	38.1^{b}	42.2^{a}	39.4^{ab}
Hemicellulose	42.0^{b}	45.1^{a}	42.1^{b}
Silage Analyses		% of the Silage DM	
CP	7.3	7.1	7.3
Ash	6.6	6.1	6.4
NDF	58.2	54.6	55.0
ADF	36.9	34.5	35.0
Cellulose	26.6	24.4	24.9
Hemicellulose	21.0	20.1	20.0
Lactic Acid	3.76	5.86	5.70
Acetic Acid	2.79	1.23	1.52
Ethanol	.22	.24	.27
Ammonia-N	.08	.05	.05
pH	4.19	3.93	3.93

[1] VI = voluntary intake, DM = dry matter, OM = organic matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

[a b] Means on the same line having different superscripts differ ($P<.05$).

Table 47.5. pH and Chemical Composition over Time for the Forage Sorghum Silages in Trials 2 and 3

Time Post [1]Filling and Items	Trial 2				Trial 3			
	Control	Clamp X	SI Conc	Clamp X + SI Conc	Control	Clamp	SI Conc	Clamp + SI Conc
Initial: pH	5.92	5.91	5.92	5.93	5.96	5.95	5.96	5.95
Hour 12: pH	4.84	4.82	4.79	4.86	4.79	4.77	4.78	4.72
Lactic Acid	.73	.76	.83	.71	1.21	1.15	1.19	1.54
Hour 24: pH	4.52	4.52	4.53	4.51	4.38	4.35	4.34	4.30
Lactic Acid	1.18	1.39	1.32	1.38	2.01	2.32	2.15	2.16
Hour 48: pH	---	---	---	---	4.08	4.07	4.06	4.01
Lactic Acid	---	---	---	---	3.36	3.79	3.77	4.64
Day 4: pH	4.09	4.02	4.09	4.01	4.01	3.97	3.99	3.94
Lactic Acid	3.61	4.00	3.54	3.66	4.59	4.33	4.39	5.22
Day 14: pH*	4.00	3.88	4.01^x	3.88	3.89	3.84^x	3.90^x	3.81
Lactic Acid*	4.25	5.13	4.21^x	5.01	6.33	6.32^x	6.58^x	6.99
Day 90: pH*	4.04	3.92	4.07^x	3.91	3.97	3.91^x	3.97^x	3.89
Lactic Acid*	4.54	5.22	4.58^x	5.29	6.01	6.54^x	6.18^x	6.93
Acetic Acid	1.57	1.85	1.67	1.77	1.58	1.52	1.61	1.53
Ethanol	.279	.286	.270	.290	.327	.329	.302	.347
NH_3-N	.082	.073	.069	.057	.057	.052	.054	.053

[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

* Statistical analyses showed control vs. treatment means differed ($P<.05$) within a trial, unless the inoculant mean has a superscript(x).

The Effect of Alfalfa Weevil Control on Alfalfa Hay Yield and Quality

Bob Ritter and Bob Bauernfeind[1]

Summary

A 2-year-old, irrigated alfalfa field was left untreated or treated with 1/4 lb, 1/2 lb, or 1 lb of Furadan® per acre on April 5, 1986. Alfalfa weevil populations were determined 2, 9, 16 and 23 days postspraying. Forage samples were collected at about the 1/10 bloom stage of maturity. All three Furadan levels provided excellent weevil control up to 23 days post-spraying, and all resulted in an increase in dry matter yield. But only the yield of the 1 lb./A. treatment was significantly ($P<.15$) greater than the untreated forage (1.97 vs. 2.44 tons/A). There was no difference in nutrient composition between the untreated and treated forage. All Furadan treatments resulted in a net economic gain per acre. In this study, between 1/2 lb and 1 lb Furadan per acre resulted in the greatest weevil control and economic return per acre.

Introduction

Adult alfalfa weevils lay their eggs inside the stems of alfalfa plants in the fall or spring. These eggs hatch in the spring, and the larvae feed on the alfalfa plant for about 3 weeks during the growth of the first cutting. Most damage is confined to the terminal and upper leaves of the plant. As feeding continues by the larvae and/or adults, the dry, tattered foliage gives the field a gray, or frosted appearance. Our study was conducted to measure the effect of alfalfa weevil damage on forage yield and quality and to determine the economic advantage of chemical control of the weevil.

Experimental Procedures

A 2-year-old, irrigated alfalfa field was divided into 16, 10 ft. by 20 ft. plots representing four replications of four treatments. The treatments consisted of an untreated control and three rates of Furadan: 1/4 lb., 1/2 lb., and 1 lb. actual ingredient per acre. All plots were sprayed on April 5, 1986, at a delivery rate of 30 gal./A. Alfalfa weevil populations were determined in the plots by making 10 net sweeps down the center of each treatment plot. Weevil populations were determined on April 7, 14, 21, and 28, corresponding to 2, 9, 16, and 23 days postspraying, respectively (Table 48.1).

