CATTLEMEN'S DAY 1985

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AGRICULTURAL EXPERIMENT STATION KANSAS STATE UNIVERSITY, MANHATTAN
JOHN O. DUNBAR, DIRECTOR

Ed Smith, bluestem grass, and range cattle — all are mentioned in the same breath by Kansas ranchers. The University's range research center was established in 1946. Ed arrived in 1947, and has been in charge of the unit ever since. The relationship between grass and cattle is complex, and that relationship has been the subject of Ed's research. His studies have resulted in over 225 co-authored scientific publications and research reports.

Long before environmental concerns became popular, Ed was developing practices that increased profitability, and at the same time, conserved the Flint Hills grass resource. Research on late spring burning was pioneered at Kansas State by Ed and his colleagues in Agronomy. It impoved profitability through increased cattle performance; moreover, it was good for the grass. Clean, productive Flint Hills pastures, free of brush and red cedar, are a tribute to Ed's foresight.

Early intensive stocking is another of Ed's innovative ideas. Why not use the grass early, when it is most productive, then let it rest and replenish itself? He and his co-workers tried it, and it worked. Cattle productivity increased, and like burning, it was good for the grass.

Ed is retiring on July 1. We wish Ed and his wife, Hinnie, a long and happy retirement. But in spite of retirement, his friends know that, come spring, Ed will probably be found somewhere around a Flint Hills grass fire.

The first paper in this publication summarizes some of Ed's findings at the range research unit. The Department of Animal Sciences and Industry is committed to continuing the work that Ed was instrumental in carrying out — understanding the relationship between cattle and grass.

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NOTICE

Kansas State University makes no endorsements, expressed or implied, of any commercial product. Trade names are used in this publication only to assure clarity of communication.

Some of the research reported here was carried out under special FDA clearances that apply only to investigational uses at approved research institutions. Materials that require FDA clearances may be used in the field only at the levels and for the uses specified in that clearance.

Contribution No. 85-319-S from the Kansas Agricultural Experiment Station.

Biological Variability and Chances of Error

The variability among individual animals in an experiment leads to problems in interpreting the results. Although the cattle on treatment X may have had a larger average daily gain than those on treatment Y, variability within treatments may mean that the difference was not the result of the treatment alone. Statistical analysis lets researchers calculate the probability that such differences were from chance rather than the treatment.

In some of the articles that follow, you will see the notation "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 from chance-- 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 small together) or negative (as one traits 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 a mean given as 2.50+ .10. The 2.50 is the mean; .10 is the "standard error". The standard error is calculated to be 68% certain that the real mean (with unlimit 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 the results regardless of the number of animals. In nearly all the research reported here, statistical analyses are included to increase the confidence you can place in the results.

KSU

Range Research Highlights

Ed F. Smith

A 1135 acre tract of native bluestem pasture 5 miles northeast of Manhattan was acquired by the Kansas Agricultural Experiment Station in 1946 for range research. Professor A.G. Picket was in charge of the beef cattle research at that time. Professor Kling Anderson of the Department of Agronomy cooperated with the Department of Animal Husbandry in collecting grazing research data. Professor Clenton Owensby, presently assisted by Mr. Gene Towne, took over Dr. Anderson's responsibilities after his retirement. Mr. Jim Whitney is responsible for supervising work at the unit. Many students, staff, faculty, and producers have aided in many aspects of the studies. Following are summaries of several of the research projects that have been carried out at the Range Research Center.

Late Spring Burning

In the bluestem pasture region of eastern Kansas, late spring burning is now a common practice. It prevents the establishment of woody species, such as red cedar, and increases weight gain of growing cattle about 25 lb per head for the season. Burning date is important in regard to the effect on vegetation and cattle performance. It should be as late as possible so bare soil will be exposed for a minimum period, but not so late as to injure new grass growth. Fall, winter, and early spring burning have been harmful to the more productive warm-season grass species and have not increased cattle gains. However, late spring burning has given an excellent return for the effort expended (see Anderson et al., J. Range Manage. 23:81).

Nitrogen Fertilization

Burned and unburned bluestem pastures were fertilized in early May with 0, 40, or 80 lb nitrogen per acre per year and grazed from May 1 to October 1 with steers. Steer gains were highest on burned pastures with either 0 or 40 lb N/acre. Gains per acre were higher where nitrogen was applied because increased stocking rates were possible. Maintenance of good quality range was favored by burning and 0 or 40 lb N/acre compared with the same fertilizer rates and no burning. At 80 lb N/acre, desirable warm-season species decreased. Forty lb N/acre applied to late-spring-burned pasture was the best combination of treatments. Whether or not to apply nitrogen depends on the cost. Stocking rate for 500 lb steers can be reduced about 1 acre by the use of 40 lb N/acre. Native bluestem pastures should not be fertilized unless they are burned in late spring to control the undesirable species encouraged by nitrogen application (see Owensby and Smith, J. Range Manage. 32:254).

Intensive - Early Summer Stocking

This practice entails stocking at about twice the normal rate early in the growing season, than removing the cattle at mid-season to allow the pasture to recover. This practice has maintained grass production and favored increases in the more desirable warm-season perennial grasses. Daily gains were slightly improved (1.88 vs 1.75 lb/hd) by intensive grazing, and since more cattle were grazed and the grass was used at its peak nutritive value, gain per acre was much greater (83 vs 62 lb) than normal, season long grazing (see Smith and Owensby, J. Range Manage. 31:14).

Supplementing Winter Grass for Spring Calving Cows

Native pasture contains too little energy and protein for optimum beef cattle performance. How do cows perform when grazing native grass year-round with no supplement other than salt? Exploratory research with young cows (identical twins) on native bluestem pasture over a period of 4 years compared feeding 2 lb of concentrate/cow/daily during the winter with no supplemental feed except salt and limited prairie hay (about 2 weeks per winter when snow covered the grass). Unsupplemented cows calved 10 days later, and their calves weighed less at birth and 23 lb less at weaning. Late calving (April) was critical to the nonsupplemented cows. Because of winter weight loss, earlier calving (in February for example) probably would have been disastrous (see Kans. Ag. Expt. Sta. Bull. 549:46).

Other research involved feeding 3 lb of alfalfa hay to spring-calving Hereford cows on winter bluestem pasture, combined with either 3 or 6 lb of sorghum grain per head daily. Weaning weights of calves from four-year-old and older cows increased from 427 to 444 lb when grain was increased from 3 to 6 lb. But, it required 513 lb of grain (171 days x 3 lb) to achieve the 17 lb increase in weaning weight (see Davis et al., J. Anim. Sci. 45:430).

Spring-calving cows grazing winter bluestem will produce 400 lb calves with only low levels of supplemental feed. Producers whose objective is to wean heavier calves (500 lb or more) need to think in terms of higher quality forage than winter native bluestem pasture and/or feed large quantities of supplemental feed, and they must carefully compare the extra feed costs to the value of the added calf weight.

Supplementing Winter Grass for Growing Cattle

The equivalent of 1 lb of soybean meal and 1 lb of sorghum grain per head daily seems adequate for growing steers where the winter period is followed by summer grazing. Over a 235-day growing period (winter, then summer grass) this combination came within 8 lb of producing as much gain as 2 lb of soybean meal. Other research shows that steers to be summer-grazed following the winter period respond economically to only about 2 lb of supplemental winter concentrate per head daily while being wintered on native grass (see Kans. Ag. Expt. Sta. Bull. 638).

Supplementing Summer Grass for Growing Cattle

As the season progresses and the plants mature from early summer through fall and winter, protein and energy decline to levels below the animals' needs for best performance. By feeding 2 lb of concentrate per head daily, steer gains can be increased 0.25 lb per head daily during early summer, and 0.35 lb during late summer. Including a feed additive, such as Rumensin®, would add another 0.1 to 0.2 lb per day. The profitability of supplemental feeding depends on the cost of feed, value of the added weight, and the expense of feeding.

On summer grass, the first increments of supplemental feed produce the most gain. Steers on early summer grass normally gain 1.5 to 2.0 lb per head daily, and maximum upside potential is about 1 lb additional gain per day. So, if cattle are fed all the supplemental feed they will consume, a gain increase of about 1 lb per head daily is all that can be expected. (see Kans. Ag. Expt. Sta. Bull. 638).

Management Systems for Growing Cattle

For growing cattle, overhead costs such as interest, depreciation, and taxes are high and nearly equal to feed costs. Certainly at present prices, when growing cattle are fed harvested roughages, gains of 1.5 lb per head daily and higher are necessary. What winter rate of gain should a producer strive for in a 10 or 12-month growing program where winter feeding is followed by summer grazing?

Table 1.1 shows a comparison of growing medium-framed steers on grass winter and summer, compared to feeding harvested forages and grain in the winter followed by summer grazing. The steers fed hay and grain in the winter gained 1.48 lb per head daily. Those wintered on native grass and 2 lb of supplement gained 0.75 lb. During the summer grazing that followed, the steers wintered on pasture showed compensatory gain of 72 lb. The use of winter grass probably depends on availability. Those who have ample grass have the choice of using it; others can use harvested forages or a combination of the two.

If the producer aims for a gain of 1.5 lb per head daily or greater in the earlier (winter) growth phases, it may be desirable because of their fleshy condition, to move the cattle directly to a finishing ration rather than continue the growing program on grass. However, with large-framed steers and with improved performance on grass by the use of supplemental protein, energy and feed additives, this practice needs to be reevaluated.

Summary

Of the management practices reported here, two stand out as rewarding, taking into consideration the resources expended. With a minimum of effort, late spring burning will maintain a pasture in excellent condition and produce an additional 25 lb of gain per steer. Early season intensive stocking will also maintain a pasture in excellent condition and produce 21 lb more gain per acre than season-long stocking at a normal rate.

By supplemental feeding of protein and energy on pasture, performance can be improved. But the deciding factor must be profitability.

This paper outlines several options available to the producer for the use of native grass. Each producer needs to evaluate them under his own conditions and determine if they fit his program.

Table 1.1. Management Systems for Growing Cattle

Item	Wintered in Dry Lot Followed by Summer Grazing	Wintered on Dry Grass Followed by Summer Grazing
Daily Winter Ration, lb/head:		
Prairie Hay	10.4	0.50
Soybean Meal	1.0	2.00
Grain	4.0	–
Winter Bluestem Pasture	–	ad lib.
Gain per Steer, lb:		
Winter, 148 days	219	111
Summer, 151 days	194	266
Total, 299 days	413	377
Variable Costs per Head:[2]		
Hay, $50/ton	$38.48	$1.85
Soybean Meal, $160/ton	11.84	23.68
Grain, $90/ton	26.64	–
Minerals and Salt	1.20	1.20
Winter Grass, 1.5 acres	–	19.50
Summer Grass, 4.0 acres	60.00	60.00
Veterinary Costs	7.00	7.00
Fuel, Oil, Utilities	6.00	6.00
Repairs	5.50	5.50
Misc.	3.50	3.50
Marketing Costs	10.00	10.00
Interest on Cattle, 14%	31.19	31.19
Total Variable Costs	201.35	143.89
Fixed Costs per Steer:		
Depreciation on Bldgs. and Equip.	5.50	5.50
Interest on Bldgs. and Equip.	7.70	7.70
Taxes and Ins. on Bldgs. and Equip.	1.10	1.10
Total Fixed Costs	14.30	14.30
Total Costs per Steer:		
Variable Cost	201.35	143.89
Fixed Cost	14.30	14.30
Steer Cost, 400 lb @ $.68 lb	272.00	272.00
Death loss, 3%	8.16	8.16
Total	493.81	438.35
Return per Steer:		
400 lb + 413 lb @ $0.64/lb	520.32	–
400 lb + 377 lb @ $0.64 lb	–	497.28
Return over Total Cost (less labor)	26.51	58.93
Selling Price Needed to Cover Total Costs (less labor) per Cwt.	$60.74	56.42

[1]Gain values are from Kans. Agr. Expt. Sta. Bull. 638.
[2]Some of these values taken from Kans. Ext. Publ. MF-594, Revised, 1983.

Stocking Rate and Supplementation of Steers Grazing Bluestem Pasture in Early Summer

Ed F. Smith, Ronald W. Graber, Jack Riley
Clenton Owensby[1], and R.R. Schalles

Summary

Native bluestem pastures were grazed from May 8 to July 18, 1984 by steers with an average beginning weight of 553 lb, at stocking rates of 1.7, 1.5, and 1.25 acres per steer. Gains per acre were higher (P<.0l) with increased stocking rate (97, 111, 132 lb/acre). Daily gains were similar for the three stocking rates (2.34, 2.35, 2.36 lb/day). Daily supplementation with about 1.5 lb sorghum grain plus Rumensin® per head significantly increased gains.

Introduction

Early-season intensive stocking (May 1 to July 15) of native bluestem pastures produces daily gains similar to those made during the same period at normal stocking rates season long. This trial evaluated different intensive stocking rates and the value of self-fed Rumensin® in a salt-limiting, sorghum grain mixture.

Experimental Procedures

One 63-acre and five 60-acre pastures were assigned randomly to one of three stocking rates: 1.7, 1.5, or 1.25 acres per steer from May 8 to July 18, 1984 with two pastures per stocking rate. Steers in one pasture at each stocking rate received a Rumensin® -sorghum grain supplement (Table 2.2), while steers in the other pastures received only salt. The steers, primarily of British breeding, averaged 553 lb initially.

Results

Results in Table 2.1 and Table 2.2 show no differences in daily gain among stocking rates. Supplementation increased (P<.0l) gains of steers over nonsupplemented steers for all stocking rates. Steers on the high and low stocking rates showed the best response to supplementation. Economically it makes sense at present cattle prices and interest costs to supplement with low levels of grain, since about 1 lb of added gain was made for each 4.2 lb of supplemental feed containing Rumensin® . Gains per acre were increased with both the highest stocking rate and supplementation.

Grass remaining after mid-July was greater at the lowest stocking rate and decreased with increased rates (Table 2.3 and 2.4). Forbs remaining after mid- July were significantly higher for the medium stocking rates than for the high or low stocking rates.

[1] Department of Agronomy.

Table 2.1. Effect of Stocking Rate on Performance of Steers Grazing Intensive Early Stocked Bluestem Pastures for 71 Days

Item	Stocking Rate (acres per steer) 1.7	1.5	1.25
Steers per Treatment	70	80	96
Beginning Wt., lb	565	550	544
Total Gain per Steer, lb	165	166	165
Daily Gain per Steer, lb	2.33	2.34	2.32
Gain per Acre, lb	97[a]	111[b]	132[c]

[a b c]Values in same row with different superscripts differ significantly (P<.0l).

Table 2.2. Effect of Grain Supplementation on Performance of Steers Grazing Intensive, Early-Stocked Bluestem Pastures

	Supplemented			Nonsupplemented		
Stocking Rate (acres/steer)	1.7	1.5	1.25	1.7	1.5	1.25
Steers per Treatment	35	40	48	35	40	48
Supplement per Head Daily (self-fed):						
Ground Sorghum Grain, lb	1.09	1.56	1.58	0	0	0
Salt, lb	.16	.24	.25	0	0	0
Rumensin®, mg	105	151	162	0	0	0
Total Gain per Steer, lb	180	172	180	150	161	150
Daily Gain per Steer, lb	2.54	2.42	2.53	2.12	2.26	2.12
Gain per Acre, lb	106	115	144	88	107	120
Supplemented vs Nonsupplemented:						
Total Gain per Steer, lb	177[a]			154[b]		
Daily Gain per Steer, lb	2.50[a]			2.17[b]		
Gain per Acre, lb	121[a]			105[b]		

[a b]Values in the same row with different superscripts differ significantly (P<.0l).

Table 2.3. Grass Remaining in Mid-July and Early October following Grazing at Indicated Stocking Rates from May 8 to July 18, 1984

	Grass Yield, Lb per Acre					
	Supplemented			Nonsupplemented		
Stocking Rate (acres/steer)	1.7	1.50	1.25	1.7	1.50	1.25
Range Site:				Mid July		
Loamy Upland	2230	1654	1054	1594	1268	1263
Breaks	1918	1033	674	817	759	685
				Early October		
Loamy Upland	2057	1739	1326	1676	1290	1271
Breaks	1580	996	753	846	846	661

Table 2.4. Forbs Remaining in Mid-July and Early October following Grazing at Indicated Stocking Rates from May 8 to July 18, 1984

	Forb Yield, Lb per Acre					
	Supplemented			Nonsupplemented		
Stocking Rate (acres/steer)	1.7	1.50	1.25	1.7	1.50	1.25
Range Site:				Mid July		
Loamy Upland	276	415	231	203	551	398
Breaks	159	162	258	135	273	119
				Early October		
Loamy Upland	188	416	357	155	456	296
Breaks	213	201	335	114	114	95

Mineral, Rumensin®, and Chlortetracycline Supplementation for Steers on Native Bluestem Pasture

Ronald W. Graber, Ed F. Smith, C.E. Owensby[1], Jack Riley, and R.R. Schalles

Summary

Eighty steers, primarily of British breeding, were allotted to one of four treatments and maintained on native bluestem pastures from January 11, 1984 to October 2, 1984. Steers received either chlortetracycline or Rumensin®, with and without mineral supplementation.

Daily gains were higher (P<.05) for steers fed Rumensin® both in the winter and summer than those getting chlortetracycline. Mineral supplementation increased (P<.01) total gain and summer gain but had no significant effect over the winter period.

Introduction

Continuous low level feeding of chlortetracycline has improved cattle performance in some situations. The basis for the improvement is not clear but may be due to control of subclinical infections. Feeding Rumensin® also has improved cattle performance on grass. This is due in part to increased digestion and utilization of the grass because of increased rumen retention time and a shift in the volatile fatty acid production. Rumensin® also has been shown to increase feed efficiency. Chemical analysis shows mature bluestem pasture to be deficient in some minerals, notably phosphorus. This study compared the effects of feeding chlortetracycline or Rumensin® with or without mineral supplementation.

Experimental Procedures

Four groups of 20 steers (averaging 434 lb) were assigned to receive supplements containing Rumensin® or chlortetracycline, with or without a mineral mixture. The steers were maintained in four native bluestem pastures, with the groups rotated every two weeks to minimize pasture differences. During the winter, Rumensin® and mineral supplements were fed three times a week in a concentrate mix supplying 1 lb each of grain sorghum and soybean meal per head daily. The chlortetracycline was mixed in salt and fed free choice. During the summer, supplements were mixed with salt and fed free choice in mineral feeders. Intake levels of supplements and individual minerals are shown in Tables 3.1, 3.2, 3.3, and 3.4 for the summer and winter periods.

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[1]Department of Agronomy.

Results

Results are shown in Table 3.5, 3.6, and 3.7. Steers fed Rumensin® gained more ($P<.05$) than those fed chlortetracycline. Mineral supplementation increased ($P<.01$) gains in the summer and increased total gain but had no significant effect in the winter.

Table 3.1. Daily Supplement Fed Per Head During the Winter Period

Item	Groups			
	1	2	3	4
Salt, lb	.10	.09	.10	.08
Chlortetracycline, mg	-	-	320	286
Grain Sorghum, lb	1.0	1.0	1.0	1.0
Soybean Meal, lb	1.0	1.0	1.0	1.0
Rumensin®, mg	120	120	-	-
Potassium Chloride, lb	.05	-	.05	-
Dicalcium Phosphate, lb	.15	-	.15	-
Trace Mineral Mix, lb[1]	.01	-	.01	-

[1]See Table 3.3.

Table 3.2. Daily Supplement Fed Per Head During the Summer Period

Item	Groups			
	1	2	3	4
Rumensin®, mg	153	152	-	-
Chlortetracycline, mg	-	-	336	347
Dicalcium Phosphate, lb	.10	-	.13	-
Trace Mineral Mix, lb[1]	.01	-	.01	-
Salt, lb	.03	.04	.06	.08
Molasses, lb	.01	.01	.01	.01

[1]See Table 3.3.

Table 3.3. Estimated Daily Mineral Requirements Compared to Levels Supplied in Mineral Supplements of Four Groups of Cattle

Mineral	Required Levels	Winter Groups 1	2	3	4	Summer Groups 1	2	3	4
Calcium, g	13.9	15.8	-	15.8	-	10.5	-	13.6	-
Phosphorus, g	12.8	12.7	-	12.7	-	8.5	-	11.0	-
Manganese, mg	29.0	18.9	-	18.9	-	18.9	-	18.9	-
Zinc, mg	145.0	108.4	-	108.4	-	108.4	-	108.4	-
Iron, mg	58.0	43.0	-	43.0	-	43.0	-	43.0	-
Copper, mg	23.0	11.0	-	11.0	-	11.0	-	11.0	-
Iodine, mg	.6	.7	-	.7	-	.7	-	.7	-
Cobalt, mg	.4	.4	-	.4	-	.4	-	.4	-
Magnesium, g	4.0	2.5	-	2.5	-	2.5	-	2.5	-
Potassium, g	34.8	11.3	-	11.3	-	11.3	-	11.3	-
Sodium, g	2.9	.6	-	.6	-	.6	-	.6	-

Table 3.4 Daily Mineral Intake of Steers from Grass, Water, Grain Sorghum, and Soybean Meal.

Mineral	Winter Grass[1,2]	Winter Water[2]	Winter Sorghum Grain[2]	Winter Soybean Meal[2]	Summer Grass[1,2]	Summer Water[2]
Calcium, g	23.8	3.4	.4	3.4	36.6	3.4
Phosphorus, g	1.3	-	1.8	3.8	9.9	-
Maganese, mg	157.7	-	16.3	18.9	213.7	-
Zinc, mg	210.2	-	35.1	108.4	210.2	-
Iron, mg	1608.0	-	29.9	114.7	3483.6	-
Copper, mg	59.7	-	4.2	9.9	213.7	-
Iodine, mg	-	-	-	-	-	-
Cobalt, mg	.8	-	.1	.1	.8	-
Magnesium, g	3.4	2.3	.9	6.1	6.1	2.3
Potassium, g	29.6	.2	1.9	8.0	78.4	.2
Sodium, mg	47.4	-	156.6	47.4	47.4	-

[1] Assumed grass intake of 12.8 lb per head daily.

[2] Values based on analysis and NRC tables.

Table 3.5. Effect of Mineral, Antibiotic, and Rumensin® Supplementation on Daily Gains of Steers on Native Blustem Pasture

	Rumensin®		Chlortetracycline	
Item	Salt	Salt + Mineral	Salt	Salt + Mineral
Winter Daily Gain, lb[1]	.47[a]	.41[a]	.40[ab]	.32[b]
Summer Daily Gain, lb[2]	1.82[b]	1.96[a]	1.52[c]	1.85[ab]
Total Daily Gain, lb	1.25[a]	1.31[a]	1.05[b]	1.21[a]

[abc]Values in same row with different superscripts differ significantly ($P<.05$).

[1]January 11 - May 1, 1984 - 111 days.

[2]May 1 - October 2, 1984 - 154 days.

Table 3.6. Effect of Rumensin® and Chlortetracycline Supplementation on Steer Gains

Item	Rumensin®	Chlortetracycline
Winter Daily Gain, lb	.44[a]	.36[b]
Summer Daily Gain, lb	1.89[a]	1.69[b]
Total Daily Gain, lb	1.28[a]	1.13[b]

[ab]Values in same row with different superscripts differ significantly ($P<.05$).

Table 3.7. Effect of Mineral Supplementation on Steer Gains

Item	Mineral	No Mineral
Winter Daily Gain, lb	.36	.43
Summer Daily Gain, lb	1.90[a]	1.67[b]
Total Daily Gain, lb	1.26[a]	1.15[b]

[ab]Values in same row with different superscripts differ significantly ($P<.01$).

Implant Comparisons for Grazing Yearling Steers[1]

Scott Laudert[2], Larry Corah, Rick Nelson[3],
and Charlie Sauerwein[4]

Summary

Three field trials were conducted with grazing yearling steers to compare Compudose® and Ralgro® implants. Compudose®-implanted steers gained faster ($P<.05$) than controls. Ralgro® improved daily gain by 3.8%. No significant difference was found between implants.

Introduction

Many stocker operators running yearling steers in summer grazing programs are using implants to increase daily gains. As new implants become available, producers need to know how the new implants compare with those currently being used. These trials were conducted to compare Compudose® and Ralgro® implants with grazing yearling steers.

Experimental Procedures

Three field trials were conducted to compare Compudose and Ralgro® implants in grazing yearling steers. In each trial, steers were allotted randomly to three treatment groups: Control (no implant); Compudose; or Ralgro®. All steers were individually identified and weighed at the beginning and end of the grazing period. Implants were administered at the beginning of each trial according to the manufacturer's recommendations. The studies used 109 steers averaging 656 lb in trial 1, 109 steers averaging 537 lb in trial 2, and 128 steers averaging 590 lb in trial 3. Trial 1 began May 24, 1984, and was completed 109 days later; trial 2 began April 9, 1984, and lasted 150 days; trial 3 began April 17, 1984, and was completed 140 days later. Data from each trial were analyzed separately and pooled for combined analysis by Least Squares Procedures to remove effects of variation in initial weight.

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[1]Appreciation is expressed to Wiley McFarland, Cimarron, KS; Gary Aldridge, Ashland, KS; and Jack and Allen Grothusen, Ellsworth, KS for supplying cattle and facilities, and to International Minerals and Chemical Corp. and Elanco Products Company for trial support.

[2]Extension Livestock Specialist, Southwest Kansas.

[3]Clark County Extention Agricultural Agent.

[4]Gray County Extension Agricultural Agent.

Results

Based on the combined results of the three trials, Compudose® and Ralgro® increased daily gain 6.9% and 3.8%, respectively, over controls. Compudose®-implanted steers gained faster ($P<.05$) than the control steers, but not significantly different from the Ralgro®-implanted steers.

Table 4.1. Comparison of Compudose and Ralgro Implants for Grazing Yearling Steers

Item	Implant Treatment		
	Control	Compudose®	Ralgro®
		Trial 1 - 109 Days	
No. of Steers	37	35	37
Final Wt., lb	809	815	812
Daily Gain, lb	1.41	1.46	1.43
		Trial 2 - 150 Days	
No. of Steers	38	37	34
Final Wt., lb	739	752	742
Daily Gain, lb	1.35	1.43	1.37
		Trial 3 - 140 Days	
No. of Steers	19	54	55
Final Wt., lb	871	905	899
Daily Gain, lb	2.01^{a}	2.25^{b}	2.21^{b}
		3 Trials Combined	
No. of Steers	94	126	126
Daily Gain, lb	1.60^{a}	1.71^{b}	1.66^{ab}

[ab] Values within the same row with different superscripts are significantly different ($P<.05$).

Effect of Treating Tall Fescue Pasture with Mefluidide on Performance of Grazing Steers[1]

Lyle Lomas[2] and Joe Moyer[2]

Summary

Mefluidide (Embark®) delays maturity and suppresses seed head formation in grasses. Mefluidide treatment increased the crude protein content of fescue pasture and improved daily gain of grazing steers by 14.3% (.21 lb per head daily).

Introduction

Mefluidide is a relatively new plant growth regulator, which is capable of improving forage quality and subsequently increasing weight gains of livestock. It increases forage quality by delaying maturity and suppressing seed head formation. In 1984, the Environmental Protection Agency approved an experimental use permit for evaluation of mefluidide on tall fescue, orchardgrass, and smooth bromegrass in Kansas. Using that permit, we evaluated the effect of treating tall fescue with mefluidide on performance of grazing steers.

Experimental Procedures

Four 5-acre Kentucky 31 fescue pastures with an average Epichloe typhina endophyte infestation level of 85% were used to evaluate the effect of mefluidide treatment on grazing steer performance. All pastures were topdressed with 80-40-40 lb of N-P_2O_5-K_2O per acre on February 6, 1984 and with 50 lb of N per acre on September 13, 1984. On April 17, 1984, 1 pint of Embark 2-S® in 30 gallons of water (with X-77 surfactant) was applied per acre to two of the pastures, using a field sprayer with flat fan nozzles. At the time of application, the fescue was approximately 4 inches tall. The two untreated pastures were designated as controls.

Thirty-two Angus x Hereford steers were implanted with Ralgro®, wormed with Tramisol®, and randomly assigned to the four pastures, eight steers per pasture on April 17. Grazing was initiated on control pastures on April 17, but steers were not allowed to graze the mefluidide-treated pastures until May 1 because of the 14-day grazing restriction following mefluidide application. Those steers grazed smooth bromegrass and then were reweighed before they were turned onto the fescue. Initial and final weights were taken following a 16-hour shrink without feed and water. Forage samples were analyzed for crude protein throughout the study. All steers received 150 mg of Rumensin® in 2 lb rolled milo per head daily and were reimplanted with Ralgro® on August 21. The study ended on November 27, 1984.

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[1] Mefluidide and partial financial assistance were provided by 3-M Agricultural Products, St. Paul, MN.

[2] Southeast Kansas Branch Experiment Station.

Results

A summary of the effect of mefluidide on fescue crude protein content is presented in Table 5.1. Mefluidide increased ($P<.05$) average crude protein content of fescue pasture with the greatest increase occurring in late June.

Steer performance results are shown in Table 5.2. Steers on mefluidide treated pastures gained 14.3% more (.21 lb per head daily) than controls and tended to shed their winter hair earlier in the summer. Pastures treated with mefluidide produced 37 lb more steer gain per acre than untreated controls. Mefluidide application resulted in 90 to 95% fescue seed head suppression.

If approved for use, mefluidide may be a useful management tool for producers that graze fescue during the summer months.

Table 5.1. Effect of Mefluidide on Fescue Crude Protein Content.

	% Crude Protein, Dry Basis	
Date	Control	Mefluidide
May 3	20.1	21.6
29	9.6	10.6
June 12	7.9	10.8
26	11.4[a]	15.4[b]
July 10	6.5	7.2
25	8.4	9.4
Aug. 6	9.6	10.3
Sept. 28	13.4	15.6
Oct. 19	22.6	21.0
AVERAGE	12.2[a]	13.5[b]

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

Table 5.2. Effect of Mefluidide on Grazing Steer Performance.

Item	Control	Mefluidide
No. Steers	16	16
Initial Wt., lb	416	446
Final Wt., lb	746	799
Total Gain per Steer, lb	330	353
Days on Trial	224	210
Average Daily Gain, lb	1.47[a]	1.68[b]
Stocking Rate, steers/acre	1.6	1.6
Liveweight Gain, lb/acre	528	565

[a b] Means with different superscripts differ significantly ($P<.0l$).

Factors Affecting Conception Rates in Heifers and Cows Synchronized with Syncro-Mate-B®[1]

J.T. Brink, C.D. Middleton, and G.H. Kiracofe

Summary

In five trials during 1983 and 1984, 238 cows and 54 heifers were synchronized with Syncro-Mate-B® and artificially inseminated 48 hours after implant removal. The conception rate was 42.5% in cows that were cycling and 19.8% in cows that were not cycling before Syncro-Mate-B® treatment. Heifers started on the Syncro-Mate-B® treatment before day 11 of the estrous cycle had a higher conception rate (64.3%) than heifers started after day 11 (38.5%). Conception rates among the trials varied from 19.8 to 64.3%.

Introduction

Syncro-Mate-B® was approved by the Food and Drug Administration in 1982 for use in the synchronization of beef and dairy heifers only. Conception rates have fluctuated between 20 and 60% in cattle synchronized with Syncro-Mate-B®. The objective of our experiments was to identify factors that affect these conception rates.

Experimental Procedures

In our trials, 238 crossbred cows and 54 Angus, Hereford, and Simmental heifers were subjected to the standard Syncro-Mate-B® treatment which consisted of a 6 mg subcutaneous implant of norgestomet in place for 9 days and an intramuscular injection containing 5 mg of estradiol valerate and 3 mg of norgestomet given at the time of implanting. Both cows and heifers were artificially inseminated approximately 48 hours after implant removal. Calves were separated from cows between implant removal and insemination. Prior to Syncro-Mate-B® treatment, two blood samples were taken from each cow for serum progesterone analysis to determine if they were cycling. Heifers were heat checked twice daily and treated with Syncro-Mate-B® on known days of the estrous cycle.

Results and Discussion

Cow data from four trials were pooled and the conception rate in cows cycling prior to synchronization was compared to that of cows not cycling. Only 19.8% (22 of 111) of the noncycling cows conceived to the synchronized insemination, while 42.5% (54 of 127) of the cycling cows conceived (Table 6.1). These data demonstrate the importance of having a high percentage of the herd cycling at the start of the breeding season when synchronization is used. Syncro-Mate-B® does induce estrus in some noncycling animals. However, our data

[1]Syncro-Mate-B® is not approved for use in cows. The use of this product in our experiment was for investigational purposes only.

indicate only about 20% of cows that are not cycling prior to treatment will conceive. This percentage may be lower depending on how close cows are to cycling.

Stage of the estrous cycle when Syncro-Mate-B® treatment is initiated also appears to influence conception rate (Table 6.1). Heifers started on Syncro-Mate-B® before day 11 (estrus = day 0) of the cycle had a 63.4% conception rate (18 of 28), while those started after day 11 had a conception rate of 38.5% (10 of 26). This difference may account for some of the variability seen in the use of Syncro-Mate-B®.

Our results emphasize the importance of having as many cows as possible cycling before synchronization. Adequate postpartum interval, body condition, and plane of nutrition are all extremely important factors in getting cows to cycle early in the breeding season.

Table 6.1. Conception Rates of Cows and Heifers Synchronized With Syncro-Mate-B®

Group	Number Head	% Conceived to Synchronized Insemination
Cycling Cows	127	42.5
Noncycling Cows	111	19.8
Heifers (early cycle)	28	64.3
Heifers (late cycle)	26	38.5

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How Does Syncro-Mate-B® Synchronize Estrus?

The Syncro-Mate-B system consists of an implant containing synthetic progesterone, and an injection at implanting time of progesterone and estradiol. Nine days later, the implant is removed. The idea is to mimic progesterone output from the corpus luteum (CL). At ovulation, a CL forms on the ovary. If the cow is bred, the CL is maintained. The CL produces progesterone, helps maintain pregnancy, and prevents the cow from showing estrus. If the cow is not bred, the CL regresses in about 17 days, and the cow cycles again. With Syncro-Mate-B, the injection causes the CL to regress, but the implant provides progesterone. At implant removal, the decline in progesterone activity should allow estrus and ovulation.

Near normal fertility can be expected in cycling cows, and timed insemination can be as effective as breeding by estrus. Producers should, however, check estrus for a period before and after inseminating. Cows should be at least six weeks postpartum before implantation. Variation in fertility can be large, but synchronization usually works well with proper nutrition and management.

Syncro-Mate-B is approved only for use in dairy and beef heifers, and approval is being sought for use in beef cows.

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A Comparison of Estrus Synchronization with Syncro-Mate-B® to Natural Service[1]

Carroll Middleton, Tom Brink, Guy Kiracofe,
John Brethour[2] and Ray Negus[2]

Summary

Conception rates and subsequent calving dates were compared between cows synchronized with Syncro-Mate-B® and inseminated by appointment and nonsynchronized cows bred by natural service. Average conception date was seven days earlier in the synchronized cows.

Introduction

Artificial insemination in beef cows remains unused by many cattlemen due to the intensive labor requirement. This experiment was designed to determine if artificial insemination can be used without heat checking after synchronization with Syncro-Mate-B® (SMB). Natural service (unsynchronized) was compared to timed insemination following estrus synchronization. Synchronizing estrus allows more opportunities for conception during the breeding season. The likelihood of earlier conception translates into an older, heavier calf at a set weaning date.

Experimental Procedures

Sixty-seven fall calving cows at the Fort Hays Branch Experiment Station were divided into two groups by age, postpartum interval, and cycling status. Treatment was timed so that cows synchronized with Syncro-Mate-B® were artificially inseminated on the same day the bull was turned with the unsynchronized control group.

The standard Syncro-Mate-B® treatment regime was followed: implant and inject, remove the implant and remove the calves nine days later, inseminate 48 hours after implant removal, then return the calves.

A cleanup bull was turned in with the cows in the treatment group three days after artificial insemination. A Simbrah bull (cows) and a Hereford bull (heifers) were used for artificial insemination. Using bulls of different breeds helped ascertain the sire of calves born before or after the expected calving date.

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[1] Syncro-Mate-B® is not approved currently for use in cows. The use of this product in our experiment was for investigational purposes only.

[2] Fort Hays Branch Experiment Station.

Results and Discussion

There was no difference in overall conception rate between the synchronized and control groups (Table 7.1). However, synchronized cows conceived seven days earlier. Under these circumstances, synchronization appears economical due to earlier, heavier calves.

Another use of this program would be to decrease calving interval in cows that are going over one year between calvings, thus reducing feed costs per calf weaned. Syncro-Mate-B® has been FDA approved for heifers but not cows. Results with Syncro-Mate-B® on heifers have been quite variable, and this may hold true with cows. Additional data are being collected to ascertain the source of these variable results.

Table 7.1. Camparison of Unsynchronized Cows with Cows Synchronized with Syncro-Mate-B®

Item	Synchronized Number	Synchronized Percent	Control Number	Control Percent
Number of Cows	34	—	33	—
Noncycling	6[a]	17.6	5	15.2
Pregnant:				
1st 10 Days of Breeding Season	18	52.9	7	21.2
1st 20 Days of Breeding Season	22	64.7	17	51.5
End of 60 Day Breeding Season	33	97.1	32	96.9
Number of AI Calves	18		—	
Average Number of Days from Start of Breeding to Conception	24		31	

[a]Three conceived to artificial insemination.

Effect of Prepartum Protein Level on Calf Birth Weight, Calving Difficulty, and Reproductive Parameters of First Calf Heifers and Mature Beef Cows

R.P. Bolze, L.R. Corah, G.M. Fink, and L. Hoover

Summary

Two trials were conducted to determine if precalving protein intake would influence calf birth weight and calving difficulty. In Trial 1 (1983), 38 spring-calving Simmental heifers and 49 cows were allotted to three, 112 day isocaloric prepartum nutritional treatments: 75 (low), 100 (control) or 150 (high) percent of daily crude protein requirements (1976 NRC) for heifers or cows in the last trimester of pregnancy. In Trial 2 (1984), 22 heifers and 51 cows were allotted to control and high protein treatments only. After calving, cows were fed to meet NRC requirements. In Trial 1, the low protein level decreased prepartum weight gain but had no effect on postpartum weight change, pre- or postpartum condition change, postpartum interval (PPI), percent cycling in the first 21 days of the breeding season, first service or overall conception, milk production, calving difficulty, calf birth or 205 day weight. In both trials, high protein intake increased prepartum weight gain and condition score, shortened the PPI and increased percent cycling in first 21 days of breeding season but had no effect on first service or overall conception, milk production, calving difficulty, calf birth or 205 day weight.

Introduction

Energy levels prior to parturition can significantly influence calf birth weight, calving difficulty, and calf losses shortly after birth. The effects of prepartum protein intakes on these factors is unknown. Therefore, our objective was to determine if prepartum protein intake influences calf birth weight, calving difficulty, or reproductive performance in first calf heifers and mature beef cows.

Experimental Procedures

In trial 1, 38 spring calving Simmental heifers and 49 cows bred to the same sires by AI and natural service were allotted by weight, age, percentage Simmental breeding, and expected calving date to one of three isocaloric diets containing 75% (low), 100% (control) or 150% (high) of the NRC (1976) daily crude protein recommendations for the last 112 days prior to average calving date. In trial 2, 22 heifers and 51 cows were allotted to control and high levels only. Daily crude protein intake for low, control and high protein intake heifers and cows was 1.7, 2.3, 3.4 and 1.1, 1.4, 2.1 lb, respectively. Daily total digestible nutrient (TDN) intake was 13.8 and 11.3 lb for heifers and cows, respectively. In both trials, initial body weights and condition scores (average of three evaluators) were determined. Two-day average body weights were monitored at 21-day intervals until calving, within three days prepartum, within 24 hours postpartum and at weaning. Condition scores were reevaluated at calving and weaning. Calving difficulty was scored and calf birth weight taken within 24 hours after parturition. At calving, cows and calves were placed on native range and fed supplemental alfalfa hay and milo to meet or exceed all postpartum nutritional needs (1976 NRC). Gomer bulls assisted twice daily observation to determine postpartum interval to first estrus. Breeding season consisted of a 42 day AI period followed by 21 days of exposure to clean up bulls. Pregnancy was determined by rectal palpation, and reproductive data included postpartum interval, percentage cycling in first 21 days of breeding season, first service and overall conception rate. Milk production was measured twice by the weigh/suckle/weigh technique and calf weaning weights were adjusted for age of dam, and calf age and sex.

Results and Discussion

No treatment by age of dam interactions existed for any variables analyzed, so heifer and cow data were combined. The low protein group gained less weight while the high protein group gained more than controls during the 112 day precalving period. Low and control protein cattle gained weight precalving, but their initial weights exceeded postpartum weights, and these groups lost condition prepartum indicating that the weight gain was due to fetal growth. Postcalving, the high protein cattle lost more or gained less weight than controls, while all groups lost condition during the lactation phase (Tables 8.1 and 8.2). Weight and condition changes prepartum would suggest possible calf birth weight differences, but protein intake had no effect on calf birth weight, calving difficulty or gestation length (Table 8.3). Cattle fed excessive protein could have been rebred earlier as this treatment shortened the postpartum interval and increased the percentage cycling in the first 21 days of the breeding season. Protein intake had no significant effect on first service or overall conception, milk production or adjusted 205 day calf weight (Table 8.4). These data suggest that the NRC protein requirements of gestating beef cows should be supplied. Excessive protein did not result in increased calf birth weight or calving difficulty, and the slight enhancement in reproductive performance is probably not cost effective.

Table 8.1. Body Weights and Weight Changes for Heifers and Cows on Various Prepartum Protein Levels

Item	Trial 1 - Protein Levels			Trial 2 - Protein Levels	
	Low	Control	High	Control	High
No. Heifers, Cows	13, 16	12, 16	13, 17	11, 26	11, 25
Initial Weight, lb	1214	1227	1213	1190	1183
Prepartum Weight, lb	1277^{a}	1350^{b}	1368^{b}	1300	1351
Prepartum Weight Change, lb	63^{a}	123^{b}	155^{c}	110^{a}	168^{b}
Postpartum Weight, lb	1128^{a}	1198^{ab}	1217^{b}	1140	1182
Fall Weight, lb	1140	1175	1141	1176	1186
Lactation Weight Change, lb	13^{a}	-23^{a}	-76^{b}	36^{a}	5^{b}

abcValues with different superscripts differ significantly (P<.05) within a trait and trial.

Table 8.2. Condition Scores[c] and Condition Score Changes for Heifers and Cows on Various Prepartum Protein Levels

Item	Trial 1 - Protein Levels			Trial 2 - Protein Levels	
	Low	Control	High	Control	High
Initial Condition Score	5.4[a]	5.4[a]	4.9[b]	5.6	5.7
Calving Condition Score	4.5[a]	4.7[ab]	5.1[b]	4.8	5.5
Prepartum Condition Score Change	-.8[a]	-.7[a]	.2[b]	-.7[a]	-.2[b]
Fall Condition Score	4.3	4.5	4.5	4.6	4.6
Lactation Condition Score Change	-.2	-.2	-.5	-.3[a]	-1.0[b]

[ab]Values with different superscripts differ significantly (P<.05) within trait and trial.
[c]1 = extremely thin, 5 = average, 9 = extremely fat

Table 8.3. Calving Data for Heifers and Cows on Various Prepartum Protein Levels

Item	Trial 1 - Protein Levels			Trial 2 - Protein Levels	
	Low	Control	High	Control	High
Birth Weight, lb	89.4	87.2	89.2	95.5	97.0
Calving Ease Score[a]	2.17	1.88	1.70	1.85	1.77
Calving Difficulty Incidence, %	48.3	32.1	36.7	30.6	25.7
Gestation Length, days	286.0	286.4	285.4	287.0	287.3

[a]1 = unassisted 3 = mechanical calf jack 5 = malpresentation
2 = slight assistance 4 = cesarean section 6 = calf death resulting from difficulty

Table 8.4. Reproductive Data, Milk Production and Calf Weights for Heifers and Cows on Various Prepartum Protein Levels

Item		Trial 1 - Protein Levels				Trial 2 - Protein Levels	
		Low	Control	High		Control	High
Postpartum Interval, Days		72.8[ab]	78.5[a]	62.3[b]		61.1	51.9
% Cycling in First 21 Days of Breeding Season		73.1[a]	70.8[a]	90.0[b]		56.5[a]	79.2[b]
Conception:							
First Service, %		29.4	45.5	58.8		47.1	32.4
Overall, %		76.9	76.6	77.0		75.3	85.0
Milk Production, lb/24 hr:	(68)[c]	19.7	18.2	15.1	(80)[c]	17.8	18.7
	(103)	22.9	17.4	19.0	(109)	17.4	17.9
Adj. 205 Day Calf Weight, lb		483.0	485.7	487.6		511.0	583.8

[ab]Values with different superscripts differ significantly (P<.05) within trait and trial.
[c]Days postpartum.

Comparison of 36 mg and 72 mg[1] Ralgro® For Suckling Steer Calves[2]

Danny D. Simms[3] and Ron Bolze

Summary

In order to evaluate whether a 72 mg Ralgro® dosage would improve growth response over 36 mg, 260 suckling steer calves on two Kansas ranches were assigned to five implant treatments. In trial 1, 72 mg Ralgro® increased gain more than 36 mg Ralgro®. In trial 2, all implant treatments gave only a slight increase in growth rate over controls. Thus, the results are inconclusive and warrant more research before an accurate evaluation of 72 mg Ralgro® for suckling steer calves can be made.

Experimental Procedures

Two hundred and sixty suckling, Simmental-cross steer calves on two Kansas ranches were assigned randomly at branding (2 to 3 mo. old) to these treatments: 1) Control - no implant, 2) 36 mg Ralgro® at branding, 3) 72 mg Ralgro® at branding, 4) 36 mg Ralgro® at branding and 36 mg Ralgro® at 5 to 6 months of age, or 5) 36 mg Ralgro® at branding and 72 mg Ralgro® at 5 to 6 months of age. Individual nonshrunk weights were taken at branding in May, at reimplanting in August, and at weaning in October. Least Squares Means Procedures were used to analyze the data.

Results

Results of these trials are shown in Table 9.1.

May to August. No significant treatment differences existed in trial 1 or trial 2, or when the data were combined during this early period.

August to October. Treatments with 72 mg Ralgro® increased or tended to increase daily gains more than treatments with 36 mg Ralgro® in Trial 1 and in the combined data. In fact, a single 72 mg implant at branding increased growth rate as much as 36 mg at branding plus 36 mg at reimplanting time. The fastest growth rate in trial 1 and in the combined data was obtained with the 36 mg + 72 mg Ralgro® treatment. However, in trial 2, calf gains on the implant treatments did not differ from controls.