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[1] South Central Area Extension Livestock Specialist and Entomologist, respectively.

Forage samples were collected from each plot by hand-harvesting 1 square yard of forage, less than one inch from the ground, from the center of the plot. The forage samples were air-dried, weighed, and chopped before being submitted for nutrient analysis. The samples were analyzed for dry matter, crude protein, acid detergent fiber (ADF), calcium (Ca), and phosphorus (P) (Table 48.2). Total digestible nutrients (TDN) were estimated from nutrient analysis. The economic impact of alfalfa weevil control was also determined, based upon yield, current hay price, Furadan cost, and application cost (Table 48.3).

Results and Discussion

All Furadan treatments provided excellent control of the alfalfa weevil through the 16-day post-spray period. Between days 16 and 23 after spraying, Furadan performance diminished, with weevil counts inversely related to application rates. However, weevil populations were still less than those of the control plots (Table 48.1).

Dry matter yield increased with increasing rates of Furadan application. The dry matter yield of the 1 lb. application rate was significantly ($P<.15$) greater than for the untreated control, (1.97 vs. 2.55 ton/A.) (Table 48.2). The alfalfa weevil infestation of this study did not affect the nutrient composition of the forage for the nutrients that were determined (Table 48.2). Although not actually measured, the leaf-to-stem ratio of the alfalfa plants appeared to increase with increasing Furadan rates. The stems of the untreated alfalfa plants appeared to have a smaller diameter than those of the Furadan-treated plants. This difference in stem diameter may have been due to the reduced photosynthetic activity of the untreated plants because of defoliation by the weevil and a reduced need for stem support.

The higher forage yields resulting from weevil control increased the net value of alfalfa production per acre (Table 48.3). The results of this trial indicate that spraying alfalfa with Furadan in the spring at a rate of 1/2 lb. to 1 lb. active ingredient per acre will increase first cut alfalfa hay yield and economic return per acre.

Table 48.1. Weevil Counts on Alfalfa Treated with Three Levels of Furadan

	Weevils per 40 sweeps (days post-spray)			
Furadan lb. per acre	2	9	16	23
0	1017	939	2188	2366
1/4	2	0	0	569
1/2	0	0	0	141
1	3	0	0	117

Table 48.2. Forage Analysis of Alfalfa Treated with Three Levels of Furadan

Furadan lb. AI/A	DM T/A	CP	TDN	ADF	Ca	P
		----------% DM basis----------				
0	1.97[a]	19.2	63.3	35.2	2.1	.24
1/4	2.31	19.7	62.7	34.5	2.1	.23
1/2	2.44	20.1	62.2	35.2	2.0	.25
1	2.55[b]	19.6	61.5	33.4	2.0	.24

[ab] Values with different letters within a column are significantly different, P<.15.

[c] TDN values were estimated from nutrient analyses

Table 48.3. Economic Returns from Three Rates of Furadan Application on Alfalfa Hay

Furadan lb. per acre	Yield advantage over untreated (tons per acre)	Advantage at $50/T	Chemical cost	Appl. Cost	Net Return $/A
1/4	.36	$18.00	$3.89	$2.50	$11.61
1/2	.51	$25.50	$7.78	$2.50	$15.22
1	.63	$31.50	$15.57	$2.50	$13.43

Weather Data, 1986-1987

On the following page are graphs of 1986 and 1987 Manhattan weather, produced by the Kansas Agricultural Experiment Station Weather Data Laboratory, and Dr. L. Dean Bark, Experiment Station Climatologist. The smooth line that starts in the lower left hand corner of each graph is the normal accumulated precipitation. The rough line represents actual precipitation. A long horizontal section of that line represents time during which no precipitation occurred. A vertical section represents precipitation. The other two smooth lines represent average daily high and low temperatures, and the rough lines represent actual highs and lows.

These graphs are included because much of the data in this publication, especially data on cow maintenance requirements and forage yields can be influenced by weather. Weather graphs have been included in Cattlemen's Day publications for the past three years.