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1 Note: 72 mg Ralgro® is not an approved dosage for Ralgro®. It was used in these trials under authorization of the FDA in conjunction with International Minerals and Chemical Co.

2 Appreciation is expressed to Norman Rohleder, Russell and Roger Wilson, Oberlin for providing cattle and assisting with data collection, and to County Extension Agricultural Agents Allen Dinkel, Decatur and Del Jepsen, Russell.

3 Extension Livestock Specialist, Northwest Kansas.

May - October. In trial 1, only the 36 mg + 72 mg Ralgro® treatment was superior to the control. In trial 2, and when the data were combined, all implant treatments gave only a slight increase in growth rate over control. Thus, the results of these two trials are inconclusive, indicating that more research with these implant treatments must be conducted before an accurate evaluation of 72 mg Ralgro® for suckling steer calves can be made.

Table 9.1. Results of Two Trials Comparing Various Dosages of Ralgro® for Suckling Steer Calves

	Implant Treatment				
Item	Control	36 mg Ralgro®	72 mg Ralgro®	36 mg Ralgro® + 36 mg Ralgro®	36 mg Ralgro® + 72 mg Ralgro®
No. Calves:					
Trial 1	25	26	23	25	26
Trial 2	27	28	28	27	25
Combined	52	54	51	52	51
Daily Gain, May to August, lb:					
Trial 1	2.34	2.32	2.34	2.43	2.34
Trial 2	2.40	2.47	2.45	2.40	2.36
Combined	2.39	2.41	2.41	2.43	2.37
Daily Gain, August to October, lb:					
Trial 1	1.36^{a}	1.47^{a}	1.61^{ab}	1.43^{a}	1.73^{b}
Trial 2	1.13	1.10	1.12	1.17	1.22
Combined	1.16^{a}	1.19^{a}	1.27^{ab}	1.21^{a}	1.38^{b}
Daily Gain, May to October, lb:					
Trial 1	1.97^{a}	2.00^{ab}	2.06^{ab}	2.05^{ab}	2.11^{b}
Trial 2	1.88	1.92	1.91	1.90	1.90
Combined	1.90	1.93	1.95	1.94	1.97
Increase over Control, May to October: Combined Trials					
Percent		1.6	2.6	2.1	3.7
Total Gain, lb		5.04	8.40	6.72	11.76

[ab]Values in the same row with different superscripts differ significantly (P<.10).

Effect of Fenbendazole on Cow-Calf Performance and Fecal Egg Counts[1]

Gerry Kuhl, Robert Ridley[2],
Eugene Francis[3] and Larry Riat[4]

Summary

A field trial was conducted with 80 cow-calf pairs to evaluate the effect of deworming both cows and calves with fenbendazole, on cattle performance and internal parasite burden. Midseason and weaning weights of calves in the fenbendazole-treated group averaged 22.4 and 33.5 lb heavier ($P<.04$), respectively, than controls. Cow and calf fecal egg counts were low throughout the grazing season and were not materially affected by treatment.

Introduction

Research evaluating the economic value of deworming cows and/or suckling calves has been inconsistent. Fenbendazole, a highly effective anthelmintic, has recently become available under the brandnames of Safe-Guard® and Panacur®. The purpose of this trial was to evaluate the effectiveness of this compound with cow-calf pairs grazing native range.

Experimental Procedures

Eighty cow-calf pairs were allotted to fenbendazole or control treatments based on the cows' previous performance records. The cattle were initially processed on April 25, 1984, prior to pasture turn out, with both cows and calves on the deworming treatment receiving fenbendazole oral suspension at the recommended body weight dosage. The cow herd had not been dewormed during the previous 18 months. Individual calf birth weights and dates were used in lieu of beginning trial weights. The calves averaged 49 days old at the beginning of the trial. Rectal fecal samples were randomly collected from about one-half of the cows and calves.

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[1]Sincere appreciation is expressed to Bevin Law, Longford, KS and Kent Law, DVM, Abilene, KS for supplying cattle, facilities and management, and to American Hoechst Corp., Somerville, NJ for providing fenbendazole and financial support. Special thanks to Jim Hoobler, Clay County Extension Agricultural Agent and Ron Bolze, Extension Assistant for assistance in data collection, and to Terry Goehring, Graduate Assistant for statistical analysis.

[2]Parasitologist, College of Veterinary Medicine.
[3]Extension Livestock Specialist, Northeast Kansas.
[4]Dickinson County Extension Agricultural Agent.

Cattle on both treatments were run together in the same rotationally grazed native pastures. In mid-summer (July 25 and 26), the calves were weighed, rectal fecal samples were collected, and those calves on the fenbendazole treatment were retreated with dewormer prior to pasture rotation.

At weaning time (November 14), the calves were weighed, cows were pregnancy tested, and fecal samples were obtained from the same cows and calves as initially. Fecal samples were analyzed for parasite eggs utilizing the sugar floatation centrifugation technique.

The effect of treatment on calf performance during the early season (up to July 25), during the late season (July 25 to November 14) and on weaning weight was evaluated using Least Squares Means Procedures to remove effects of dam age, calf age, sex and sire, and pasture.

Results and Discussion

The effect on cow performance of deworming cow-calf pairs in the spring, followed by retreating the calves midsummer, is shown in Table 10.1. Fenbendazole increased early season calf gains by 22.4 lb ($P<.03$) and 252 day weaning weights by 33.5 lb ($P<.04$) compared to controls. Deworming tended to increase late season calf gains, but this was not statistically significant. Fall pregnancy rates of the cows were not affected by treatment.

Table 10.2 shows the average fecal egg counts and percentage of cattle passing detectable levels of parasite eggs at the beginning of the trial, midseason, and at weaning time. Egg counts of cows and calves were very low irrespective of treatment. Level and incidence of fecal parasite eggs in the cows decreased from spring to fall. In contrast, the strongyles (major roundworms afflicting cattle) and tapeworm egg counts of calves increased during the grazing season, while strongyloides (intestinal threadworm) counts dramatically dropped from spring to summer and fall.

The level of coccidia oocysts in the fecal samples was also qualitatively evaluated to determine their incidence and seasonal changes. It should be noted that dewormers are ineffective against this internal parasite. However, we noted that the percentage of cows with detectable fecal oocysts decreased over the grazing season, while the incidence of coccidia in calves increased substantially from spring to fall, infecting 89 to 100% of the calves in the two groups at weaning time.

Table 10.1. Effect of Fenbendazole on Suckling Calf Performance

Treatment	Least Square Means, Lb: Early Season Gain-140 Days	Late Season Gain-112 Days	252 Day Weaning Wt.
Control	227.6[a]	139.4	453.0[c]
Fenbendazole	250.0[b]	150.5	486.5[d]

[a,b] Means with different superscripts are significantly different ($P<.03$).
[c,d] Means with different superscripts are significantly different ($P<.04$).

Table 10.2. Effect of Season of Year and Deworming on Fecal Egg Counts of Cows and Suckling Calves

Item	Cows: Control	Cows: Fenbendazole	Calves: Control	Calves: Fenbendazole
No. Cattle [1]	24	20	18	23
Spring (April 25):				
Strongyles, EPG (%)[2]	12.5 (58)	8.5 (40)	3.3 (11)	2.2 (17)
Strongyloides, EPG (%)[3]	1.2 (12)	ND (0)	62.8 (56)	90.0 (74)
Coccidia, %[4]	42	40	28	39
Summer (July 25):				
Strongyles, EPG (%)	—	—	22.8 (61)	32.6 (91)
Strongyloids, EPG (%)	—	—	1.1 (11)	.4 (4)
Tapeworms, EPG (%)	—	—	37.2 (6)	25.2 (9)
Coccidia, %	—	—	72	70
Fall (November 14):				
Strongyles, EPG (%)	.4 (4)	.5 (5)	45.0 (83)	37.8 (87)
Strongyloids, EPG (%)	ND (0)	ND (0)	ND (0)	ND (0)
Tapeworms, EPG (%)	ND	ND (0)	12.8 (11)	141.3 (30)
Coccidia, %	8	15	89	100

[1]Rectal samples were collected from the same animals during each season. Cows were not sampled in summer.

[2]Average eggs per gram and percentage of cattle with detectable levels of strongyles, including brown stomach, large stomach, and small intestinal worm species.

[3]Intestinal threadworms.

[4]Percentage of cattle with clinically significant levels of coccidia oocysts.

[5]Not detectable.

Estimating Frame Score from Hip Height and Age

R.R. Schalles

Summary

Frame score is a convenient way of describing the skeletal size of cattle. With adequate height growth curves most animals should maintain the same frame score throughout their life, while their actual height increases with age. Environmental factors can alter the normal skeletal growth rate. Nutrition level is a major factor. Cattle fed less than adequate nutrition will grow slower than the tables indicate, while cattle fed extremely high levels will grow faster. Large framed cattle grow faster and for a longer time than small framed cattle. Bulls grow faster than heifers. The accompanying tables and equations are currently the best estimates of cattle height growth rate and have been accepted by the Beef Improvement Federation.

Experimental Procedures

Hip height of 522 head of cattle at Michigan State University, University of Arkansas, University of Nebraska, and Kansas State University was measured by the same person approximately every two months from weaning until cattle numbers at a location became so few that further observations became impractical. The maximum age was approximately 22 months. The cattle included 241 bulls and 281 heifers representing Angus, Polled Hereford, Hereford, Charolais, and Red Poll. Growth curves were developed for each animal using nonlinear least-squares procedures from the model:

$$H = A + C\,(1 - e^{-B \times \text{age in days}})$$

Where

- H = Hip height in inches
- A = Estimate of Y intercept at age zero
- C = Estimate of growth curve slope
- B = Height growth rate
- e = constant (2.718)

The height at 365 days of age was calculated for each animal and frame score determined using 41 inches as frame score 1 for bulls and 39 inches as frame score 1 for heifers, with each unit increase in frame score increasing height 2 inches. This is in agreement with the original Missouri work. To simplify calculations, a linear equation was developed that would fit the growth curve over the age limits of the available data. The linear frame score equations using hip height, age, age squared, and the interaction between age and hip height gave an excellent fit to the nonlinear equations between the ages of 5 and 21 months. Frame score charts and equations are given in Tables 11.1 and 11.2. Figure 11.1 shows the growth curves of selected frame scores for heifers and bulls.

Table 11.1. Bull Hip Height in Inches and Frame Score*

Age in Months	Frame Score 1	2	3	4	5	6	7	8	9
5	33.6	35.2	36.8	38.4	39.9	41.5	43.1	44.7	46.3
6	34.9	36.5	38.2	39.8	41.5	43.1	44.8	46.4	48.1
7	36.1	37.8	39.5	41.2	42.9	44.7	46.4	48.1	49.8
8	37.2	39.0	40.8	42.6	44.3	46.1	47.9	49.6	51.4
9	38.3	40.1	42.0	43.8	45.6	47.4	49.3	51.1	52.9
10	39.3	41.2	43.0	44.9	46.8	48.7	50.6	52.5	54.4
11	40.1	42.1	44.0	46.0	48.0	49.9	51.9	53.8	55.8
12	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0	57.0
13	41.7	43.7	45.8	47.9	50.0	52.0	54.1	56.2	58.3
14	42.3	44.4	46.6	48.7	50.8	53.0	55.1	57.2	59.4
15	42.8	45.0	47.2	49.4	51.6	53.8	56.0	58.2	60.4
16	43.3	45.5	47.8	50.1	52.3	54.6	56.8	59.1	61.3
17	43.7	46.0	48.3	50.6	52.9	55.3	57.6	59.9	62.2
18	44.0	46.3	48.7	51.1	53.5	55.9	58.2	60.6	63.0
19	44.2	46.6	49.1	51.5	53.9	56.4	58.8	61.3	63.7
20	44.3	46.8	49.3	51.8	54.3	56.8	59.3	61.8	64.3
21	44.3	46.9	49.5	52.0	54.6	57.1	59.7	62.3	64.8

*Frame Score = -16.846 + 0.6745 (Ht) - .0212 (Days of Age) + .00003678 (Days of Age)^2 - .000468 (Ht)(Days of Age).

Table 11.2. Heifer Hip Height in Inches and Frame Score*

Age Month	Frame Score 1	2	3	4	5	6	7	8	9
5	33.2	35.2	37.3	39.4	41.4	43.5	45.6	47.7	49.7
6	34.1	36.2	38.3	40.3	42.4	44.4	46.5	48.6	50.6
7	35.1	37.1	39.2	41.2	43.3	45.3	47.4	49.4	51.5
8	35.9	38.0	40.0	42.1	44.1	46.2	48.2	50.2	52.3
9	36.8	38.8	40.8	42.9	44.9	46.9	49.0	51.0	53.0
10	37.6	39.6	41.6	43.6	45.6	47.7	49.7	51.7	53.7
11	38.3	40.3	42.3	44.3	46.3	48.3	50.3	52.4	54.4
12	39.0	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0
13	39.6	41.6	43.6	45.6	47.5	49.5	51.5	53.5	55.5
14	40.2	42.1	44.1	46.1	48.1	50.1	52.0	54.0	56.0
15	40.7	42.7	44.6	46.6	48.6	50.5	52.5	54.5	56.4
16	41.2	43.1	45.1	47.0	49.0	51.0	52.9	54.9	56.8
17	41.6	43.5	45.5	47.4	49.4	51.3	53.3	55.2	57.2
18	42.0	43.9	45.8	47.8	49.7	51.6	53.6	55.5	57.5
19	42.3	44.2	46.1	48.1	50.0	51.9	53.8	55.8	57.7
20	42.6	44.5	46.4	48.3	50.2	52.1	54.0	56.0	57.9
21	42.8	44.7	46.6	48.5	50.4	52.3	54.2	56.1	58.0

*Frame Score = -11.7542 + 0.4686 (Ht) - 0.0229 (Days of Age) + 0.0000121 (Days of Age)^2 + 0.0000874 (Ht)(Days of Age).

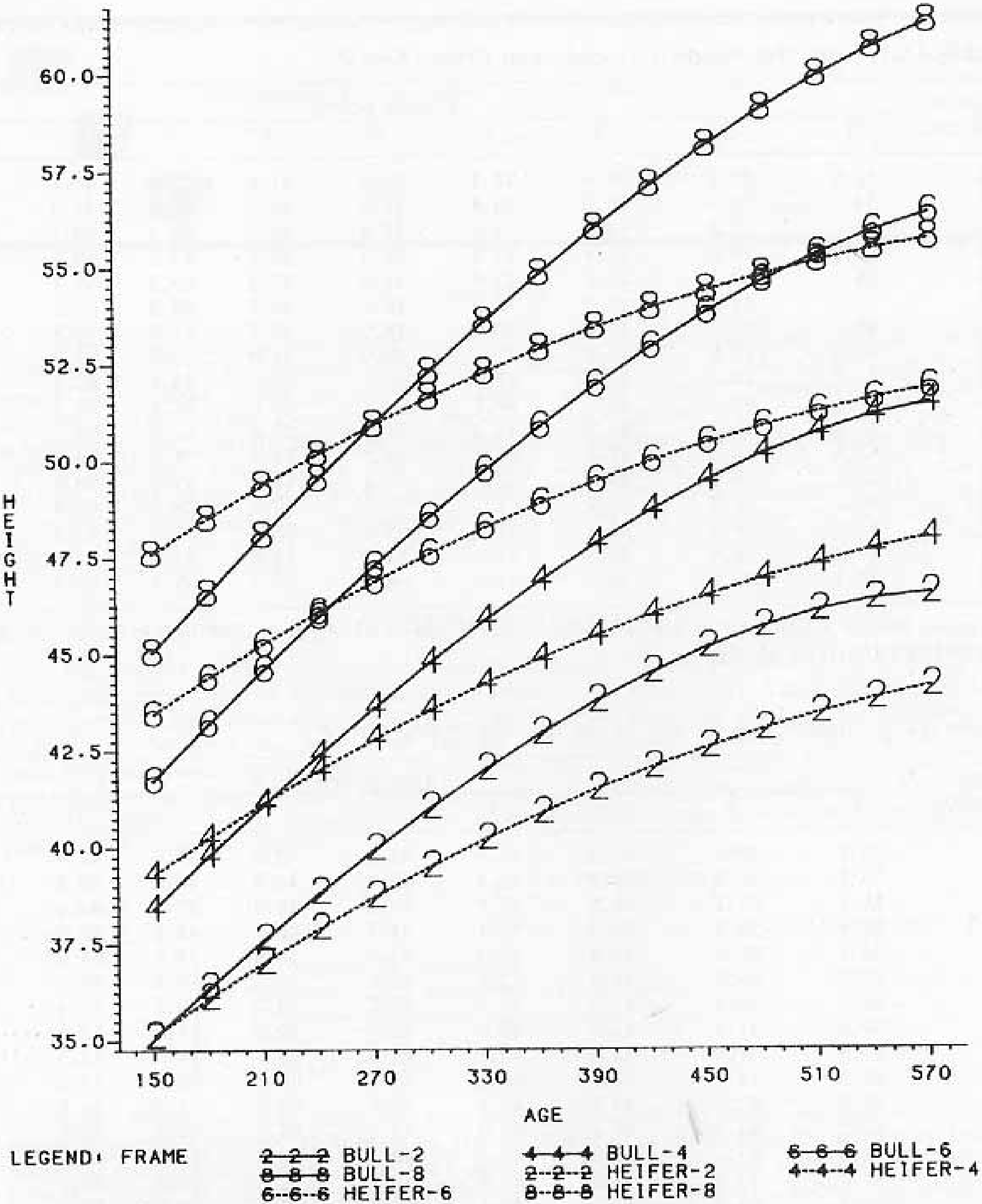

Figure 11.1. Hip height in inches and age in days for bulls and heifers in different frame scores.

The Effects of Levamisole, Receiving Diets, and Pre and PostTransit Potassium on Gain and Health of Stressed Calves[1]

Frank K. Brazle[2], Jack Riley,
Frank Blecha[3], J.B. McLaren[4]

Summary

We purchased 264 calves (125 bulls and 139 steers) in Tennessee and transported them to Kansas to evaluate the effects of levamisole injections and potassium supplementation, before and after transit, and feedlot receiving rations on performance and health of stressed calves. The calves were held for 48 to 96 hours in the order-buyer barn, fed either a 1.1% or 1.5% potassium (K) ration, transported for 24 hours, and fed either a 40% concentrate or hay-plus protein-supplement receiving diet fortified with either 1.1 or 1.7% K for 28 days. They were met in Kansas with 16 hr of cold driving rain, followed by severe cold temperatures, so stress was extreme. Subsequently, the calves grazed native pasture for 60 days.

Levamisole reduced (P<.10) feedlot mortality. Bulls were castrated upon arrival and levamisole reduced mortality in castrated bull calves more than in steer calves (P<.05). Levamisole tended to increase IBR antibody titers and enhance change in BVD titers. Mortality was 12.3% in calves fed the 40% concentrate diet and 8.5% in those fed hay and protein supplement. More (P<.10) medical treatments per calf were required in the concentrate-fed calves than in the hay-fed calves. Due to the extreme-stress conditions during the first week in the feedlot, the calves required most of the 28-day receiving period to recover purchase weight and gains were similar (P>.05) in all groups.

Fewer of the calves fed the 1.5% K pretransit diet died during the first 3 days in the feedlot than of those fed the control diet, but the posttransit K (1.7% K) diet resulted in a trend toward higher mortality during the receiving period.

Introduction

Feeder calves undergo numerous stresses while they are marketed, transported, and adapted to feedlot environments. These stressors, in combination with viral and bacterial pathogens, can increase incidence of bovine respiratory disease (BRD) and make adaptation to the feedlot environment difficult. Lack of appetite may add to the stress and increase the incidence of BRD.

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[1] This study was conducted in cooperation with the University of Tennessee. Partial financial assistance was provided by American Cyanamid Co., Priceton, NJ.
[2] Extension Livestock Specialist, Southeast Kansas.
[3] Department of Anatomy and Physiology.
[4] Department of Animal Science, University of Tennessee.

Experimental Procedures

In March 1983, three loads of calves were purchased at auction markets in Eastern Tennessee and North Carolina. The mixed-breed calves (125 bulls and 139 steers) were randomized to treatment groups within sex status at an order- buyer barn (OBB) in Newport, Tennessee. The calves were processed at the OBB and one third were injected with 10 ml of levamisole phosphate (13.65% active ingredient).

The calves were held at the OBB for 48 to 96 hours, depending on when they were purchased. The calves received 2 pounds of cracked corn per head daily with either 1.1 or 1.5% potassium supplementation, plus ad libitum intake of mixed grass hay. The calves were mainly medium-frame, number one-muscled calves that were black and red in color. Each load was penned separately at the OBB. The three loads of calves traveled together and were in transit for 24 hours. After arrival in Kansas, the calves were processed immediately and another third of the calves were injected with levamisole phosphate. All calves were vaccinated for infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD), parainfluenza$_3$ (PI_3), and blackleg (4-way). The bull calves were castrated with a knife, and the cords were stapled with steel staples. The calves consumed the receiving diets for 28 days, consisting of either a 40% concentrate diet or a grass hay ration plus 2 lb of 32% crude protein supplement. Each ration contained 1.1 or 1.7% potassium. This was followed by a holding period of 17 days, during which the calves were fed silage, then 60 days on native grass pasture (May 15 to July 14).

Calves were examined daily for visual signs of morbidity and treated when they were subjectively determined to be sick. Rectal temperatures of all calves were taken at the OBB, on arrival at the feedlot, and on days 7 and 14. If an animal's temperature exceeded 104° F, it was treated. The calves were mass medicated on days 3 and 4 when a high percentage were visually sick after 16 hours of exposure to cold driving rain, followed by severe low temperatures. This exposure resulted in an inordinate percentage of morbidity and a subsequent high death loss. A wide range of antibiotics, prescribed by a practicing veterinarian, was used.

Results and Discussion

Injection with levamisole either at the OBB or upon arrival at the feedlot decreased ($P<.10$) mortality (Table 12.1). Mortality was 14.8% in control calves, 9.6% in calves injected with levamisole at the OBB, and 6.8% in calves injected with levamisole upon arrival at the feedlot. There was a trend for levamisole to reduce mortality most in calves shipped as bulls and castrated upon arrival. Death loss was 19.0% for the control calves, 12.2% for those injected with levamisole at OBB, and 4.8% for those injected on arrival. Levamisole has been shown to increase antibody titers when administered with a vaccine. Our calves were vaccinated against BVD and IBR, and levamisole treatment tended to enhance the change in BVD antibody titers and increase IBR antibody titers at feedlot day 28.

The receiving diets (hay vs. concentrate) did not influence gain during the 28-day receiving period, but the high stress level may have nullified any ration effect. In fact, the castrated bull calves still had not recovered purchase weight after 28 days in the feedlot. These super-stressed calves required most of the 28 days to recover purchase weight. Of the concentrate-fed calves, 12.3% died vs

8.5% of the hay-fed calves. In the castrated bulls, morbidity was 14.3% of those fed the concentrate receiving diet vs. 9.7% of those fed the hay diet, with little difference in mortality. Calves fed the 40% concentrate diet required more ($P<.10$) medical treatments per calf from feedlot day 7 to day 28 than did those fed hay and protein supplement.

The concentrate-fed calves had higher ($P<.05$) body temperatures at feedlot day 14 than those fed the hay diet. They also tended to have less change in lymphocyte blastogenesis and BVD antibody titers than hay-fed calves. All the health parameters favored the hay diet in these super-stressed calves, especially with bull calves castrated on arrival. In calves subjected to less stress, a higher energy receiving ration may be desirable because of increased gains.

There was no clear-cut effect of supplemental potassium on mortality or morbidity. However, most of the forage that the calves consumed in Tennessee prior to transit contained at least 2.5% potassium. This may explain, in part, the failure of the calves to respond to higher dietary potassium at the feedlot. Earlier research showed a poorer response of fall-shipped calves when the potassium level reached 3.1%. The potassium level of the diet before calves enter the marketing channels may effect the level of potassium required in a receiving ration for maximum benefit in terms of reduced health problems.

Table 12.1. Effects of Levamisole and Receiving Diets on Calf Gains and Health

Item	Least Squares Means[a]: Control	Levamisole Injected at Tennessee		Injected at Manhattan
Total Gain, lb (purchase to end pasture period, 105 days)	141.0[b]	148.9[c]		152.5[c]
% Mortality: All calves	14.8[b]	9.6[c]		6.8[c]
Castrated Bulls	19.0[b]	12.2[c]		4.8[d]
		Feedlot Diet: Hay plus 2 lb Protein Suppl.		40% Concentrate
Receiving Period Gain, lb (28 days)		54.6		60.1
Silage and Pasture Gain, lb (77 days)		135.7		138.2
% Mortality: All calves		8.5		12.3
Castrated Bulls		9.7[b]		14.3[c]
No. Treatments/Animal (day 7 to 28)		.84[b]		1.12[c]
	Control	Feedlot K	OBB K	Feedlot and OBB. K
Purchase to Feedlot Day 28 Gain, lb	2.6	6.4	8.0	7.8
% Mortality	7.3[b]	16.6[c]	7.9[b]	9.9[b]

[a]The least squares model included levamisole, sex status, potassium, feedlot diet, feedlot diet by potassium interaction.

[bcd]Means within a row with a different superscript differ significantly ($P<.10$).

Effect of Sex Status and Breed-type on Performance of Highly Stressed Calves

F.K. Brazle[2], Frank Blecha[3], Jack Riley, and J.B. McLaren[4]

Summary

Bull and steer calves of mixed breed type were shipped from Newport, Tennessee to Manhattan, Kansas. Bull calves were castrated on arrival at Manhattan. Calves were classified into four breed types as follows: (1) black, polled, medium-frame, number one muscling; (2) white-faced, feather-necked, medium-frame, number one muscling; (3) black or red with white face, medium-frame, number one muscling; and (4) large-frame, mixed-color calves. The calves were in transit for 24 hours. Calves purchased and transported as steers outgained those purchased as bulls and castrated upon feedlot arrival by 26 lbs during the receiving phase and by 13 lbs on pasture. Fewer steer calves died than castrated bulls (7.7% vs. 13.2%). Steer calves had higher BVD antibody titers than bulls. Medium-frame, number one muscled, white-faced calves had a higher mortality rate (18.4%) than the average of other breed types (7.4%). The large-frame, number one muscled, mixed-color calves had the highest total gain.

Introduction

Substantial numbers of calves moving into western feedlots originate in the Southeastern United States and many are purchased as bulls. Thus, the stresses of marketing, transporting, and adapting to the feedlot are compounded by the additional stress of castration. Bull calves castrated soon after arrival at the feedlot generally gain faster than when castration is delayed for one or two weeks, but calves purchased as steers gain faster than bulls handled in either manner.

Experimental Procedures

The previous paper (page 31) describes how these cattle were purchased, transported, and handled during arrival and feedlot adaptation. Calves were classified as follows: (1) medium-frame, number one muscling, black, polled calves; (2) medium-frame, number one muscling, white-faced, feather-necked calves; (3) medium-frame, number one muscling, black or red, white-faced calves without white on the neck; and (4) large-frame, number one muscling, crossbred calves of mixed color.

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[1] This study was conducted in cooperation with the University of Tennessee.
[2] Extension Livestock Specialist, Southeast Kansas.
[3] Department of Anatomy and Physiology.
[4] Department of Animal Science, University of Tennessee.

Results and Discussion

Calves purchased and transported as steers gained 45.1 lbs (P<.001) more during the 105-day study than calves purchased and transported as bulls and castrated upon arrival (Table 13.1). However, bull calves shrank 8.5 lbs less (P<.1) during the transit period.

Steers gained more (P<.05) from purchase to feedlot day 28 than castrated bulls. Castrated bull calves had not regained purchase weight by the end of the 28-day receiving period, probably due to the excessive stress to which they were subjected. Steers gained 33 lbs more (P<.1) from purchase to the end of the pasture period than did the castrated bulls. If allowances were made for differences in mortality and chronic illness, the steers had 66 lbs more saleable weight at the end of the pasture period than calves purchased as bulls and castrated upon arrival.

Stress is difficult, if not impossible, to quantify. However, in this study, stress was extreme. It is possible that our results on castration upon arrival only apply to cattle under inordinate stress.

Black, polled, medium-frame, number one muscled calves shrank almost 5 lbs less (P<.1) than did calves of other breed types during transit (Table 13.2). Large-frame, number one muscling, mixed-color calves gained 21.5 lbs more (P<.10) than the average of the other breed types during the silage and pasture periods.

Mortality of the castrated bull calves was greater (P<.10) than that of steer calves (13.2% vs 7.6%). Moreover, the difference in mortality among calf types was surprising. Mortality ranged from 18.4% for white-faced, medium-framed, number one muscling calves down to 2.8% for the black, medium-framed, number one muscling calves. Death loss for the white-faced, medium-framed, number one muscling bull calves was 24.3%.

Steers had higher (P<.1) antibody titers for BVD both before shipment and after 28 days in the feedyard than did bulls, but BVD titer changes during the receiving period were similar. Thus, calves purchased as steers should have had more protection than the castrated bulls even though both groups were vaccinated against BVD. There was no difference between bulls and steers with respect to IBR titers after 28 days in the feedlot.

More (P<.05) treatments per animal were required for castrated bulls than steers (3.76 vs. 3.13) during the 28-day receiving period. More (P<.05) treatments per animal were required for white-faced, medium-frame, number one muscling calves than for the other groups, with the fewest (P<.05) treatments per animal required in the black, medium-frame, number one muscling group. All cattle were mass medicated on days 3 and 4. However, from feedlot day 7 to day 28, castrated bulls required 19.5% more treatments than did steers, and the white-faced, medium-frame, number one muscling calves required 30% more treatments than did calves of all other breed types. Steers had a greater (P<.1) change in serum lymphocyte blastogenesis from the order buyer's barn to feedlot day 28 than did bulls, indicating higher immune potential in the steers.

Bulls tended to have higher rectal temperatures than steers during the first 2 weeks. White-faced, medium-frame, number one muscling calves had higher (P<.1) rectal temperatures at the order buyer's barn and upon arrival at the feedlot than calves of other breed types. This may indicate that white-faced calves and bull calves are more susceptible to early stress.

Table 13.1. Effect of Sex Status on Calf Gain and Health

Item	Sex Status: Steers	Sex Status: Castrated Bulls	P
No. Animals	139	125	
	— Least Squares Means[a] —		
Purchase Wt., lb	519.4	526.9	
Transit Shrink, lb	-52.8^{f}	-44.0^{g}	<.10
Receiving Period Gain (28 days), lb	70.6^{d}	44.0^{e}	<.01
Silage and Pasture Gain (77 days), lb	146.7^{f}	128.2^{g}	<.10
Gain, Purchase to End of Pasture Period, lb	164.1^{f}	130.9^{g}	<.10
Purchase to End Receiving Period, lb	17.6^{b}	-5.1^{c}	<.05
Mortality, %	7.7^{f}	13.2^{g}	<.10
No. Treatments/Animal (28 days)	3.13^{f}	3.76^{g}	<.10

[a] The Least-squares model accounted for Leavamisole, calf type, potassium level, feedlot diet, sex status, and feedlot diet by potassium, and calf type by sex status interactions.

Table 13.2. Effects of Breed Type on Calf Gains and Health

Item	Black, Medium-Frame	White-Faced, Medium-Frame	Black & Red Baldy Medium-Frame	Large-Frame, Mixed Color
No. Animals	77	68	65	34
	— Least Squares Means[a] —			
Purchase Wt., lb	522.7	524.9	522.0	526.5
Transit Shrink, lbs	-47.5	-53.2	-50.8	-52.6
Receiving Period Gain, lb (28 days)	53.7	59.0	57.9	57.9
Silage & Pasture Gains, lb (77 days), lb	134^{d}	136.8^{d}	130.9^{d}	151.6^{e}
Gain, Purchase to End of Pasture Period, lb	142.1^{d}	148.9^{d}	142.1^{d}	156.6^{e}
Mortality, %	2.8^{f}	18.4^{g}	12.9^{g}	6.3^{f}
No. Treatments/Animal (28 days)	3.22^{f}	3.82^{g}	3.40^{f}	3.44^{f}

[a] The Least-squares model accounted for Leavamisole, calf type, potassium level, feedlot diet, sex status, and feedlot diet by potassium, and calf type by sex status interactions.

[de] Means in same row with different superscripts are significantly different (P<.01).

[fg] Means in same row with different superscripts are significantly different (P<.1).

Effect of Vitamin Supplementation of Receiving Diets on the Performance of Stressed Beef Calves

Bob Lee[1], Rob Stuart[2],
Kevin Perryman[2], and Ken Ridenour[3]

Summary

Ration formulation for stressed beef calves needs careful consideration, since low feed intakes, rumen dysfunction, and various other health and management problems may influence nutrient intakes and requirements. Supplementation with Vitamin E and B-complex vitamins in starting and receiving diets appears to improve animal performance and health.

Introduction

Vitamin requirements for beef cattle, as listed by the NRC (1984), range from values that are fairly well established and tested (vitamin A) to values that are good approximations (vitamins D and E), to cases where recommendations are practically nonexistent (B complex). Additionally, we have been taught not to worry about certain vitamins for beef cattle because they are thought to be adequately supplied by feedstuffs, or are synthesized in the rumen in adequate amounts to supply the animal. Compounding this problem is a lack of information on the nutrient needs of the stressed calf. Low feed and water intakes, as well as health problems, combine to form a different set of requirements for the stressed calf. We have ideas about energy, protein, water, and certain mineral requirements, but what about vitamins? To answer some of these questions, we examined the effect of vitamin supplementation on health and performance of newly arrived feedlot cattle.

Experimental Procedure

Three receiving studies utilizing beef calves weighing from 450 to 650 lb were conducted at the Garden City Experiment Station to determine the effect of various vitamin supplementation programs. The ration listed in Table 14.1 was fed ad lib in all the studies. All calves were processed within 24 hr after arrival and were vaccinated for IBR, PI_3, BVD, and 7-way clostridium. They also received a pour-on grubicide, and were dewormed, implanted, branded, and ear tagged for identification.

Experiment 1. Two hundred British crossbred steer calves weighing approximately 450 lb were trucked from Hopkinsville, KY to Garden City, KS. The

[1] Garden City Branch Experiment Station

[2] Hoffmann-LaRoche, Inc., Nutley, N.J.

[3] Micro Chemical, Inc., Amarillo, TX.

cattle were in transit 22 hr and shrank 9 percent. They were processed immediately after arrival and were assigned to the following treatment groups: Control (40,000 IU vitamin A and 4,000 IU vitamin D per head daily), or three levels of B-complex and vitamin E supplementation.

Experiment 2. Based on the results of experiment 1, 98 head of 650 lb steer calves were allotted to the following treatments: Control (40,000 IU vitamin A and 4,000 IU vitamin D per head daily); control plus 400 IU vitamin E per head daily, and Control plus E plus B-complex vitamins (600 mg niacin, 200 mg thiamin and 750 mg choline per head daily plus minor quantities of the other B-complex vitamins). The cattle had been preconditioned on native grass and were trucked 2 hours.

Experiment 3. The same treatments were used as in experiment 2, but we used 120 head of 450 lb freshly weaned calves, all from one ranch near McPherson, KS.

Results and Discussion

All three experiments showed the same pattern of improved performance and reduced morbidity when B-complex vitamins and vitamin E were added to the diet.

Table 14.2 shows the performance results of the different treatments for all three trials. A significant ($P<.08$) increase in average daily gain was observed when vitamin E was added, and an additional increase occurred when B-complex vitamins were added. A corresponding improvement was seen in feed to gain ratio.

Table 14.2. also shows the reducted morbidity, lower medicine costs per head, and decreased death loss with the various additional vitamin supplementation treatments.

Table 14.1. Ration Composition for the Stressed Calf Receiving Studies[a]

Ingredient	% As Fed
Corn, Dry Rolled	54.4
Alfalfa, Chopped	19.0
Pelleted Wheat Midds	10.0
Molasses	6.7
Corn Silage	5.1
Supplement[b]	4.8

[a] Deccox® was used the 1st 28 days, then Rumensin/Tylan® at 25 and 10 g/ton, respectively.

[b] Protein, mineral and salt mixture.

Table 14.2. Performance Summary of Calves on Three Receiving Rations with Vitamins

Item	Control	Vitamin E	B Complex plus E
Daily Gain, lb	2.65[a]	2.79[b]	2.94[c]
Feed Intake, lb as-Fed	16.74	16.50	15.56
Feed/Gain, lb	6.43[d]	6.11[de]	5.46[e]
Morbidity, %	43.6	42.5	43.4
No. Treatments per Calf Pulled	6.2	6.3	6.2
Medicine Cost/Head	$4.29	$4.00	$4.04
Death Loss, %	1.33	.67	0

[abc]P<.08.

[de]P<.02.

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Thiamin and Niacin in the Rumen

Until the last few years, we assumed that rumen bacteria synthesize adequate amounts of the B-complex vitamins. Recent research is showing that assumption may be wrong.

The rate of thiamin synthesis in the rumen appears to be fairly low. Also, under certain conditions, rumen bacteria produce an enzyme that rearranges the thiamin molecule, and apparently creates a compound that is toxic to the central nervous system. The result is a condition called polioencephalomalacia. Many refer to the disease as "PEM." Affected cattle become very depressed, wander aimlessly, often press their heads against solid objects, and may be become blind. If not treated quickly, they will go into convulsions and die. If treated soon enough with large, IV doses of thiamin, they respond dramatically.

Niacin supplementation has improved performance of cattle and sheep in a number of experiments. In dairy cattle, niacin improves milk yield in early lactation, and may help prevent ketosis. Niacin appears to increase protein synthesis in the rumen. If niacin is fed, the rumen bacteria respond by synthesizing less niacin. But supplementation increases the rumen niacin level because niacin is generally supplemented at fairly high levels.

Both thiamin and niacin may be especially important to stressed animals, and animals adapting to high grain diets. A review of thiamin and niacin research in ruminants was recently (September, 1984) published by Kansas State researchers (Journal of Animal Science, 59:813).

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Effects of Ralgro® Implants from Birth to Slaughter on Performance, Masculinity, and Behavior of Young Bulls

J.A. Unruh, D.G. Gray, and M.E. Dikeman

Summary

Implanting bulls with Ralgro® from birth to slaughter resulted in performance similar to that of nonimplanted bulls. However, implanted bulls were less masculine, had smaller scrotal circumferences up to 16 months of age, had lower serum testosterone levels up to 13 months of age, and were less aggressive from 12 to 14 months of age compared to nonimplanted bulls.

Our results indicate that Ralgro® implantation of young bulls from birth to slaughter has minimal effects on performance, yet delays masculinity and adverse behavioral development.

Introduction

Improved production efficiency, performance and carcass leaness makes feeding of bulls for slaughter an attractive alternative. However, early masculinity development and aggressive behavior of feedlot bulls often offsets some of these advantages. Our study was designed to investigate the effects of implanting young bulls with Ralgro® from birth to slaughter on performance, masculinity and behavioral traits.

Experimental Procedures

Seventy-two Simmental bull calves were allotted randomly at birth to either a Ralgro® implanted (I) or nonimplanted control (C) treatment. At birth, I bulls were implanted with 36 mg of Ralgro® and reimplanted at average intervals of 84 days until slaughter. Calves were weaned at 7.7 months, randomly assigned to slaughter ages of 12.0, 13.8, 15.7 and 17.4 months, and fed on 85% concentrate corn-based diet until slaughter. Four or five calves of the same treatment and slaughter age were assigned partially covered, concrete floored, 14 x 28 ft. pens.

Individual weights, hip heights, scrotal circumferences and masculinity scores were taken at 7.7 months and prior to each slaughter time. From 12 months until slaughter, pens were observed 1/2 hr. each week during the time of maximum daily activity (1/2 hr. prior to and after sunset) to study behavior.

Blood samples were obtained at regular intervals and serum was assayed for testosterone by radioimmunoassay.

Results

Weights and hip heights were similar (P>.10) for I and C bulls (Table 15.1). In addition, I and C bulls had similar average daily gains (3.44 vs 3.37 lb/day) and feed efficiencies (5.55 vs 5.66 feed DM/gain, respectively). Masculinity scores for coarseness and development of the head, crest and forequarter, and hair texture were lower (P<.05) for I bulls than for C bulls (Table 15.2). Scrotal circumferences were smaller (P<.05) for I bulls at all ages except at 17.4 months. The largest differences were observed early in the feeding period. Associated with the lower masculinity scores and smaller scrotal circumferences, I bulls also had decreased (P<.05) serum testosterone levels at 8.3 and 12.9 months compared with C bulls (Figure 15.1).

From 12.0 to 13.8 months of age, I bulls had fewer (P<.05) encounters of passive butting, mounting, facility rubbing, and lower (P<.05) activity scores than C bulls (Table 15.3). During the same time, I bulls had fewer (P<.05) aggressive butting encounters for the first 5 weeks, but had similar numbers of encounters as C bulls for the last 2 weeks. During the 13.8 to 15.7 months and 15.7 to 17.4 months observation periods, I and C bulls were similar (P>.10) for all behavioral traits. The behavioral differences between I and C bulls occurred at the same ages when differences in serum testosterone were observed. During the 12.0 to 13.8 month period, I bulls had lower (P<.05) testosterone levels (12.0 and 12.9 months) but were similar (P>.10) to C bulls from 13.8 to 16.6 months of age (Figure 15.1).

According to our results, implanting young bulls with Ralgro® from birth to slaughter retards masculinity and behavioral development with no detrimental effects on performance. This could eliminate some of the problems associated with feeding bulls.

Table 15.1. Weights and Hip Heights at Different Ages of Ralgro® Implanted and Control Bulls

Age (mo)	No. Bulls	Weight, lbs Implanted	Weight, lbs Control	Hip Height, in. Implanted	Hip Height, in. Control
7.7	72	472	484	42.8	43.0
12.0	72	908	935	47.3	47.7
13.8	54	1143	1139	51.9	52.0
15.7	36	1288	1281	52.9	53.4
17.4	18	1338	1314	54.1	54.3

Table 15.2. Masculinity Scores and Scrotal Circumferences at Different Ages of Ralgro® Implanted and Control Bulls

Age (mo)	No. Bulls	Masculinity Score[a] Implanted	Masculinity Score[a] Control	Scrotal Circumference, cm Implanted	Scrotal Circumference, cm Control
7.7	72	2.0[b]	3.1[c]	17.7[d]	25.7[e]
12.0	72	2.2[b]	3.9[c]	26.6[d]	36.1[e]
13.8	54	3.0[b]	3.9[c]	32.8[d]	38.8[e]
15.7	36	3.1[b]	3.7[c]	36.8[d]	39.3[e]
17.4	18	3.2[b]	3.9[c]	37.7	38.3

[a]Scores of 1 to 5: 2=slightly masculine; 3=moderately masculine; 4=masculine.
[bc]Means in the same row with different superscripts differ (P<.05).
[de]Means in the same row with different superscripts differ (P<.05).

Table 15.3. Behavioral Observations at Different Slaughter Ages of Ralgro® Implanted and Control Bulls

	Observation Periods					
	12.0 to 13.8 mo.		13.8 to 15.7 mo.		15.7 to 17.4 mo.	
Trait	Implant	Control	Implant	Control	Implant	Control
No. of Pens	6	6	4	4	2	2
Passive Butting[a]	5.8[c]	8.6[d]	6.3	7.0	10.4	11.9
Aggressive Butting[a]	2.0*	4.9*	.7	.7	1.3	2.3
Mounting Attempts[a]	.4[c]	2.2[d]	.4	1.2	1.3	1.9
Facility Rubbing[a]	2.9[c]	5.0[d]	3.9	6.0	5.7	5.7
Activity Score[b]	2.2[c]	3.2[d]	2.1	2.2	3.0	3.3

[a]Encounters per 30 min.
[b]Scaled from 1 to 6: 2=slightly inactive; 3=slightly active; 4=active.
[cd]Means in the same row within observation periods with different superscripts differ (P<.05).
*Implanted bulls had fewer (P<.05) aggressive encounters in 5 of 7 observations during the 12.0 to 13.8 month period only.

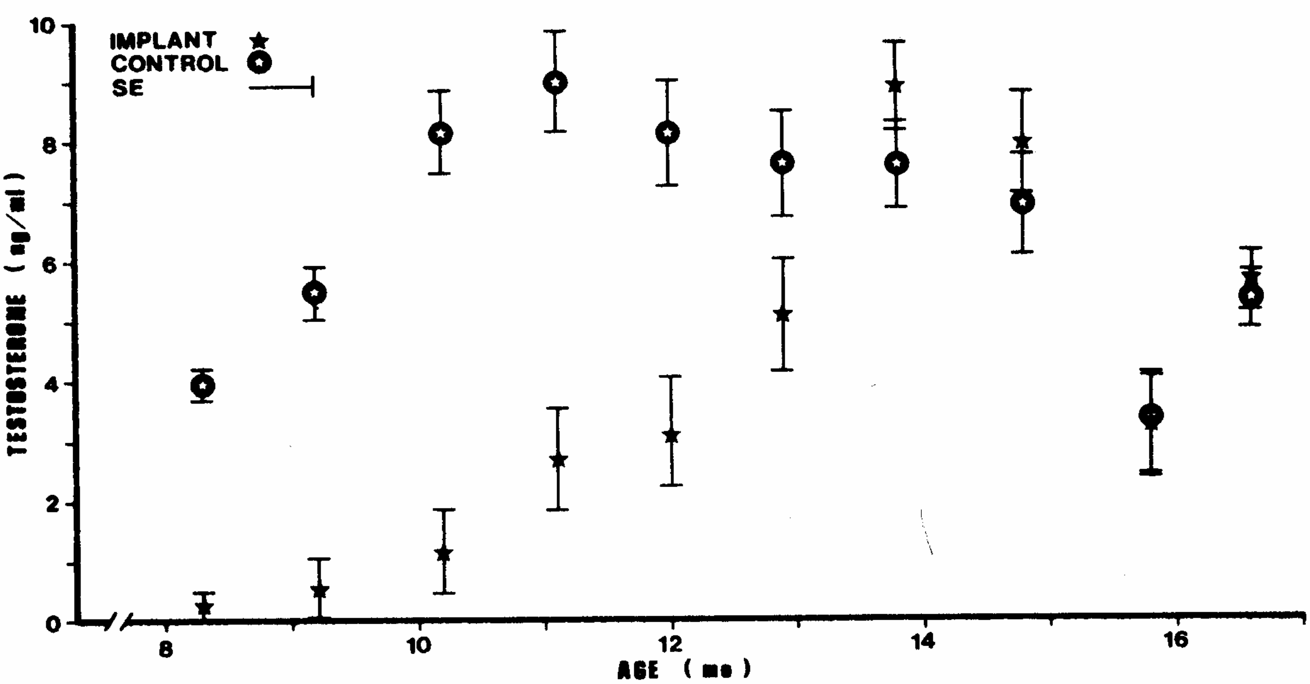

Figure 15.1. Serum Testosterone Levels at Different Ages for Ralgro® Implanted and Control Bulls

Action of Decoquinate in Altering Feed Efficiency of Ruminants

David L. Harmon

Summary

The effects of adding decoquinate (Deccox®) to the diet at 0, 0.5, or 5 mg per kg body weight were evaluated with diets of 30 and 80% concentrate. Decoquinate did not influence rumen or plasma metabolites, diet digestibility, or volatile fatty acid production. No metabolic effects were seen that would suggest a role for decoquinate in altering rumen fermentation and feed efficiency of ruminants.