Biological Variability and Statistical Evaluation of Data

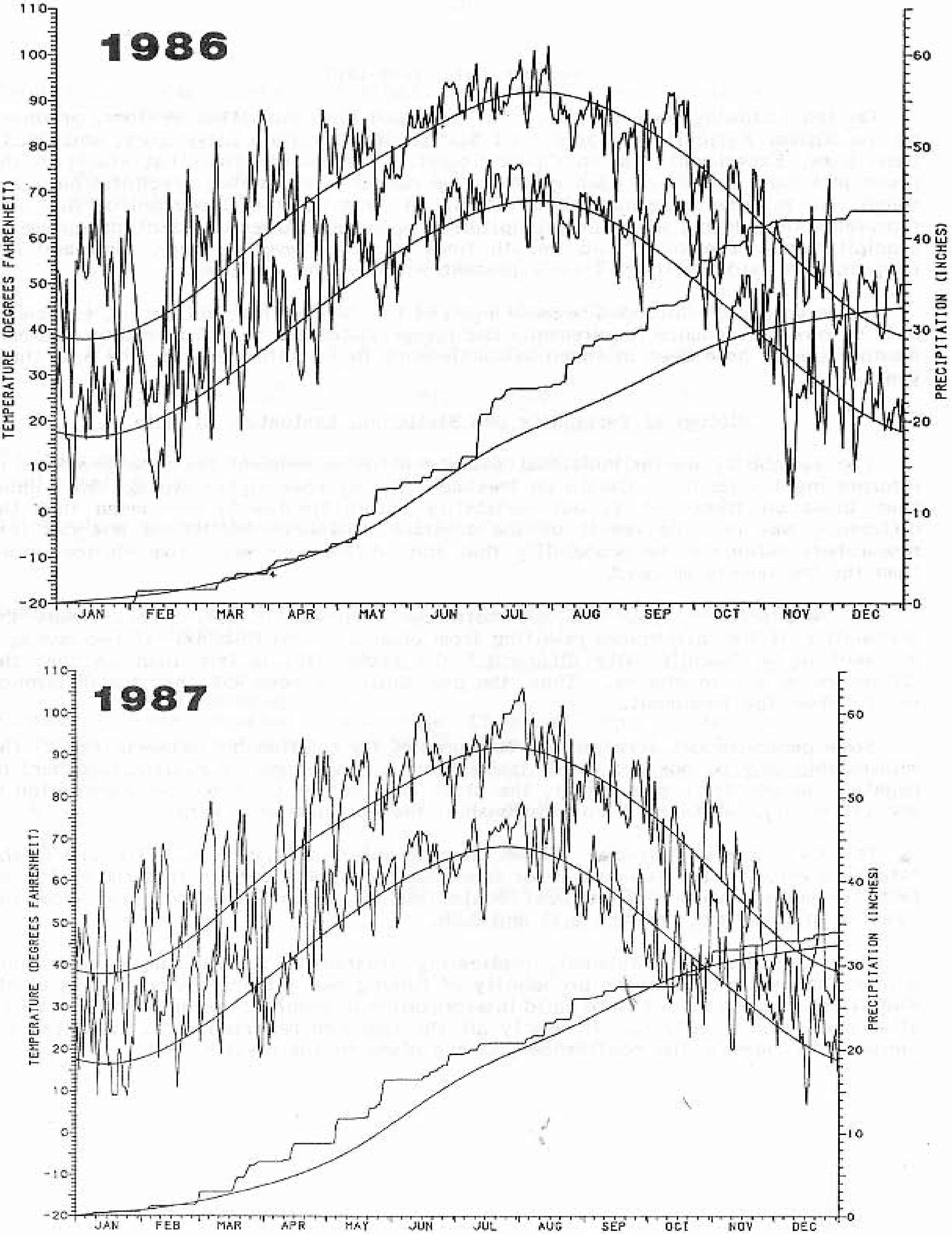
The variability among individual animals in an experiment leads to problems in interpreting the results. Cattle on treatment X may have higher average daily gains than those on treatment Y, but variability within treatments may mean that the difference was not the result of the treatments alone. Statistical analysis lets researchers calculate the probability that such differences were from chance rather than the treatments imposed.

In some articles, you will see notations such as "P<.05". That means the probability of the differences resulting from chance is less than 5%. If two averages are said to be "significantly different," the probability is less than 5% that the difference is due to chance. Thus, the probability exceeds 95% that the difference results from the treatment.

Some papers report correlations; measures of the relationship between traits. The relationship may be positive (both traits tend to get bigger or smaller together) or negative (as one trait gets bigger, the other gets smaller). A perfect correlation is one (+1 or -1). If there is no relationship, the correlation is zero.

In other papers, you may see an average given as 2.50 ±.10. The .10 is the "standard error." The standard error is calculated by 68% certain that the real mean (with unlimited number of animals) would fall within one standard error from the mean — in this case, between 2.40 and 2.60.

Many animals per treatment, replicating treatments several times, and using uniform animals increases the probability of finding real differences when they exist. Statistical analysis allows more valid interpretation of results regardless of the number of animals used in a trial. In nearly all the research reported here, statistics are included to increase the confidence you can place in the results.



Graphical Weather Summary for Manhattan, Kansas

ACKNOWLEDGMENTS

Listed below are individuals, organizations, and firms that have contributed to this year's beef research program through financial support, product donations or services. We appreciate your help!