Introduction

Decoquinate is a synthetic compound marketed under the name Deccox® as a feed additive to control coccidia infestations. Previous research has shown that decoquinate, added to the ration at the level of 0.5 mg/kg body weight per day, resulted in improved feed intake and animal performance. It is unclear whether these improvements were due to the action of decoquinate as a coccidiostat, or to independent effects. Our objective was to find out if decoquinate altered rumen fermentation and digestive efficiency.

Experimental Procedures

Two experiments were conducted using ruminally fistulated cattle (570 lb) consuming two levels of dietary concentrate; 30% in Experiment 1 and 80% in Experiment 2. Corn was the concentrate and soybean meal was the supplemental protein in both diets. Animals received either 0, 0.5, or 5 mg of decoquinate per kg body weight daily. Feed was offered in two equal portions daily with each animal receiving half of the daily dose of decoquinate in 0.45 lb of grain immediately prior to feeding.

We measured volatile fatty acids (VFA), pH, lactic acid, and ammonia levels as indicators of rate and efficiency of rumen fermentation, as well as rate of VFA production and digestibility of dry matter, starch, and several fiber components. Plasma lactate and glucose levels were also determined.

Results and Discussion

The data on rumen and serum metabolites (Table 16.1), rumen VFA concentrations (Table 16.2), starch, dry matter, and fiber digestibilities (Table 16.3), and VFA production (Table 16.4), indicate that decoquinate had little, if any, effect on digestion or rumen metabolism.

For the diets we evaluated, we see no evidence that would suggest a role for decoquinate, other than as a coccidiostat.

Table 16.1. Rumen and Plasma Metabolites in Steers Supplemented with Decoquinate

Item	Level of Decoquinate[a]					
	30% Concentrate			80% Concentrate		
	0	0.5	5.0	0	0.5	5.0
Rumen pH	6.61	6.60	6.64	6.53	6.49	6.38
Rumen NH_3, mg/dl	5.06	5.03	5.49	2.71	3.50	1.76
Rumen L(+) lactate, mM	.01	.01	.01	0.05	0.02	0.03
Plasma L(+) lactate, mM	1.12	0.55	0.85	0.57	0.59	0.68
Plasma Glucose, mg/dl	61.82	56.76	63.81	83.30	92.75	85.66

[a]mg per kg body weight daily.

Table 16.2. Rumen Volatile Fatty Acids in Steers Supplemented with Decoquinate

Item	Level of Decoquinate[a]					
	30% Concentrate			80% Concentrate		
	0	0.5	5.0	0	0.5	5
Acetate, molar%	75.56	75.12	75.69	65.78	64.28	70.24
Propionate, molar%	13.19	13.26	13.35	20.25	20.20	17.85
Butyrate, molar%	9.78	10.01	9.45	9.57	10.67	7.75
Others, molar%	1.47	1.60	1.51	4.39	4.85	4.16
Total VFA, mM	87.17	85.59	80.42	92.16	84.09	97.82

[a]mg per kg body weight daily.

Table 16.3. Intake and Digestibility of Steers Supplemented With Decoquinate

	Level of Decoquinate[a]					
	30% Concentrate			80% Concentrate		
Item	0	0.5	5.0	0	0.5	5.0
Dry Matter Intake, lb	13.34	12.94	13.58	15.92	15.81	16.05
Dry Matter Digestibility, %	54.99	53.53	52.87	64.70	65.93	64.96
Neutral Detergent Fiber Digestibility, %	55.27	47.89	56.19	62.65	68.63	61.22
Acid Detergent Fiber Digestibility, %	47.27	40.82	46.60	56.03	52.04	51.92
Hemicellulose Digestibility, %	60.71	59.14	61.40	67.20	79.36	62.39
Starch Digestibility, %	60.71	59.14	61.40	80.46	82.63	82.42

[a]mg per kg body weight daily.

Table 16.4. Rate of In Vitro Volatile Fatty Acid Production in Steers Supplemented with Decoquinate

	Level of Decoquinate[a]					
	30% Concentrate			80% Concentrate		
Volatile Fatty Acid	0	0.5	5	0	0.5	5.0
	Rate of Production[b]					
Acetate	24.27	28.00	34.67	28.20	30.09	29.68
Propionate	5.52	5.77	6.01	6.09	11.70	10.07
Butyrate	3.97	7.07	4.01	4.48	5.84	3.61
Total VFA	34.11	44.63	45.23	40.69	49.49	45.33

[a]mg per kg body weight daily.
[b]mmole per liter rumen fluid per hour.

KSU

New Developments in Feeding Wheat to Cattle

John Brethour[1], Bob Lee[2], and Jack Riley

Summary

At least for the varieties we studied, hard red winter wheat was superior to soft red winter wheat in beef cattle rations. That contradicts the perception that feed wheats should be soft. The net energy values of Larned hard wheat and Hart soft wheat were 102% and 99% that of corn, respectively. Adding Rumensin® to wheat rations improved performance, probably by reducing acidosis instead of increasing ration net energy value. There was a positive associative effect when wheat and milo were fed together but not when wheat and corn or corn and milo were combined. Steer performance was improved by adding 3% fat to rations; that improvement was proportional to the amount of wheat in the rations and was probably due to the fat's added energy. Steers that were fed fat graded better and gained more uniformly. When 100% wheat was fed, overall performance was satisfactory only when fat was included.

Introduction

Depressed export markets have emphasized the need for alternate ways to use surplus wheat. Because wheat is the state's leading grain crop, and about 15 % of the national wheat crop was fed last year, it is important to improve the management of wheat in cattle rations. This project is a joint effort of scientists of the Department of Animal Sciences and Industry and the Fort Hays and Garden City Branch Experiment Stations. The experiments reported here were conducted at Hays.

Experimental Procedures

Four feeding trials were conducted with mostly Angus X Hereford yearling steers that initially weighed about 800 pounds. Cattle were fed in groups of 17 to 25 head. Since implanting experiments were superimposed on the feeding trials, most cattle were implanted. All cattle were followed through a packing plant and carcass data were obtained. Final live weights were adjusted to a constant 62 dressing percentage.

Both milo and wheat were finely rolled. Forage sorghum silage and prairie hay was used as roughage. Milo and soft wheat rations were supplemented with soybean meal and urea but no supplemental protein was needed when hard wheat was fed. Rumensin® and Tylan® were fed unless otherwise indicated. A premix was used containing vitamin A, niacin, zinc methionine, and trace minerals. Rations also contained ammonium sulfate and ground limestone.

[1]Fort Hays Branch Experiment Station.
[2]Garden City Branch Experiment Station.

Experiment 1: One objective was to identify properties that might differentiate a good feed wheat from a good milling wheat, so we compared a typical Kansas hard red winter wheat (Larned) with a soft red winter wheat (Hart). Soft wheats have less protein than hard wheats, but we added enough supplemental protein to the soft wheat rations to eliminate this factor in the comparisons.

Three other treatments included the addition of 3% fat (a mixture of beef tallow and soybean oil) to the milo, hard wheat, and soft wheat rations.

Experiment 2: We have recommended limiting wheat and mixing it with another grain to avoid depressed performance and possible lower carcass grade of high wheat rations. This experiment was conducted to determine if there are associative effects from combining 2 grains. An associative effect means that a combination of certain grains performs differently than would be expected from the individual characteristics of the grains. Ration combinations included milo-wheat, corn-wheat, and milo-corn, as well as each grain fed by itself.

Experiment 3: This study measured the effect of Rumensin® on soft and hard wheat diets. We wanted to know if different wheats respond differently to Rumensin®, thus affecting our interpretations of the experiments. Tylan® was fed in all rations.

Experiment 4: This test included milo, milo-wheat, and wheat rations, with or without added fat. It let us examine more closely the effect of level of wheat on the response to added fat, as well as confirm the complementary effect of combining wheat with milo.

Results and Discussion

Experiment 1: Larned hard wheat performed slightly better than Hart soft wheat (Table 17.1). Feed intake was only 3% less for the hard wheat than the soft wheat, so wheat gluten does not seem to explain the depressed intake when high levels of wheat are fed. NEg values averaged 3.3% higher ($P<.01$) for hard than for soft wheat. The average value for the soft wheat (1.47 Mcal/kg) was slightly less than that for corn (1.48); the value for the hard wheat (1.52) was 2.5% more. It was not necessary to add protein to rations that contained hard wheat. Since kernel softness, per se, had no advantage, at least in the varieties we studied, those wheats with superior milling quality may also be best for feeding. That may be fortunate for Kansas agriculture. The logistics of keeping hard and soft wheat separate in the marketing system seem nearly impossible. Producers should also benefit from not being forced to decide at planting time whether to grow a feed or a milling wheat.

When wheat was the only grain fed, feed intake was 13% less and gain was 16% less than when milo was fed. But when fat was added to the wheat rations, performance and carcass grade were almost equal to the milo fed cattle (Table 17.1). There was little response when fat was added to the milo rations. Adding fat did not affect grain net energy estimates, so responses to fat probably resulted from increased energy consumption.

Experiment 2: If there is an associative effect from combining two grains, performance should exceed the average of the two grains fed separately. As shown at the bottom of Table 17.2, that occurred only when wheat and milo were combined, and supports the idea that, if grains are to be combined in cattle finishing rations, one grain should be slowly digested (milo) and the other rapidly digested (wheat). There were no associative effects when the combinations included corn.

Performance of cattle fed milo, corn, or wheat alone were typical of those seen in previous experiments. Gain and carcass grade of cattle fed milo were similar to those fed corn but feed efficiency was 5% poorer with milo. Steers fed the all wheat ration consumed much less feed which depressed daily gain and final weight, thereby reducing dressing percent and carcass grade.

Experiment 3: Adding Rumensin® to either finely rolled soft or hard wheat rations improved feed efficiency only 3% and did not affect net energy values for wheat (Table 17.3). Rumen acidosis and liver abscesses were less prevalent, and gains were more uniform when Rumensin® was fed. Consequently, wheat rations benefited from Rumensin®, but probably from reducing of acidosis rather than modification of the volatile fatty acid profile. Even though the tests with soft and hard wheat were concurrent, we do not feel this experiment was a valid comparison of soft and hard wheat. However, note that acidosis was more frequent when soft wheat was fed.

Experiment 4: This study confirmed many of the observations made in the three previous experiments. Adding 3% fat increased gain 2.5% in the milo ration, 8.9% in milo-wheat ration, and 11.7% in the wheat ration (Table 17.4). That response was directly related to the proportion of wheat in the ration. Likewise, there was evidence of an associative effect from combining milo and wheat because gains and feed efficiency were better than the average results from feeding milo and wheat individually.

The net energy values of milo and wheat computed from this trial are listed at the bottom of Table 17.4. The best way to determine if wheat should be fed is to use least cost computer ration formulation, but that requires accurate nutritional coefficients such as those generated by this research. Least cost formulation also takes into account the value of the extra protein in wheat.

There seemed to be several advantages to the half milo - half wheat ration. This combination eliminated the need for supplemental protein and exploited the possible associative effects of wheat and milo. There appeared to be more response from adding fat to this ration than when milo was fed alone. Finally, daily gain, dressing percent, and carcass grade were similar to rations containing no wheat.

In conclusion, this research has contributed new knowledge on how to manage wheat in cattle rations. Because of the economic multiplier effects of livestock and meat packing, feeding Kansas wheat to Kansas cattle may have a greater impact on the state's economy than exporting wheat.

Table 17.1. Soft or Hard Wheat, with or without Fat, for Finishing Steers.
Rep 1: May 18 to September 16, 1984, 122 days
Rep 2: June 18 to October 14, 1984, 119 days.

Item	Milo		Soft Wheat (Hart)		Hard Wheat (Larned)	
	No Fat	Fat	No Fat	Fat	No Fat	Fat
No. of Head	38	40	41	41	41	40
Initial Weight, lb	786.4	781.6	783.4	784.0	781.4	785.0
Final Weight, lb	1191.2	1195.6	1123.4	1179.6	1130.8	1176.0
Gain, lb	404.8	414.0	340.0	395.6	349.4	391.0
Daily Gain, lb	3.36	3.44	2.82	3.28	2.90	3.24
Avg. Daily Ration, lb (as fed):						
Sorghum Silage	12.44	12.43	11.99	12.10	12.00	11.96
Rolled Milo	20.67	20.36	—	—	—	—
Rolled Wheat	—	—	17.42	17.65	16.98	17.03
Fat	—	.54	—	.54	—	.54
Soybean Meal	.32	.32	.52	.52	.22	.22
Urea	.05	.05	.08	.08	.03	.03
Rumensin-Tylan® Premix	.55	.55	.55	.55	.55	.55
Dry Matter Total	22.62	22.87	19.88	20.67	19.48	20.02
Lb DM/100 lb Gain	672.3	665.8	709.2	620.9	678.2	621.1
Percent Response	—	+1.0%	-5.2%	+8.3%	-0.9%	+8.2%
Carcass Data:						
Dressing Percent	63.07	63.68	61.90	63.45	61.38	62.43
Marbling Score	4.89	4.97	4.69	4.82	4.48	4.80
Percent Choice	76%	78%	66%	75%	41%	73%
Backfat, in	.51	.58	.44	.50	.42	.50
NE gain of Grain, mcal/kg	1.40	1.37	1.47	1.47	1.51	1.52

Table 17.2. Milo, Corn, and Wheat - Compared Alone or in Combination, July 16 to November 11, 1984, 119 days

Item	Milo	Corn	Wheat	Milo Corn	Milo Wheat	Corn Wheat
No. of Steers	28	28	28	28	28	28
Initial Weight, lb	691.1	698.3	686.0	700.9	692.3	699.3
Final Weight, lb	1116.1	1130.3	1033.4	1119.3	1094.1	1088.2
Total Gain, lb	425.0	432.0	347.4	418.4	401.8	388.9
Daily Gain, lb	3.57	3.63	2.92	3.52	3.38	3.27
Avg. Daily Ration, lb (as fed):						
Sorghum Silage	10.81	10.77	10.61	10.83	10.63	10.63
Rolled Milo	21.09	—	—	10.32	9.43	—
Rolled Corn	—	19.78	—	10.32	—	9.20
Rolled Wheat	—	—	16.44	—	9.43	9.20
Prairie Hay	.20	.20	.20	.20	.20	.21
Soybean Meal	.40	.40	.17	.40	.29	.29
Urea	.11	.11	.05	.11	.08	.08
Premix	.55	.55	.55	.55	.55	.55
Dry Matter Total	22.16	21.32	18.63	21.93	20.50	20.24
Lb DM/100 lb Gain	621.3	589.1	640.0	618.7	616.0	621.6
Percent Improvement Compared to Milo	—	+5.5%	-2.9%	+0.4%	+0.9%	+0.0%
Carcass Data:						
Dressing Percent	64.23	63.55	61.48	62.90	62.18	62.08
Marbling Score	5.03	5.21	4.40	5.26	4.73	4.90
Percent Choice	75%	82%	43%	86%	57%	74%
Backfat, in	.51	.53	.41	.44	.44	.43
Observed Daily Gain				3.52	3.38	3.27
Expected Gain (average of grains fed individually)				3.60	3.24	3.27
Percent Deviation				-2.2%	+4.3%	0.0%

Table 17.3. Soft or Hard Wheat - with or without Rumensin®,[1] July to October 28, 1984, 111 days.

Item	Soft Wheat (Hart)		Hard Wheat (Larned)	
	Control	Rumensin®	Control	Rumensin®
No. of Steers	17	17	18	17
Initial Weight, lb	825.0	819.0	822.3	817.3
Final Weight, lb	1078.8	1066.3	1083.8	1095.0
Total Gain, lb	253.8	247.3	261.5	277.7
Daily Gain, lb	2.29	2.23	2.36	2.50
Avg. Daily Ration, lb (as-fed):				
Sorghum Silage	10.54	11.43	11.33	11.49
Rolled Wheat	17.57	16.66	16.87	17.11
Prairie Hay	.32	.32	.30	.32
Soybean Meal	.40	.40	—	—
Urea	.17	.17	.17	.17
Premix	.44	.55	.44	.55
Dry Matter Total	19.88	19.16	19.26	19.62
Lb DM/100 lb Gain	884.8	858.2	816.5	788.8
Percent Improvement from Rumensin®	—	+3.1%	—	+3.5%
Carcass Data:				
Dressing Percent	61.12	60.66	60.59	60.25
Marbling Score	5.25	4.95	5.14	4.94
Percent Choice	100%	82%	94%	82%
Backfat, in	.47	.41	.46	.44
No. of Foundered Cattle	4	0	1	0
No. of Liver Abscesses	0	1	4	0
Net Energy of Wheat:				
NE gain, mcal/kg	1.44	1.43	1.50	1.50
NE maintenance, mcal/kg	2.19	2.19	2.32	2.32

[1] The four treatments were concurrent, however pens were assigned to measure Rumensin® response and there may have been effects that invalidate the soft versus hard wheat comparison.

Table 17.4. Adding Fat to Milo, Milo-wheat, and Wheat Rations, October 1, 1984 to January 12, 1985, 105 days.

Item	Milo		Milo-wheat		Wheat	
	No Fat	Fat	No Fat	Fat	No Fat	Fat
No. of Head	25	25	25	24	25	25
Initial Weight, lb	777.6	782.4	780.6	776.9	782.9	779.1
Final Weight, lb	1204.7	1220.7	1169.7	1201.6	1115.7	1150.7
Gain, lb	427.1	438.3	389.1	424.7	332.8	371.6
Daily Gain, lb	4.07	4.17	3.71	4.04	3.17	3.54
Avg. Daily Ration, lb (as fed):						
Sorghum Silage	11.50	11.47	11.26	11.35	10.97	11.20
Prairie Hay	.45	.52	.37	.35	.30	.30
Rolled Milo	24.57	24.18	10.91	11.02	—	—
Rolled Wheat	—	—	10.91	11.02	18.94	19.11
Fat	—	.58	—	.58	—	.58
Soybean Meal	.60	.60	.05	.05	.03	.03
Urea	.05	.05	.01	.01	—	—
Rumensin-Tylan® Premix	.55	.55	.55	.55	.55	.55
Dry Matter Total	25.14	25.45	22.67	23.45	20.45	21.24
Lb DM/100 lb Gain	618.0	609.6	611.7	579.6	645.0	600.1
Percent of Milo Control	—	+1.4%	+1.0%	+6.6%	-4.2%	+3.0%
Carcass Data:						
Dressing Percent	62.05	61.81	60.88	61.62	60.49	61.09
Marbling Score	4.82	5.21	5.05	4.99	4.54	4.88
Percent Choice	80%	84%	88%	83%	52%	80%
Backfat, in	.46	.52	.41	.44	.37	.41
Net energy of Grain:	milo	milo	wheat	wheat	wheat	wheat
NE gain, mcal/kg	1.40	1.39	1.53	1.50	1.48	1.49
NE maintenance, mcal/kg	2.12	2.10	2.40	2.33	2.29	2.31

High Moisture Corn Ensiled With Urea

Jean Heidker[1], Keith Bolsen, Mark Hinds,
Harvey Ilg, Bogdon Janicki[2] and Bruce Young

Summary

High moisture corn harvested at 18 and 26% moisture, rolled, treated with 0, .75, 1.5, or 2.25% urea (DM basis), and ensiled was evaluated for fermentation rate, chemical composition, and aerobic stability. Adding urea to 26% moisture corn increased the rate and extent of fermentation as measured by lactic, acetic, and total acid concentrations. Only a very limited fermentation occurred in the 18% moisture corn. No statistically significant differences were noted in DM loss or aerobic stability among the eight corn treatments.

Introduction

Urea is commonly used as a nitrogen supplement for cattle fed high energy finishing rations. In a previous report (Report of Progress 448), high moisture corn treated with urea and ensiled in concrete stave silos had higher lactic and acetic acid concentrations and improved aerobic stability (bunk life) when compared with untreated high moisture corn. In this trial, we monitored fermentation rate, chemical composition, and aerobic stability of high moisture corn treated with various levels of urea.

Experimental Procedures

High moisture corn was harvested at 18% (LM) and 26% (HM) moisture, rolled, treated with one of three levels of urea, and ensiled in 5 gallon laboratory silos. Treatments (DM basis) were: 1) no additive (control); 2) 0.75% urea; 3) 1.5% urea; and 4) 2.25% urea. Urea was added to the corn in a urea-water solution (50:50 wt/wt) followed by mixing 10 minutes in a Harsh Mobil Mixer®. Six silos per treatment were filled (approximately 30 lb of corn per silo), packed with a hydraulic press, sealed, and weighed. Fifteen additional silos each of HM-control and HM-1.5% urea were prepared in order to follow the fermentation dynamics during the ensiling process. All silos were stored at 30 C until opened. Pre-ensiled, post-treated samples were analyzed for DM, pH, crude protein (CP), hot water insoluble nitrogen (HWIN), and non-protein nitrogen (NPN). Three silos each of HM-control and HM-1.5% urea were weighed, mixed, and sampled 1, 2, 4, 7, 21, and 158 days post-ensiling. All six silos of each of the remaining treatments were weighed, and sampled at approximately 158 days post-ensiling. Dry matter loss was determined for each silo and aerobic stability was also measured by placing 5.5 lb of ensiled corn in an expanded polystyrene container as described on page 60 of this Report. Six containers of each silo were monitored for temperature rise, with

[1]Department of Grain Science and Industry.

[2]Former visiting research assistant (1982-83) from the University of Agriculture, Bydogoszez, Poland.

three containers being removed on days 5 and 10 for determination of DM loss and chemical change. Chemical analyses for all ensiled corn included DM, CP, ammonia-nitrogen, pH, lactic and acetic acids, and ethanol.

Results and Discussion

Chemical analyses of the pre-ensiled corn are shown in Table 18.1. As expected, CP, NPN, and pH increased with the addition of urea. Dry matter losses and chemical analyses during fermentation for the HM-control and HM-1.5% urea treatments are shown in Table 18.2. The HM-1.5% urea underwent a more rapid and extensive fermentation and had a higher final pH due to ammonia from the urea. Ammonia-nitrogen values steadily increased for the HM-1.5% urea, indicating hydrolysis of the urea as fermentation progressed. Dry matter loss was not affected by treatment.

Dry matter losses and chemical analyses of the final ensiled corn for all treatments at both moisture levels are shown in Table 18.3. All LM corn underwent very limited fermentation, as indicated by low total acids and minimum pH decrease. The increased fermentation noted in the urea-treated LM corn was likely due to the slight increase in moisture content from the addition of the urea-water solution. There was no difference in protein content between the 1.5 and 2.25% urea levels after the fermentation in the LM corn, suggesting that volatile ammonia was lost during storage. All HM corn underwent a lactic acid fermentation, with the extent of fermentation increasing with the addition of urea up to 1.5 percent. Increasing levels of urea resulted in increased crude protein, ammonia-nitrogen, and pH values. Dry matter loss was numerically higher in the urea-treated HM corn. Ethanol, which is not a desirable chemical component in ensiled grain, was present in very low amounts in both the LM and HM corn treatments. All ensiled corn was stable in air for at least 5 days, regardless of moisture level or urea treatment, and very little chemical change was noted for any treatment through 10 days of exposure to air. There were no apparent benefits in the preservation of either LM or HM corn from adding urea in this trial.

Table 18.1. Chemical Analyses for the Pre-Ensiled 18 and 26% Moisture Corn

Moisture Level and Treatment	Moisture %	pH	CP[1]	HWIN[2]	NPN[2]
18% Moisture					
Control	17.5	6.07	8.8	92.9	5.2
.75% Urea	17.6	7.35	10.7	71.7	12.3
1.5% Urea	17.9	8.30	13.3	55.8	21.7
2.25% Urea	17.1	8.45	13.6	58.7	21.3
26% Moisture					
Control	25.9	5.78	9.0	90.1	1.7
.75% Urea	26.4	6.13	10.7	70.0	15.4
1.5% Urea	26.3	6.18	12.7	63.4	27.6
2.25% Urea	26.5	6.27	14.5	59.4	34.2

[1]Percent of the DM ensiled.
[2]Percent of the total corn nitrogen.

Table 18.2. Dry Matter Losses and Chemical Analyses During the Fermentation of 26% Moisture Corn Ensiled with 0 or 1.5% Urea

Time Post-Ensiling and Treatment	Moisture %	DM Loss[1]	CP[2]	Ammonia-N[3]	pH	Fermentation Acids[2] Lactic	Acetic	Total
Day 0 (Pre-Ensiled)								
Control	25.9	—	9.03	—	5.78	—	—	—
Urea	26.3	—	12.73	—	6.18	—	—	—
Day 1								
Control	26.4	.91	10.31	.4	5.38	—	—	—
Urea	26.8	.84	13.78	3.7	6.32	—	—	—
Day 2								
Control	26.5	1.21	9.82	.7	5.20	trace	.10	—
Urea	26.6	.84	13.44	6.3	6.06	.36	.17	.3
Day 4								
Control	26.9	1.95	10.11	.8	5.08	trace	.15	—
Urea	26.8	1.32	13.50	13.8	7.08	.99	.22	1.20
Day 7								
Control	27.2	2.38	10.27	1.2	4.82	.27	.20	.48
Urea	27.4	2.24	13.68	16.8	6.62	1.40	.29	1.69
Day 21								
Control	27.4	2.87	10.13	3.2	4.35	1.00	.39	1.43
Urea	27.5	2.78	13.76	26.2	6.41	2.59	.52	3.24
Day 158								
Control	28.4	4.36	10.03	5.9	3.96	1.68	.43	2.36
Urea	28.5	4.59	13.35	31.4	5.12	3.67	.65	4.47

[1] Percent of the DM ensiled.

[2] Percent of the corn DM.

[3] Percent of the total corn nitrogen.

Table 18.3. Dry Matter Losses and Chemical Analyses of the 18 and 26% Moisture Corn Ensiled with and without Urea

Moisture Level and Item	Percent Urea, DM basis			
	0	0.75	1.5	2.25
18% Moisture				
Post-Ensiled Moisture, %	19.2	19.5	19.0	18.7
pH	6.02^{a}	7.51^{b}	8.37^{c}	8.52^{d}
	% of the DM Ensiled			
DM Loss	2.73^{c}	2.73^{c}	1.85^{b}	1.20^{a}
	% of ensiled corn DM			
Lactic Acid	.09	.11	.08	.06
Acetic Acid	$.09^{a}$	$.22^{b}$	$.28^{c}$	$.36^{d}$
Total Fermentation Acids	$.18^{a}$	$.33^{b}$	$.39^{bc}$	$.42^{c}$
Ethanol	trace	trace	trace	trace
Crude Protein	9.4	11.3	12.0	12.0
	% of the Total Corn Nitrogen			
HWIN	73.8	80.5	66.0	79.0
Ammonia-N	$.1^{a}$	1.0^{b}	1.5^{c}	1.8^{d}
26% Moisture				
Post-Ensiled Moisture, %	28.4	28.7	28.5	28.3
pH	3.96^{a}	4.34^{a}	5.12^{b}	7.46^{c}
	% of the DM Ensiled			
DM Loss	3.36	4.52	4.59	4.16
	% of the Ensiled Corn DM			
Lactic Acid	1.68^{b}	2.75^{a}	3.67^{a}	3.53^{a}
Acetic Acid	$.43^{a}$	$.56^{ab}$	$.65^{b}$	$.65^{b}$
Total Fermentation Acids	2.36^{a}	3.55^{b}	4.47^{c}	4.25^{bc}
Ethanol	$.07^{a}$	$.08^{ab}$	$.08^{ab}$	$.10^{b}$
Crude Protein	10.0	11.7	13.3	13.4
	% of the Total Corn Nitrogen			
HWIN	66.2	57.6	56.8	50.3
Ammonia-N	5.9^{a}	19.8^{b}	31.4^{c}	44.8^{d}

[abcd]Values in the same row with differ superscripts differ ($P<.05$).

Effect of Water Temperature on Cattle Performance[1]

Dave Nichols, Pat Murphy[2],
Jack Riley, and Ron Pope

Summary

When average outside air temperature was about 40 F, water temperatures of 40, 60, or 80 F had little effect on water intakes of yearling steers and heifers. In addition, there were no significant differences in average daily feed or efficiency. No electrical energy was required to maintain water at 40 F, and it took about twice as much electricity to maintain water at 80 F instead of 60 F.

Introduction

Kansas has a feedlot capacity of about 1.4 million head. Assuming 1 waterer per 100 head, that accounts for about 14,000 waterers. Most waterers use an electric element and a thermostat to prevent freezing. Electrical usage of waterers depends on the waterer and insulation, number of cattle watered, temperature of incoming water, outside temperature, and other factors. Since the cost of operation increases as the heated water temperature increases, it is desirable to operate the waterers at the lowest possible water temperature consistent with optimal animal performance. An additional concern must be to prevent freeze damage to the waterer.

When cattle consume large quantities of cold water, heat energy from the animal is needed to raise water up to body temperature. A producer has to decide between two alternatives: 1) warm the water offered to the cattle to reduce feed energy required or 2) allow the animal's feed energy and heat increment to warm the water. If a producer chooses to heat water, he must also decide on an acceptable temperature.

Our study examined the effect of water temperature on animal performance and electricity costs for water heating.

Experimental Procedures

Twenty four steers and heifers (6 pens of 4 head) were assigned to one of three water temperature treatments: 40 F, 60 F, or 80 F. Cattle averaged 528 lb initially, and were fed an 89% dry matter ration containing milo, alfalfa pellets and cottonseed hulls for a six-week period (1/24 - 3/6/84).

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[1]Appreciation is expressed to Mirco Corp., Grinnell, IA for providing insulated automatic waters and funding.

[2]Department of Agricultural Engineering.

Water temperature and intake were measured daily. Cattle and feed were weighed weekly to measure feed intake, gain, and feed efficiency. Daily minimum and maximum ambient temperatures were recorded. Water heaters for the 60F and 80F treatments were equipped with electric meters to measure daily electric usage.

Results and Discussion

No differences were observed in daily water intake, feed intake, daily gain or feed efficiency (Table 19.1). Significantly more electric energy was required to maintain water at 80 F versus 60 F. Thus, heating water above 40 F increased cost of production and failed to improve performance. Water consumption was more highly correlated to daily minimum ambient air temperature than to water temperature.

When buying waterers, choose those that prevent freezing but also minimize electrical use. When several waterers were checked at random, we found water temperatures ranged from a low of 40 F to a high of 100 F. The thermostats in many fountains do a poor job of regulating water temperature. In our study, waterers were highly insulated, with a minimum amount of exposed water surface. The daily energy cost per waterer was 26¢ for the 80 F and 12¢ for the 60 F. Waterers without sufficient insulation and with large open bowls are extremely expensive to operate at high water temperatures during cold weather.

In choosing and installing waterers, several factors must be considered:

1. The waterer should supply adequate clean, fresh water regardless of air temperature.

2. The waterer should be easily accessible to livestock and there should be no hazard of electrical shock. Be sure the unit is properly grounded and installed according to manufacturer's recommendations.

3. The waterer should be well insulated and energy efficient. Replacement of many old waterers could be paid for by energy savings alone.

4. The supply line to the waterer should be insulated to prevent freezing. Shut-off valves should be placed below the frost line to turn off the waterer when not in use.

5. The waterer should be easily drained and cleaned. In addition, floats and valves should be readily accessible.

6. The waterer must be reasonably trouble free. When stock tanks were the primary watering device, breakdowns were less serious. But most waterers today have small reservoirs and cattle can soon become thirsty.

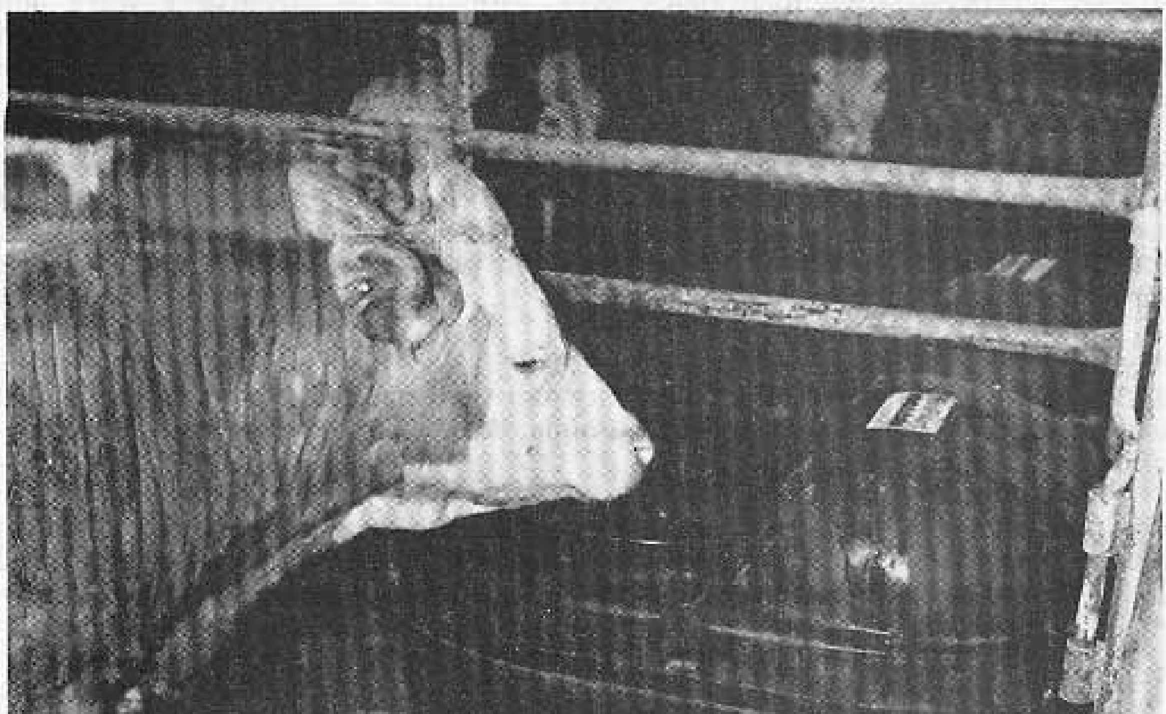
7. Thermostats that lack precise control may lead to freeze-ups or water overheating. Both are expensive. Check thermostats regularly to see that they are working properly.

8. The open surface of the waterer should be minimized. Large open troughs are more expensive to keep unfrozen, unless the water is constantly moving.

Table 19.1. Effects of Water Temperature on Cattle Performance and Electricity Costs

Item	Water Temperature, F		
	40	60	80
Daily Water Consumption, gal/hd	5.8	5.9	6.1
Daily Feed DM Intake, lb	19.4	19.2	20.5
Daily Gain, lb	2.67	2.55	2.95
Feed/Gain, lb	7.27	7.53	6.96
Daily Electric Usage KWH/waterer	—	1.72	3.75
Daily Electric Cost/Waterer[a]	—	$ .12	$ .26

[a] At @7¢/KWH.



Drought-stressed, Irrigated, and Additive-treated Corn Silages for Growing Cattle[1,2]

Keith Bolsen, Harvey Ilg, Russell Smith,
Jim Hoover, and Dirk Axe

Summary

Cattle fed drought-stressed corn silage gained about 10% slower but were just as efficient as cattle fed irrigated corn silage. Because the irrigated corn out yielded the drought corn (17.4 vs. 8.2 tons per acre), the irrigated silage gave a much higher cattle gain per acre (1928 vs. 940 1b). Silo Guard II®-treated silage had an advantage in DM recovery and feed conversion over its control and produced 4.6 more pounds of cattle gain per ton of crop ensiled. Cattle fed H/M Inoculant®- treated silage gained significantly faster than cattle fed the control, however, the treated silage gave only slight improvements in DM recovery and gain per ton of crop ensiled.

Experimental Procedures

Two corn varieties (Ferrie Morse 4020 and Pioneer 3183) were grown with irrigation or without (drought-stressed) in 1983. Silages were made by the alternative load method in 10 x 50 ft concrete stave silos. Corn was harvested in the late-dent stage; August 16 for the drought-stressed and August 31 for the irrigated. The dought-stressed corn had a grain yield of 20.5 bu per acre; the irrigated corn, 128. One silo of irrigated and one of drought-stressed corn served as controls. One silo of drought-stressed corn was treated with Silo Guard II® and one silo of irrigated with H/M Inoculant®. Ensiling temperatures were monitored for the first 42 days in all four silos and nylon bags (nine per silo) were buried for additional observations of silage DM recoveries. The silos were opened on February 8, 1984.

The silages were fed to light weight yearling steers and heifers in six pens of four cattle per silage. Silages were full-fed and all cattle received 2.0 lb of supplement daily (as-fed basis). Rations were formulated to provide 12% crude protein (DM basis), 200 mg of Rumensin® per animal daily, and equal amounts of calcium, phosphorus, and vitamins A, D, and E.

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[1] Silo Guard II® contains enzymes, sodium sulfate, and sodium sulfite and is manufactured by International Stock Foods, Inc., Waverly, which provided partial financial assistance.

[2] H/M Inoculant® contains Streptococcus faecium, Lactobacillus plantartum, and Pediococcus fermentation products and is marketed by Triple “F” Feeds, Des Moines, IA, which provided partial financial assistance.

The silos were emptied at a uniform rate and samples taken twice weekly. Feed offered was recorded daily for each of the 24 pens and the quantity of silage was adjusted daily to assure that fresh feed was always in the bunks. Feed not consumed was removed, weighed, and discarded every 7 days.

All calves were weighed individually on two consecutive days at the start (February 8 and 9, 1984) and at the end of the 84-day trial (May 2 and 3). Intermediate weights were taken before the A.M. feeding on days 28 and 56.

Three aerobic stability (bunk life) measurements were made on each silage. Approximately 60 lb of fresh silage was obtained from 3 ft below the surface in the center of each silo, while feeding out the top, middle, and bottom thirds of the silos. These were divided into 4.0 lb lots and each lot was placed in an expanded polystyrene container lined with plastic. A thermocouple wire was placed in the center of each container and cheesecloth stretched across the top. Containers were stored at 18 to 20 C and the silage temperature was recorded twice daily. After a designated number of days of air exposure, replicated containers of each silage were weighed, mixed, and sampled and dry matter loss was determined.

Results and Discussion

Visual appraisal indicated that all four silages were well preserved. Chemical analyses are shown in Table 20.1. The drought silages, which were much wetter at harvest than the irrigated silages, had more extensive fermentations with higher lactic and acetic acids and lower insoluble nitrogen and pH values. Neither additive significantly affected chemical composition.

Adjusted ensiling temperatures are shown in Figure 20.1. The maximum ambient temperature on the day of harvest was 108 F for the drought silages and 91 F for irrigated. As a result, initial temperature of the forage entering the silos was 7.7 degrees higher for the drought silages (99.4 VS 91.7).

Silage DM recovery and loss results are shown in Table 20.2. In the concrete stave silos, DM lost during fermentation, storage, and feedout was 36% higher for the drought silages (8.25%) than for the irrigated silages (5.25%). The buried nylon bags gave results similar to the silos, with irrigated silages having lower losses than drought silages. Feedable DM recoveries for the treated silages were slightly higher than their controls: 90.9 VS. 89.0% for Silo Guard II and 93.0 VS. 92.2% for H/M Inoculant.

Aerobic stabilities of silage from the top, middle, and bottom thirds of each silo are shown in Table 20.3. In general, stability increased as feeding progressed and the additives had little influence on stability.

Performance by cattle fed the control and treated silages is shown in Table 20.4. Cattle fed Silo Guard II -treated silage gained slightly faster and more efficiently than those fed its control. Cattle fed H/M Inoculant-treated silage gained faster ($P<.05$) and consumed 4.7% more feed than those fed its control. Also shown in Table 20.4 are cattle gains per ton of corn ensiled. These data combine silage recoveries (Table 20.2) and cattle performance. Silo Guard II silage produced 4.6 extra pounds of gain and H/M Inoculant, 2.3 extra pounds when compared with their control silages.

Performance by cattle fed the drought and irrigated silages is shown in Table 20.5. Cattle fed irrigated silage consumed more (P<.05) feed and gained faster (P<.05) than those fed drought silage. However, drought silage was utilized just as efficiently as irrigated silage. Also shown in Table 20.5 are cattle gains per ton of corn ensiled and per acre. The nutritive value of irrigated and drought silages was similar and a ton of each produced about the same amount of cattle gain. However, irrigated silage had double the yield per acre of drought silage (17.4 vs. 8.2 tons) and gave double the cattle gain per acre (1928 vs. 940 lb).

Table 20.1. Chemical Analyses of the Four Corn Silages Made in the Concrete Stave Silos

	Drought Silage		Irrigated Silage	
Item	Control	Silo Guard II	Control	H/M Inoculant
Dry matter:				
Pre-ensiled, %	30.4	30.6	40.0	40.6
Silage, %	29.7	29.6	39.3	40.1
	% of the Silage DM			
Lactic Acid	8.0	8.6	5.9	5.5
Acetic Acid	3.5	3.7	1.9	1.6
Total Fermentation Acids[1]	11.6	12.3	7.9	7.2
Crude Protein	10.0	10.1	8.0	8.0
	% of Total Silage N			
Hot Water Insoluble N	33	33	49	45
ammonia N	9.0	7.3	6.4	6.6
pH	3.88	3.85	3.94	3.98
Lactic:Acetic Ratio	2.3	2.5	3.2	3.6

[1] Only traces of other acids (ie. propionic or butyric) in any of the silage samples.

Table 20.2. Dry Matter Recoveries and Losses From the Concrete Stave Silos and Buried Bags for the Four Corn Silages

Item	DM Recovery Feedable	DM Recovery Non-feedable (Spoilage)	DM Lost During Fermentation, Storage, and Feedout
	% of the DM Ensiled		
		Drought Corn:	
Concrete Stave Silos			
Control	89.0	2.2	8.8
Silo Guard II	90.9	1.4	7.7
Average	89.95	1.8	8.25
Buried Nylon Bags			
Control	92.9	---	7.1
Silo Guard II	93.5	---	6.5
Average	92.2		6.8
		Irrigated corn:	
Concrete Stave Silos			
Control	92.2	2.4	5.4
H/M Inoculant	93.0	1.9	5.1
Average	92.6	2.15	5.25
Buried Nylon Bags			
Control	95.3	---	4.7
H/M Inoculant	93.8	---	6.2
Average	94.55		5.45

Table 20.3. Aerobic Stabilities of the Four Corn Silages

Silage Treatment	Day of Initial Temp. Rise Above Ambient (64 F)	Maximum Temp. (F)	Day of Maximum Temp.
		Drought Corn:	
Top Third			
Control	2.5	120	3
Silo Guard II	4.2	117	4
Middle Third			
Control	7.9	123	13
Silo Guard II	7.8	110	13
Bottom Third			
Control	13.5	76	14
Silo Guard II	*	*	*
		Irrigated Corn:	
Top Third			
Control	6.9	106	7
H/M Inoculant	3.5	106	4
Middle Third			
Control	6.8	119	12
H/M Inoculant	6.0	129	10
Bottom Third			
Control	7.5	108	9
H/M Inoculant	*	*	*

*No rise in temperature or visible aerobic deterioration occurred during 14 days of exposure to air.

Table 20.4. Performance by Cattle Fed the Four Corn Silages and Cattle Gain per Ton of Corn Ensiled

Item	Drought Silage		Irrigated Silage	
	Control	Silo Guard II	Control	H/M Inoculant
No. of Cattle	24	24	24	24
Initial Wt., lb	481	478	476	476
Avg. Daily Gain, lb	2.10	2.14	2.28[b]	2.43[a]
Daily Feed Intake, lb[1]				
Silage	11.63	11.63	13.39	14.10
Supplement	1.80	1.80	1.80	1.80
Total	13.43	13.43	15.19	15.90
Feed/lb of Gain, lb[1]	6.42	6.29	6.66	6.56
Silage Fed, lb/Ton Ensiled[2]	1780	1818	1843	1859
Silage/lb of Gain, lb[2]	15.8	15.5	16.8	16.6
Cattle Gain/Ton of Crop Ensiled, lb[2]	112.7	117.3	109.7	112.0

[a b] P<.05 for irrigated control vs. H/M Inoculant.

[1] 100% dry matter basis.

[2] All values are adjusted to the same silage DM content, 35 percent.

Table 20.5. Performance by Cattle Fed the Drought and Irrigated Corn Silages, Cattle Gain per Ton of Corn Ensiled, and Cattle Gain per Acre

Item	Corn Silage	
	Drought	Irrigated
No. of Cattle	48	48
Avg. Daily Gain, lb	2.12[b]	2.36[a]
Daily Feed Intake, lb[1]	13.43[b]	15.55[a]
Feed/lb of Gain, lb[1]	6.36	6.61
Silage Fed, lb/Ton Ensiled[2]	1800	1851
Silage/lb of Gain, lb[2]	15.7	16.7
Cattle Gain/Ton of Crop Ensiled, lb[2]	114.6	110.8
Silage Yield, Tons/Acre[2]	8.2	17.4
Cattle Gain/Acre, lb[2]	940	1928

[1] 100% dry matter basis.

[2] All values are adjusted to the same silage DM content, 35 percent.