American Cyanamid Co., Princeton, New Jersey
Arco Seed Company, Woodland, California
BioTechniques Laboraatories, Inc., Redmond, Washington
B P Chemicals, LTD, London, England
Brinks Brangus, Eureka, Kansas
Cattlemen's Beef Promotion and Research Board, Chicago, Illinois
Chr. Hansen's Laboratories, Milwaukee, Wisconsin
Church & Dwight Company, Inc., Piscataway, New Jersey
C-I-L, Inc., London, Ontario, Canada
Coopers Animal Health, Kansas City, Missouri
Elanco Products Company, Division of Eli Lilly, Indianapolis, Indiana
Farmland Industries, Inc., Kansas City, Missouri
Finnish Sugar Co., LTD, Espoo, Finland
Great Lakes Biochemical Co., Inc., Milwaukee, Wisconsin
Hoffmann-LaRoche, Inc., Nutley, New Jersey
IMC Pitman-Moore, Inc., Terre Haute, Indiana
InterBio, Inc., Naperville, Illinois
Iowa Beef Processors, Emporia and Holcomb, Kansas
Kemin Industries, Inc., Des Moines, Iowa
Livestock and Meat Industry Council, Inc. (LMIC), Manhattan, Kansas
Mann Enterprises, Inc., Waterville, Kansas
Medipharm USA, Des Moines, Iowa
Merck & Company, Inc., Rahway, New Jersey
National Beef Packers, Liberal, Kansas
National Byproducts, Inc., Wichita, Kansas
New Breeds Industries, Inc., Manhattan, Kansas
Norden Laboratories, Inc., Lincoln, Nebraska
Pfizer, Inc., Lee's Summit, Missouri
Pioneer Hi-Bred International, Inc., Des Moines, Iowa
QualiTech, Inc., Chaska, Minnesota
Richard Porter, Reading, Kansas
Ralston Purina, Inc., St. Louis, Missouri
Roode Packing Co., Fairbury, Nebraska
Select Sires, Plain City, Ohio
Stauffer Chemical Co., Washington, Pennsylvania
Syntex Animal Health, Inc., Des Moines, Iowa
The Upjohn Company, Kalamazoo, Michigan
TransAgra International, Inc., Storm Lake, Iow
Western America Feed Fat, Inc., Douglasville, Texas
Xeroferm Laboratories, Portland, Oregon

NOTICE

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WALTER M. AND FRANCES A. LEWIS TRUST
Established by Frances A. Lewis

The Livestock and Meat Industry Council, Inc. and the Department of Animal Sciences and Industry at Kansas State University salutes Frances A. Lewis for establishing the Walter M. and Frances A. Lewis Trust. Mrs. Lewis, her late husband, Walter, and his brother, Joe, owned and operated Alfalfa Lawn Farms, a premier Polled Hereford breeding establishment at Larned, Kansas. The trust provides a life income for Frances, and on her death will benefit animal agriculture through supporting research and educational activities.

A true K-State family, Mrs. Lewis' parents were Louis and Edith Aicher, graduates of Kansas State Agricultural College in 1910 and 1905. Frances and Walter's daughter, Martha Lewis Starling, graduated from Kansas State, then received her Ph.D. at Pennsylvania State Univ., where she is on the faculty. Their son, Robert, graduated in Animal Husbandry at Kansas State then completed his Ph.D. at the Univ. of Wisconsin. He is a successful businessman at the ranch in Larned.

A quote by Eric Hofer describes Frances: "Sense of usefulness is more important to quality of life than affluence and abundance." Her priorities were her husband, her family, and Alfalfa Lawn Farms. The American Polled Hereford Association presented her their Award of Merit for Youth Activities in 1975. She has been active in both Kansas and National Pollettes organizations. In 1981, she was the Kansas Pollette of the year. She received national recognition for creating a new cookbook, "Polled Hereford Collections" in 1983.

Kansas State University recognized her contributions in 1985 with the Distinguished Service Award in Home Economics. She and Walter were recognized for meritorious service by the Kansas 4-H Foundation. She has served on the Pawnee County Homemakers Council, the Home Economics Advisory Board and the Kansas Home Economics Extension Council, and has contributed countless hours working for 30 years as a 4-H Club leader, and judge of 4-H projects at numerous county fairs. In 1951, Frances was named Kansas Master Farm Homemaker. The Spring Judging Contest and Field Day at Alfalfa Lawn Farms was a highlight for youth interested in livestock for 46 years.

Frances has been a gracious hostess at Alfalfa Lawn Farm to Polled Hereford and Hereford breeders from all over the world. In addition, she maintained the records and registered Alfalfa Lawn's calves for 49 years.

Contributions such as Mrs. Lewis' insure the future of the livestock industry through the support of research, development, and education. Please join the Livestock and Meat Industry Council and Kansas State University in expressing our appreciation.

NOTICE

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Report of Progress 539 March 1988

3-88-4M