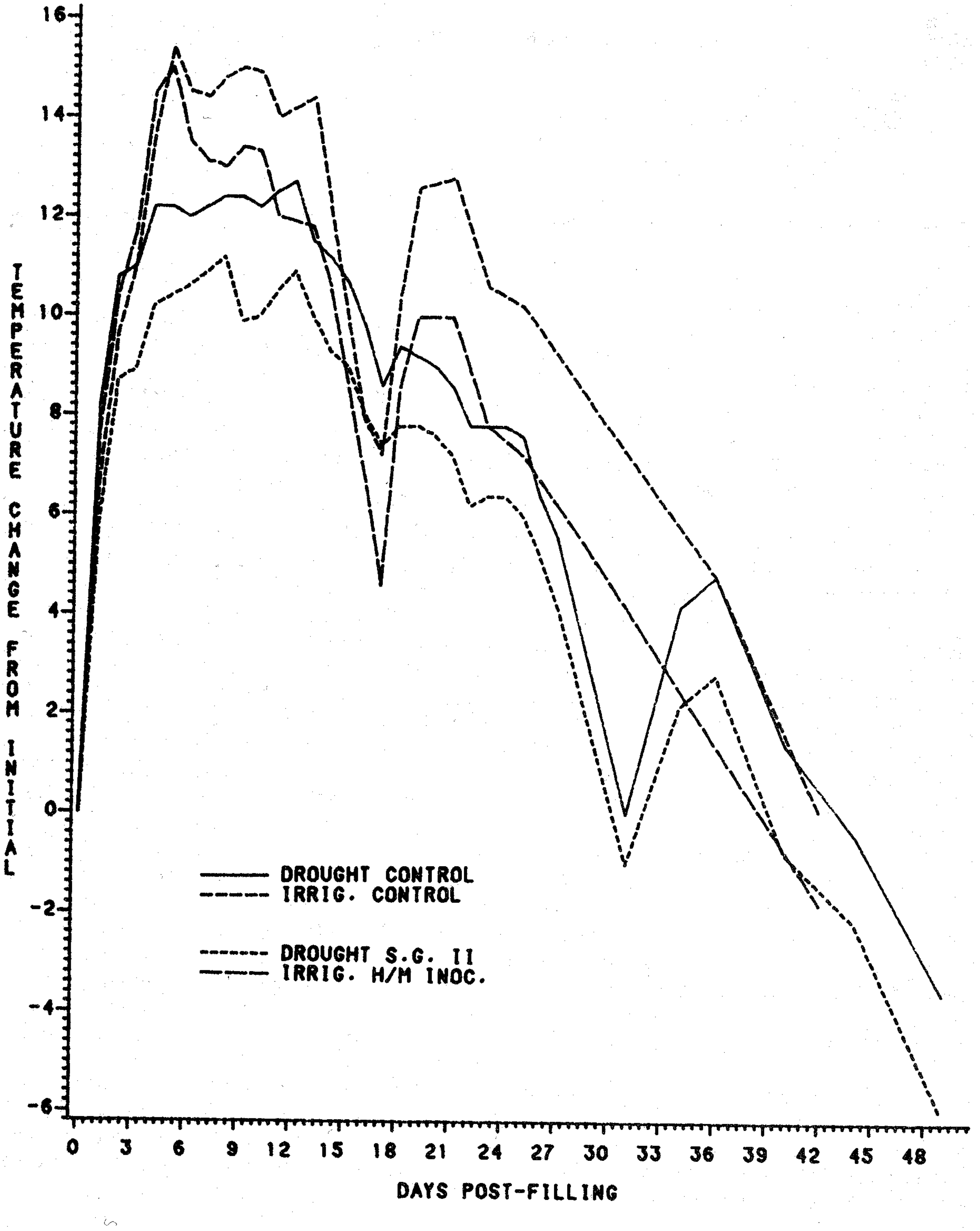

Figure 20.1. Ensiling Temperature (Rise Above Initial Forage Temperature) for the Two Drought Silages (August 16 to September 27, 1983) and the Two Irrigated Silages (August 31 to October 12, 1983).

Effects of Delayed Filling and H/M Inoculant® on Preservation and Quality of Corn Silage[1]

Keith Bolsen, Mark Hinds, Harvey Ilg, and Jim Hoover

Summary

Eight whole-plant corn silages were evaluated using laboratory silos. Treatments were: 1) control (no additive); 2) H/M Inoculant applied to the fresh crop at the forage harvester (H/M-field); and 3) H/M Inoculant applied to the fresh crop at the time of ensiling (H/M-silo). The control and H/M-field treatments were ensiled at 0, 4.5, and 12 hours post-harvest with the fresh crop remaining in the forage wagons until ensiled. The H/M-silo treatment had the inoculant applied immediately prior to ensiling at 4.5 and 12 hours post-harvest.

All eight corn silages were well preserved and underwent predominantly lactic acid fermentations. H/M Inoculant did not influence lactic acid content or 1actic:acetic and lactic:DM loss ratios. However, H/M-field silage ensiled immediately showed small improvements in quality over the control silage, as judged by lactic acid content and the two fermentation efficiency ratios. H/M Inoculant did not effect DM recovery at any ensiling time. However, when averaged across inoculant treatment, silages made at 4.5 hours post-harvest had the highest DM recoveries; silages at 12 hours, the lowest. All 4.5 and 12 hour post-harvest silages had less lactic and total acids than those made at harvest. The silages made as soon as possible after harvest had a faster accumulation of lactic and total fermentation acids than the same fresh crop ensiled 12 hours post-harvest.

Introduction

Our primary objective was to determine the efficacy of H/M Inoculant for whole-plant corn silage. A secondary objective was to document the effects of time of inoculation and time of silo filling on silage quality.

Experimental Procedures

Silages were made from whole-plant corn, harvested on September 1, 1983 in the late-dent stage at 62 to 64% moisture. The corn was grown under irrigation near Manhattan and had a grain yield of 128 bu per acre. The following three additive treatments were used: 1) control (no additive); 2) H/M Inoculant applied to the fresh crop at the forage harvester (H/M-field); and 3) H/M Inoculant applied to

[1]H/M Inoculant® contains Streptococcus faecium, Lactobacillus plantarum, and Pediococcus fermentation products and is marketed by Triple "F" Feeds, Des Moines, IA.

the fresh crop at the silage blower (H/M-silo). The control and H/M-field treatments were ensiled at 0, 4.5, and 12 hours post-harvesting. Harvested crop remained in the forage wagons until ensiled. Fresh crop for the H/M-silo treatments had the inoculant applied immediately prior to ensiling at 4.5 and 12 hours post-harvesting. The temperature of the pre-ensiled, fresh crop in the forage wagons was monitored from 0 to 12 hours post-harvesting with four thermocouples. The incomplete factorial experimental design is summarized in Table 21.1.

All silages were. made in 5-gallon capacity plastic laboratory silos using a hydraulic press to fill all silos to the same density. Five silos for each of the eight treatments were opened at 56 days post-filling. In addition, ensiling dynamics were measured for control and HM-field treatments ensiled at 0 and 12 hours post-harvesting by opening three silos per treatment at 0.5, 1, 2, 4, and 7 days post-filling.

Chemical analyses of all samples included dry matter (DM) total nitrogen, hot water insoluble-nitrogen, pH, lactic acid, and volatile fatty acids. Aerobic stability of the eight end-product, 56-day silages was determined using procedures described on page 60 of this Report.

Results and Discussion

56-Day Silages. All eight corn silages were well preserved and there were no obvious visual differences among them (Table 21.2). H/M lnoculant did not affect DM recovery at any ensiling time. However, H/M Inoculant applied at the silo 12 hours post-harvest gave a higher (P<.05) DM recovery than H/M Inoculant applied in the field and ensiled 12 hours post-harvest. When averaged across inoculant treatment, silages made at 4.5 hours post-harvest tended to have the highest DM recoveries; silages at 12 hours, the lowest.

All silages underwent predominantly lactic acid fermentations, as evidenced by low pHs (range of 3.76 to 3.86), high lactic acids (range of 5.18 to 6.46%), and low acetic acids (range 1.26 to 1.56%). H/M Inoculant did not influence the lactic acid content or lactic:acetic or lactic:DM loss efficiency ratios. However, H/M Inoculant silage made immediately after harvest showed small improvements in quality over the control silage, as judged by lactic acid content and the two fermentation efficiency ratios. In general, all silages made at 4.5 and 12 hours post-harvest had less lactic and total acids than those made at harvest. Preservation of plant protein, as determined by hot water insoluble-nitrogen (HWIN), was influenced by ensiling time but not by H/M lnoculant. Surprisingly, silages made at harvest had lower HWIN than silages made at 4.5 hours and 12 hours post-harvest (0.60 vs. 0.68 and 0.73%, respectively).

Aerobic stability, as measured by day of initial temperature rise, was not affected by inoculant treatment or ensiling time. All eight silages were only moderately stable. The average initial temperature rise occurred on day 4, approximately 86 hours after the silos were opened.

Ensiling Dynamics. The results for fermentation dynamics of the control and H/M-field silages made at 0 and 12 hours post-harvest are shown in Table 21.3 and 21.4. There were only small differences among control and H/M Inoculant silages at any of the six post-filling times. The silages made at harvest fermented very rapidly and had lactic acid contents of near 4.0% by 24 hours and pH values below 4.0 after 48 hours. In the 12-hour post-harvest silages, some fermentation occurred while the crop was in the forage wagons, as evidenced by the pH (about 5.1) and amount of total acids in the material at silo-filling (about 1.0%). Since the material was not tightly packed in the wagons, considerable plant cell respiration likely took place, which elevated the crop temperatures from about 30 C at harvest to over 45 C after 12 hours. The crop DM loss in the wagons was estimated (using buried nylon bags) to be 1.0 to 1.5 percent. H/M lnoculant did not affect the temperature or DM loss during the 12 hours and both control and H/M-field silages underwent rapid lactic acid fermentations after ensiling.

Table 21.1. Corn Silage Treatments and the Number of Laboratory Silos per Treatment

Additive Treatment	Time of Ensiling (hrs Post-Harvesting)		
	0	4.5	12
Control	20	5	20
H/M-Field	20	5	20
H/M-Silo	--	5	5

Table 21.2. Dry Matter Recoveries, Chemical Analyses, and Aerobic Stabilities of the Eight End-product Corn Silages

	0 hrs Post-Harvest		4.5 hrs Post-Harvest			12 hrs Post-Harvest		
Item	Control	H/M-Field	Control	H/M-Field	H/M-Silo	Control	H/M-Field	H/M-Silo
Silage DM, %	35.3	35.1	35.1	35.3	36.1	37.0	34.7	37.0
	% of the DM Ensiled							
DM Recovery	93.96^{bc}	94.04^{bc}	94.33^{ab}	95.85^{a}	94.43^{ab}	93.10^{bc}	92.48^{c}	94.47^{ab}
	% of the Silage DM							
Lactic Acid	6.21^{ab}	6.46^{a}	5.89^{bc}	5.60^{cd}	5.18^{d}	5.86^{bc}	5.96^{abc}	5.70^{c}
Acetic Acid	1.36^{ab}	1.30^{a}	1.35^{ab}	1.45^{ab}	1.35^{ab}	1.26^{a}	1.32^{ab}	1.56^{b}
Total Fermentation Acids	7.56^{ab}	7.75^{a}	7.23^{ab}	7.05^{bc}	6.53^{c}	7.11^{bc}	7.28^{ab}	7.25^{ab}
Efficiency Ratios:								
Lactic:Acetic	4.6^{ab}	5.0^{a}	4.4^{bc}	3.9^{cd}	3.8^{d}	4.7^{ab}	4.5^{ab}	3.8^{d}
Lactic:DM Loss[1]	1.0^{b}	1.2^{ab}	1.1^{b}	1.5^{a}	$.9^{b}$	$.9^{b}$	$.8^{b}$	1.1^{b}
pH: At Ensiling	5.74	5.85	5.22	5.40	5.32	5.11	5.06	5.25
Silage	3.82^{bc}	3.79^{ab}	3.76^{a}	3.79^{ab}	3.80^{ab}	3.79^{ab}	3.79^{ab}	3.86^{c}
Aerobic Stability: Day of Initial Temp. Rise After Exposure to Air	3.8	4.0	4.1	3.2	4.3	3.0	3.4	2.9

[abcd] Values in the same row with different superscripts differ P<.05.

[1] Percent lactic acid: Percent of the DM lost.

Table 21.3. Chemical Analyses and Dry Matter Recoveries over Time for the Control and H/M-Field Silages Made at Harvest.

Time Post-Filling and Treatment	Silage DM, %	DM Recovery[1]	pH	Fermentation Acids[2] Lactic	Acetic	Total	Efficiency Ratios Lactic: DM Loss[3]	Lactic: Acetic
Day 0 (harvest)								
Control	37.5	--	5.74	.21	.19	.4	--	--
H/M-Field	37.1	--	5.85	.19	.05	.3	--	--
SE	--	--	--	--	--	--	--	--
Day .5								
Control	37.1	98.9	5.20	1.03	.45	1.5	1.5	2.3
H/M-Field	36.9	99.3	5.22	1.27	.48	1.8	2.2	2.7
SE	.18	.48	.03	.04	.02	.06	.71	.06
Day 1								
Control	36.6	97.4	4.08	3.97	.51	4.5	1.7	8.0
H/M-Field	36.6	98.3	4.14	4.08	.71	4.8	2.5	5.7
SE	.10	.28	.01	.16	.04	.18	.28	.64
Day 2								
Control	36.4	97.0	3.97	4.42	.55	5.0	1.6	9.2
H/M-Field	36.2	97.1	3.99	4.68	.59	5.3	1.6	8.3
SE	.15	.40	.01	.51	.10	.51	.33	2.41
Day 4								
Control	36.4	96.8	3.95	5.23	.69	5.9	1.6	7.6
H/M-Field	35.8	96.0	3.97	4.85	.82	5.7	1.3	6.1
SE	.15	.40	.01	.28	.05	.25	.19	.61
Day 7								
Control	36.2	96.5	3.96	5.17	.72	5.9	1.5	7.2
H/M-Field	35.9	96.2	3.96	5.35	.82	6.2	1.4	6.6
SE	.10	.27	.01	.25	.05	.28	.10	.26
Day 56								
Control	35.3	94.0	3.82	6.21	1.36	7.6	1.1	4.6
H/M-Field	35.1	94.0	3.79	6.46	1.30	7.8	1.2	5.0
SE	.22	.60	.10	.06	.06	.14	.14	.23

[1] Percent of the DM ensiled.

[2] Percent of the silage DM.

[3] Percent lactic acid: percent of the DM lost.

Table 21.4. Chemical Analyses and Dry Matter Recoveries over Time for the Control and H/M-Field Silages Made at 12 Hours Post-harvest

Time Post-Filling and Treatment	Silage DM, %	DM Recovery [1]	pH	Fermentation Acids [2] Lactic	Acetic	Total	Efficiency Ratios Lactic: DM Loss [3]	Lactic: Acetic
Day 0 (12 hrs Post-Harvest)								
Control	39.3	--	5.11	.69	.38	1.2	--	--
H/M-Field	37.0	--	5.06	.44	.39	.9	--	--
SE	--	--	--	--	--	--	--	--
Day .5								
Control	38.6	98.1	4.37	2.09	.44	2.6	1.1	4.7
H/M-Field	36.9	99.5	4.31	2.53	.45	3.1	5.1	5.6
SE	.07	.20	.02	.09	.01	.09	.82	.14
Day 1								
Control	38.5	97.7	4.03	3.93	.60	4.6	1.9	6.9
H/M-Field	36.6	98.9	4.00	3.62	.51	4.2	3.4	7.1
SE	.12	.32	.01	.11	.07	.14	.35	.74
Day 2								
Control	38.3	97.2	3.94	4.49	.61	5.2	1.8	7.4
H/M-Field	36.4	98.1	3.92	3.24	.77	4.1	1.9	4.3
SE	.22	.54	.02	.26	.05	.25	.38	.48
Day 4								
Control	38.3	97.3	3.92	4.72	.72	5.5	1.8	6.5
H/M-Field	36.0	97.0	3.89	4.93	.90	5.9	1.7	5.6
SE	.12	.27	.01	.17	.06	.15	.15	.48
Day 7								
Control	38.3	97.1	3.91	4.43	.80	5.3	1.6	5.6
H/M-Field	36.2	96.2	3.88	5.06	.96	6.1	1.8	5.3
SE	.23	.51	.01	.27	.07	.34	.20	.14
Day 56								
Control	37.0	93.1	3.79	5.86	1.26	7.1	.9	4.7
H/M-Field	34.7	92.5	3.79	5.96	1.32	7.3	.8	4.5
SE	.19	.51	.02	.13	.05	.17	.08	.14

[1] Percent of the DM ensiled.

[2] Percent of the silge DM.

[3] Percent lactic acid: percent of the DM lost.

Whole-Plant Forage, Grain, or Nonheading Sorghum Silages for Growing Cattle

Russell Smith, Keith Bolsen, Harvey Ilg, Jim Hoover, and John Dickerson

Summary

Three sorghum hybrid types were used to make six silages in the fall of 1983. Eight silage rations were compared using 160 steer calves in an 84-day growing trial. Using forage sorghum silage as a base (100), grain sorghum silage had a feeding value of 133, and nonheading sorghum silage 89, when evaluated for comparative rates and efficiencies of gain. Silages from concrete stave silos produced faster and more efficient steer gains than silages from Silopress® bags. Rolling the grain sorghum silages at feeding time to break 95% of the grain significantly improved steer performance. The feeding value of corn silage was not enhanced by processing.

Introduction

Unlike corn, sorghums have a wide range of grain yield, plant height, and forage dry matter content. Therefore, large variations in feeding value often occur among sorghum varieties. A producer must choose a variety (or type) that will best fit the needs of his livestock and return the greatest economic benefit.

One objective of this trial was to further substantiate previous results concerning the feeding values of grain-type, grain producing forage-type, and nonheading forage-type sorghum silages. Another objective was to determine the effect of storage structure, concrete stave silo VS. Silopress® bag, on the feeding value of the forage and nonheading sorghums. Previous research has shown that processing (rolling) whole-plant sorghum silages is not cost effective (Reports of Progress 427 and 448). This trial measured the response to processing grain sorghum silages harvested at two stages of maturity.

Experimental Procedures

Six silages were made from three sorghum hybrids in the fall of 1983. The crops were: 1) DeKalb FS 25A+ forage sorghum; 2) Funk's G 1990 nonheading sorghum and 3) DeKalb 42Y grain sorghum. The forage sorghum (late-dough stage of maturity) and nonheading sorghums were harvested in concrete stave silos (10 x 50 ft) and Silopress® bags. The grain sorghum was harvested at two stages of maturity and ensiled in a 12 x 60) ft concrete stave silo (late-dough) or a 14 x 40 ft Harvestore® (hard-grain). The harvest dates, dry matter (DM) contents, and type of structure are shown in Table 22.1.

Table 22.1. Crops, Harvest Dates, Dry Matter Contents, and Storage Structures

Sorghum	1983 Harvest Dates	% DM at Harvest	Type of Structure
Forage	Sept. 28	27.9	Silopress bag
	Sept. 30	29.2	Concrete stave
Nonheading	Sept. 28	26.9	Silopress bag
	Sept. 29	27.1	Concrete stave
Grain	Aug. 28-30	42.1	Concrete stave
	Sept. 15-16	50.8	Harvestore

All crops were direct-cut using a Field Queen forage harvester. About 80 to 85% of the sorghum grain was whole when ensiled.

Growth Trial. Eight silage rations were compared: each of the six silages fed without further processing, and the two grain sorghum silages fed after processing through a Roskamp® roller mill to break 95% of the grain. Each silage ration was fed to 20 crossbred steers (four pens of five steers per ration). The silages were full-fed with 2 lb of supplement per steer daily (as-fed basis). Rations were formulated to provide 12.0% crude protein (DM basis), 200 mg of Rumensin® per calf daily, equal amounts of calcium and phosphorus, and vitamin A. The steers received hormonal implants at the start of the trial. The growing trial lasted 84 days, December 15, 1983 to March 9, 1984.

To minimize fill effects, all steers were fed forage sorghum silage to provide a DM intake of 1.75% of body weight for one week before the trial began. Then the steers were weighed individually on two consecutive days after 16 hr without feed or water at the start and end of the trial. The average initial weight was 571 pounds.

Samples of each silage were taken twice weekly. Feed intake was recorded daily for each pen and the quantity of silage fed adjusted daily to assure that fresh feed was always in the bunks. Feed not consumed was removed, weighed, and discarded as necessary.

Digestion Trial. Thirty-six steers similar to those in the growth trial were individually fed six silage rations. The two grain sorghum silages fed in the growth trial and a whole-plant corn silage (40% DM) were each fed unprocessed or rolled. The corn silage is described on page 60 of this report. Chromic oxide was used as a marker to determine digestibility.

The trial consisted of a 14-day adaptation period followed by a 7-day fecal collection period. Fecal samples were taken twice daily according to an advancing 2 hr schedule designed to minimize diurna1 variations in digestion.

Results and Discussion

Chemical analyses and dry matter recoveries of the six silages are shown in Table 22.2. The DM contents ranged from 24.9% for the nonheading sorghum from the concrete stave silo to 50.9% for the late harvested grain sorghum silage. There was little difference in the DM content of the forage and nonheading sorghums. In previous trials (Report of Progress 448), the nonheading silage was wetter.

In spite of the fact that the drier grain sorghum silages underwent less extensive fermentations than the other four silages, as is indicated by their higher pH values and lower acid contents, they were adequately preserved. As a result of their more limited fermentations, DM recoveries were higher. DM recoveries from Silopress bags were slightly higher than those from the concrete stave silos.

Growth Trial. Performance by steers fed the three whole-plant silages made in concrete stave silos is shown in Table 22.3. Grain sorghum produced the fastest gains and highest intakes, nonheading sorghum the slowest gains, and forage sorghum the lowest intakes. Relative feeding values were assigned to each sorghum type based on comparative rates and efficiencies of gain. Performance by steers fed forage sorghum silage was given a value of 100. Grain sorghum had a relative feeding value of 133, reflecting its higher grain content. Nonheading sorghum silage had a relative feeding value of 89, which was likely the result of its higher fiber content.

Data on steer performance from the silo-type comparison are shown in Table 22.4. Silages from the concrete stave silos produced faster gains ($P<.05$) than the silages from the Silopress bags. Intake was higher ($P<.05$) for the nonheading silage from the concrete stave silo than for that made in the bag, however, intakes were numerically lower for the forage sorghum silage from the stave silo when compared to its respective bag silage. Feed efficiencies were better for the stave silo silages.

Performance by steers fed the grain sorghum silages is shown in Table 22.5. Processing the silages prior to feeding significantly improved steer performance. For the earlier harvested silage, processing increased ($P<.05$) gain by 11% and improved ($P<.10$) feed efficiency by 12%, but did not affect DM intake. The responses to processing the grain sorghum silages in this trial were much greater than those observed in our two previous trials (Reports of Progress 427 and 448). However, both grain sorghum silages fed in this trial were harvested at a more mature stage and both contained much higher estimated grain to forage ratios than those fed in previous years.

Digestion Trial. Apparent digestibility coefficients of the six silage rations are shown in Table 22.6. There was no difference between DM digestibility and organic matter (OM) digestibility within any of the silages. For the earlier harvested grain sorghum silage, processing increased DM digestibility by 15% and starch digestibility by 22 percent ($P<.05$). For the later harvested silage, DM digestibility was increased only 5% but starch digestibility was improved 22 percent ($P<.05$). Digestibilities of acid detergent fiber (ADF), cellulose, and crude fiber were not affected by processing the grain sorghum silages. However, ADF, cellulose, and crude fiber digestibilities were decreased when the corn silage was processed. A possible explanation for this lower fiber digestibility is that processing the corn silages reduced the particle size of the corn cob and increased the intake of that portion of the silage. There was a greater refusal of the cobs in the unprocessed corn silage. Corn silage also showed a slightly negative response in DM and OM digestibilities due to processing. Starch digestibility was increased by 8% when the corn silage was processed.

These results suggest that the benefits from processing grain sorghum silage are influenced by grain maturity and grain content. The higher intake of the more mature grain sorghum silage compared with the dough stage silage (Table 22.5) is likely related to differences in DM content (Table 22.2).

When comparing the two unprocessed grain sorghum silages, the lower starch digestibility of the more mature silage (51 vs 65%) accounts for much of the difference in feed efficiency (8.68 vs. 7.75). Even though the processed late-dough grain sorghum silage was numerically more digestible (DM, OM, and starch) than the more mature sorghum silage, the higher intake of the hard-grain silage appeared to compensate for the improvement in digestibility. This was evident in the nearly identical average daily gains of steers fed these two silages (Table 22.5).

Table 22.2. Chemical Analyses and Dry Matter Recoveries for the Six Silages

	Forage Sorghum		Nonheading Sorghum		Grain Sorghum	
Item	Concrete Stave Silo	Silopress Bag	Concrete Stave Silo	Silopress Bag	Late-Dough	Hard-Grain
Silage DM, %	25.1	25.8	24.9	25.8	42.3	50.9
DM Recovery, % of the DM Ensiled	86.5	90.2	86.4	89.8	96.7	97.9
pH	3.82	3.78	3.75	3.69	4.19	4.34
	% of the Silage DM					
Lactic Acid	8.78	9.45	9.61	9.26	5.92	4.56
Acetic Acid	2.43	1.96	3.01	2.26	1.54	1.22
Butyric acid	trace	trace	none	none	trace	trace
Total Fermentation Acids	11.26	11.42	12.62	11.52	7.48	5.81
Acid Detergent Fiber	38.8	39.8	40.3	42.0	23.3	23.1
Neutral Detergent Fiber	63.9	64.3	64.9	65.8	40.1	45.2
Lignin	6.6	7.4	6.8	7.5	3.8	4.0
Cellulose	28.5	28.8	30.3	30.9	17.3	16.6
Hemicellulose	24.3	24.0	23.9	23.5	17.1	22.2
Crude Protein	6.2	6.0	6.1	6.2	10.9	10.1
	% of the Total N					
Ammonia-N	4.2	4.8	5.2	4.8	6.5	5.0
Hot Water Insoluble-N	55.2	51.7	47.1	44.1	46.7	56.3
Acid Detergent-N	14.0	14.5	15.8	10.6	11.1	13.3

Table 22.3. Performance by Steers Fed the Three Whole-plant Silages Made in Concrete Stave Silos

Item	Nonheading Sorghum	Forage Sorghum	Grain Sorghum[1]
No. of Calves	20	20	20
Initial Wt., lb	572	572	573
Final Wt., lb	677	687	762
Avg. Daily Gain, lb	1.25	1.37	2.25
Avg. Daily Feed, lb[2]	12.62	11.94	19.41
Feed/lb of Gain, lb[2]	10.12	8.87	8.68
Relative Feeding Value[3]	89	100	133

[1] Late-dough stage of maturity, unprocessed.
[2] 100% dry matter basis.
[3] Based on comparative rates and efficiencies of gain, with performance of steers fed forage sorghum silage assigned a value of 100.

Table 22.4. Performance by Steers Fed the Forage Sorghum and Nonheading Sorghum Silages

Item	Forage		Nonheading	
	Concrete Stave Silo	Silopress Bag	Concrete Stave Silo	Silopress Bag
No. of Calves	20	20	20	20
Initial Wt., lb	572	570	572	571
Final Wt., lb	687	669	677	647
Avg. Daily Gain, lb	1.37[a]	1.18[b]	1.25[a b]	.91[c]
Avg. Daily Feed, lb[1]	11.94[a b]	12.46[a b]	12.62[a]	11.84[b]
Feed/lb Gain, lb[1]	8.87[a]	10.60[a]	10.12[a]	13.42[b]

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

[1] 100% dry matter basis.

Table 22.5. Performance by Steers Fed the Grain Sorghum Silages

Item	Late-Dough		Hard-Grain	
	Unprocessed	Processed	Unprocessed	Processed
No. of Calves	20	20	20	20
Initial Wt., lb	573	570	569	570
Final Wt., lb	762	780	746	776
Avg. Daily Gain, lb	2.25[b]	2.50[a]	2.11[b]	2.45[a]
Avg. Daily Feed, lb[1]	19.41[d]	19.37[d]	19.86[c d]	20.82[c]
Feed/lb Gain, lb[1]	8.68[d]	7.75[c]	9.44[e]	8.53[d]

[ab] Means with different superscripts differ significantly (P<.05).

[c d e] Means with different superscripts differ significantly (P<.10).

[1] 100% dry matter basis.

Table 22.6. Apparent Digestibilities of the Six Grain Sorghum and Corn Silage Rations

Item	Grain Sorghum Silage				Corn Silage		SE
	Late-Dough		Hard-Grain				
	Unproc.	Proc.	Unproc.	Proc.	Unproc.	Proc.	
Apparent Digestibility:	%						
Dry Matter	53.7[b]	61.9[a b]	55.0[b]	57.8[b]	63.1[a]	60.9[b]	2.86
Starch	65.0[c]	79.0[b]	50.7[d]	65.4[c]	86.2[a b]	93.4[a]	3.16
Organic Matter	53.7[b]	61.9[a b]	55.1[b]	57.8[b]	63.2[a]	61.0[b]	2.86
ADF	49.5[a b]	49.9[a b]	55.8[a]	56.1[a]	50.7[a b]	42.8[b]	3.60
Cellulose	60.1[a b]	58.9[a b]	62.4[a]	62.9[a]	59.4[a b]	52.4[b]	3.25
Crude Fiber	58.8[a b]	58.5[a b]	65.3[a]	64.3[a]	59.4[a b]	54.0[b]	3.01
Crude Protein	42.7[a b]	51.5[a]	38.2[b]	42.5[a b]	37.9[b]	32.6[b]	4.49

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

Effects of Hybrid Maturity and Growth Stage on Yield and Composition of Forage and Grain Sorghums when Harvested as Silage

John Dickerson, Russell Smith,
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Summary

Thirteen sorghum hybrids chosen to represent a range of sorghum types were evaluated in two separate trials. Each was harvested at three stages of grain development: milk to early-dough, late-dough, and hard-grain.

Among the forage sorghums, there was a 26-day range in days to half bloom from early to late maturing varieties. Harvest date did not affect crude protein content. However, whole-plant DM yield was significantly lower at the last harvest for the three latest maturing varieties. Grain yield increased over time in the early and intermediate hybrids. Lodging increased significantly over time for all varieties except DeKalb FS-25E.

Among the grain sorghums, there was only a 4-day range in days to half bloom and very little difference in plant height. The forage sorghum was later maturing and taller. Whole-plant DM yields for the grain sorghums were highest at late-dough. Grain yields and grain to forage ratios generally increased with maturity, except when there were losses due to birds. Grain sorghums started to lodge by the hard-grain stage.

Introduction

Sorghum's importance as a feed grain and silage crop has increased steadily in the High Plains region during the past 25 years. In recent years, more acres and tons of sorghum were harvested, stored, and fed as silage in Kansas than corn. Today, improved sorghum hybrids often give DM yields comparable to corn with lower production costs. But, there are often large variations among sorghum hybrids. Research in Texas indicates that whole-plant grain sorghum harvested and fed as silage produces about one-third more cattle gain per acre than harvesting and feeding only the grain portion.

Our objective was to determine how sorghum hybrids with different characteristics are affected by stage of development at harvest.

Experimental Procedures

Two separate experiments were conducted under dryland conditions during the summer of 1984. The forage sorghum trial included two early, two intermediate, and two late maturing hybrids. Included in the grain sorghum trial were two early, two intermediate, and one late maturing hybrids. A forage sorghum, intermediate in maturity, also was included in the grain sorghum trial for

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comparison purposes. Hybrids were chosen to represent a range of sorghum pedigrees, which included variations in maturity, plant height, and grain and forage yields. Each variety was harvested at three stages of grain development; milk to early-dough, late-dough, and hard-grain. Treatments were arranged in a split-plot design with stages of harvest as main plots and varieties as sub-plots with four replications.

About 90 lb per acre of anhydrous ammonia and a broadcast pre-emergence herbicide spray (Ramrod-atrazine) were applied before planting. Soil tests indicated that phosphorus and potassium were adequate. All plots were planted June 1, but heavy rains during emergence ruined stands on the forage sorghum plots, so they were replanted on June 25. The grain sorghum stands were a little thin in spots, but acceptable. Furadan insecticide was placed in the furrows at planting and Cygon insecticide spray was applied July 31 for greenbug control. Each plot consisted of six rows, 30-inches apart and 30 ft in length. Two to three weeks after emergence, the plots were thinned to 34,848 plants per acre (six inches between plants).

Agronomic data collected on each plot included days to half bloom, plant height, lodging, whole-plant DM, and grain yields. Days to half bloom measured maturity, and is defined as number of days between the planting date and the date half of the main heads had some florets in bloom. Plant height was measured to the tallest point of the head immediately prior to harvest. Whole-plant yields for each plot were determined by harvesting a 20 ft length from each of the two center rows with a modified one-row forage harvester. Chopped forage from each plot was weighed, sampled for DM, and collected for silage-making. Silage was made from each plot in a 5-gallon capacity plastic laboratory silo. Grain yields were determined by hand clipping the heads from 20 ft of one of the remaining rows. Then, the heads were dried and threshed in a stationary thresher.

Results and Discussion

Forage Sorghum Trial. Shown in Table 23.1 are days to half bloom and plant height of the six varieties of forage sorghum. There was a 26-day range in days to half bloom from early to late maturing varieties. Unexpectedly, plant height was highest for the earlier maturing varieties and lowest for the intermediate maturing varieties. The relatively late planting date (June 25) and an early freeze (September 27) probably were responsible for this unusual relationship.

The data for yield and composition by variety are also shown in Table 23.1. An early freeze damaged the late maturing DeKalb FS-25E and resulted in a much lower grain yield and grain to forage ratio than in the other five varieties. Forage DM content was significantly higher at the third harvest for all varieties, except DeKalb FS-25E. No significant differences in whole-plant crude protein (CP) due to harvest date were observed in any variety. Forage DM yield was significantly lower for the three latest maturing hybrids (Silomaker, Cow Vittles, and DeKalb FS-25E) at the hard-grain stage. Grain yield was highest ($P<.05$) for the late-dough and hard-grain harvests in the early and intermediate varieties. Grain to forage ratios were numerically lowest at the milk to early-dough stage for all varieties. Lodging percents were significantly higher at the last harvest date for all varieties, except DeKalb FS-25E.

Grain Sorghum Trial. The earliest and latest maturing grain sorghum varieties differed by only 4 days to half bloom (Table 23.2). Likewise, plant heights were similar for all grain sorghums. The forage sorghum (Pioneer 947) was later maturing and significantly taller than the grain sorghums.

The data for yield and composition by variety are also presented in Table 23.2. Whole-plant DM content for the grain sorghums was significantly higher at each successive harvest, while Pioneer 947 remained constant after the first harvest. About 10 days elapsed between each successive harvest stage. The effect of harvest stage on CP content was significant for only one variety (TX 2752 x TX 430), however there was a trend for CP content to decrease with maturity for all varieties except Asgrow Colt. A1though differences were not statistically significant, all grain sorghum varieties produced their highest DM yields at the late-dough stage of development, while the forage sorghum declined in DM yield at each successive harvest. Grain yields and grain to forage ratios generally increased with maturity, but due to severe damage by birds in some plots, grain yields were reduced at the third harvest for three of the grain sorghum varieties. Lodging increased significantly at the third harvest for four of the five grain sorghums. The forage sorghum also lodged more as maturity progressed, however these values were likely inflated since it was not surrounded by a crop of similar height.

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Sorghum Performance Tests

Sorghum Performance Tests are conducted annually by the Kansas Agricultural Experiment Station to provide farmers, Extension workers, and private research and sales personnel with unbiased agronomic information on many sorghum hybrids marketed in Kansas. Cooperating seed firms nominate test entries, select test sites, and pay entry fees to cover part of the test costs. Because the program is voluntary, not all hybrids grown in the state are included in tests, and hybrids are not grown uniformly at all locations.

Results of the 1984 Sorghum Performance Tests are summarized in Report of Progress 465. It can be obtained through Extension personnel, or the Kansas Agricultural Experiment Station.

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Table 23.1. Yield and Composition of the Six Forage Sorghum Varieties Harvested at Three Stages of Maturity

		Whole-plant		Yield/Acre			
Variety	Harvest[1]	DM %	CP[2] %	Whole-plant tons[2]	Grain bu[3]	Grain: Forage Ratio	Lodging %
Early Maturity							
Buffalo Canex	1	27.2[b]	7.1	5.4[c]	35.3[b]	.20	0.0[c]
(55[4], 86[5])	2	25.8[c]	5.7	5.9[ab]	54.7[a]	.30	7.5[ab]
	3	29.2[a]	6.8	6.2[a]	55.1[a]	.28	11.5[a]
Warner Sweet-Bee	1	24.8[c]	6.9	5.5[b]	45.8[b]	.26	15.8[b]
(62, 93)	2	26.8[b]	6.8	6.1[a]	58.6[ab]	.31	34.3[ab]
	3	30.4[a]	6.7	6.6[a]	64.3[a]	.31	44.0[a]
Intermediate Maturity							
Pioneer 947	1	30.5[b]	9.1	5.6	49.0[b]	.28[b]	.8[b]
(68, 81)	2	31.7[b]	8.7	6.1	82.5[a]	.51[a]	2.8[ab]
	3	41.9[a]	9.1	6.4	77.1[a]	.44[a]	7.3[a]
Golden Acres T-E Silomaker	1	27.0[b]	8.2	6.2[ab]	41.3[b]	.20	3.0[ab]
	2	30.5[a]	8.5	6.6[a]	61.5[a]	.30	2.0[b]
(76, 71)	3	30.1[a]	8.6	5.8[b]	49.9[ab]	.28	12.3[a]
Late Maturity							
Conlee Cow Vittles	1	24.5[b]	8.1	6.3[a]	23.3	.10[b]	6.0
(79, 84)	2	26.0[a]	7.7	6.2[a]	35.5	.16[ab]	10.8
	3	25.8[a]	7.7	5.6[b]	41.9	.24[a]	28.5
De Kalb FS-25 E	1	26.9[a]	8.3	6.7[a]	9.6	.04	0
(81, 82)	2	24.7[b]	7.9	6.3[ab]	11.6	.05	0
	3	24.7[b]	8.1	6.2[b]	10.6	.04	0

[1] Harvest 1, milk to early-dough; harvest 2, late-dough; harvest 3, hard-grain.

[2] 100% dry matter basis.

[3] Adjusted to 12.5% moisture.

[4] Days to half bloom.

[5] Plant height, inches.

[a b c] Means within a variety with same letter are not different (P<.05).

Table 23.2. Yield and Composition of the Sorghums in the Grain Sorghum Trial

Variety	Harvest[1]	Whole-plant DM %	Whole-plant CP[2] %	Yield/Acre Whole-plant tons[2]	Yield/Acre Grain bu[3]	Grain: Forage Ratio	Lodging-%
Early Maturity							
DeKalb DK-42Y	1	32.2^{a}	10.9	5.1	70.6	.51^{a}	0.0
(61[4], 43[5])	2	41.9^{b}	10.5	5.5	96.0	.76^{a}	0.0
	3	50.9^{c}	10.1	5.3	85.5	.65^{ab}	2.2
Northrup-King 2778	1	31.4^{a}	10.7	4.8	64.2^{b}	.51^{b}	0.0^{a}
(61, 43)	2	41.5^{b}	10.5	5.4	101.0^{a}	.86^{a}	0.0^{a}
	3	49.9^{c}	9.4	5.0	86.7^{ab}	.76^{ab}	6.2^{b}
Intermediate Maturity							
TX 2752 x TX 430	1	35.1^{a}	10.8^{a}	5.5	72.6^{b}	.49^{b}	0.0^{a}
(62, 43)	2	42.9^{b}	10.5^{a}	5.9	107.4^{a}	.84^{ab}	0.0^{a}
	3	53.1^{c}	9.3^{b}	5.3	107.5^{a}	1.05^{a}	15.0^{b}
Funk's G-522DR	1	34.2^{a}	10.5	5.4^{b}	70.5^{b}	.49^{b}	0.0^{a}
(63, 42)	2	43.8^{b}	10.3	6.2^{a}	102.9^{a}	.71^{ab}	0.0^{a}
	3	55.1^{c}	9.8	5.6^{ab}	103.9^{a}	.83^{a}	11.5^{b}
Late Maturity							
Asgrow Colt	1	31.4^{a}	10.0	5.2	63.0	.41	0.0^{a}
(65, 44)	2	39.2^{b}	10.0	5.9	102.2	.76	0.0^{a}
	3	47.6^{c}	10.0	4.8	85.3	.79	11.7^{b}
Pioneer 947 (forage)	1	39.1^{a}	9.4	6.2	83.4	.50	47.6^{a}
(72, 78)	2	45.2^{b}	8.8	6.1	85.5	.53	62.9^{a}
	3	45.5^{b}	8.5	5.8	91.2	.62	70.0^{b}

[1] Harvest 1, milk to early-dough; harvest 2, late-dough; harvest 3, hard-grain.

[2] 100% dry matter basis.

[3] Adjusted to 12.5% moisture.

[4] Days to half bloom.

[5] Plant height, inches.

^{abc}Means within a variety with same letter are not different (P<.05).

Urea and Limestone Additions to Forage Sorghum Silage

Keith Bolsen, Harvey llg, Dirk Axe,
and Russell Smith

Summary

Adding urea or limestone to forage sorghum silage increased lactic and acetic acids compared with untreated silage. Urea also elevated the ensiling temperature and increased the DM loss in the silo. Although calves fed the three silages had similar performance, those fed the urea-treated silage tended to have the highest consumption but poorest feed conversion. There were no apparent improvements in silage conservation or feeding value from either urea or limestone.

Introduction

In four previous trials with corn and sorghum silages (Reports of Progress 377, 394, and 448), non-protein nitrogen (ammonia or urea) has increased the crude protein content by 3 to 5 percentage units, increased the amount of fermentation acids, and extended the bunk life of the silage. However, adding NPN to the silage generally decreased cattle performance when compared to an all-natural supplement, and decreased silage dry matter recovery. Although ammonia is a cheaper source of NPN, urea is safer to handle and a higher percent of the nitrogen is retained in the silage. Limestone has been added to corn in the past to increase the calcium and lactic acid contents of silage, but little is known about its use with wetter forage sorghum silages.

Our objectives were to further document the effects of urea and limestone on the conservation and feeding value of sorghum silages.

Experimental Procedures

Three whole-plant forage sorghum silages were compared: 1) control (no additive); 2) urea (10 lb/ton of fresh crop); and 3) limestone (15 lb/ton of fresh crop). Urea was applied in a 50% water solution; limestone, in dry form. The silages were made by the alternate load method in 10 x 50 ft concrete stave silos on September 27 and 28, 1983 from Pioneer 947 forage sorghum harvested in the hard-dough stage at 27 to 28% dry matter (DM). Ensiling temperatures were monitored for the first 42 days and nylon bags of crop (six per silo) were buried for additional observations of silage DM recoveries. The silos were opened on November 16 and emptied at a uniform rate during the following 14 weeks.

Each silage was fed to 12 crossbred steer calves housed in individual pens. The 84-day growing trial began November 17, 1983 and ended February 9, 1984. Silages were full-fed and all calves received 2.0 lb of supplement daily (as-fed basis). Rations were formulated to provide 12.5% crude protein (DM basis), 150 mg of Rumensin® per calf daily, and equal amounts of calcium, phosphorus, and vitamin A.

Calf weights, silage samples, and silage bunk life procedures were similar to those described on page 60 of this report.

Results and Discussion

Performance by calves fed the three forage sorghum silage rations is shown in Table 24.1. Calves fed the limestone silage gained slowest; those fed urea silage had the highest DM intake; and those fed control silage had the lowest feed to gain ratio. None of the performance differences were statistically significant.

Chemical analyses and ensiling temperatures of the silages are shown in Table 24.2. All three silages appeared well preserved, although the urea silage was a darker brown and reached higher ensiling temperatures than the other two silages. Urea and limestone produced much more extensive fermentations with higher pH and total acid values, and lower lactic to acetic acid ratios than untreated silage. Approximately 95% of the urea-nitrogen added to the fresh crop was recovered in the silage.

Silage DM recovery and loss results are shown in Table 24.3. In the concrete stave silos, the DM lost during fermentation, storage, and feedout was highest for the urea silage. The silage in buried nylon bags was similar to that in the silos, with the control and limestone silages having lower losses than urea silage. Al1 three silages were highly stable in air, in spite of a rather slow feeding rate.

There were no apparent benefits with either urea or limestone. The greater DM loss in the silo from adding urea agrees with our previous trials. NPN silages have usually given poorer performance with calves, but not in this trial. We were surprised that limestone gave a DM recovery nearly identical to the control, since the increased acids indicate more extensive fermentation.

Table 24.1. Performance by Calves Fed the Control, Urea, and Limestone Silages

	Silage Treatment		
Item	Control	Urea	Limestone
No. of Calves	12	12	12
Initial Wt., lb	466	467	466
Avg. Daily Gain, lb	1.10	1.08	1.01
Avg. Daily Feed, lb[1]	11.38	11.87	11.55
Feed/lb of Gain, lb[1]	11.0	11.3	11.8

[1] 100% dry matter basis.

Table 24.2. Chemical Analyses and Ensiling Temperature for the Control, Urea, and Limestone Silages Made in the Concrete Stave Silos[1]

Item	Silage Treatment: Control	Urea	Limestone
Dry Matter:			
Pre-Ensiled, %	27.0	27.2	28.4
Silage, %	25.0	25.4	27.4
Maximum Temp. Rise From Initial Forage Temp., °F	17	23	19
Day of Maximum Temp.	7	10	7
	— % of the Silage DM —		
Lactic Acid	7.96	10.91	10.72
Acetic Acid	2.25	4.50	4.96
Total Fermentation Acids	10.4	15.6	15.8
Crude Protein	4.8	9.9	5.2
pH	3.86	4.21	4.36
Lactic:Acetic Ratio	3.8	2.9	2.5

[1] Each value is the mean of 14 samples.

Table 24.3. Forage Sorghum Silage Recoveries and Losses From the Concrete Stave Silos and Buried Bags for the Control, Urea, and Limestone Silages

Silo and Silage Treatment	DM Recovery: Feedable	DM Recovery: Non-feedable (Spoilage)	DM Lost During Fermentation, Storage, and Feedout
	— % of the DM Ensiled —		
Concrete Stave Silos:			
Control	86.5	2.0	11.5
Urea	79.3	2.0	18.7
Limestone	86.9	2.2	10.8
Buried Nylon Bags:			
Control	93.5	-	6.5
Urea	90.1	-	9.9
Limestone	93.6	-	6.4

Sodium Bicarbonate and Sodium Bentonite Supplements for Cattle Fed Corn or Sorghum Silages[1,2]

Dirk Axe, Keith Bolsen, Kate Jacques, and Dave Harmon

Summary

Supplementing forage sorghum silage rations with sodium bicarbonate ($NaHCO_3$) improved performance of growing cattle over the control supplement. However, neither $NaHCO_3$ nor sodium bentonite supplementation to corn silage rations improved cattle performance.

Introduction

Beef cattle research with sodium bicarbonate ($NaHCO_3$) has involved mainly high concentrate feeding programs with little emphasis on silage-based rations for growing/backgrounding cattle. In two previous trials at Manhattan, addition of $NaHCO_3$ to high silage rations has improved rate and efficiency of gain (Reports of Progress 427 and 448). Sodium bentonite (colloidol clay), an inert material, is not new to the cattle feeding industry, but results have been inconsistent. These trials further evaluated $NaHCO_3$ and sodium bentonite supplements for growing cattle fed forage sorghum and corn silage rations.

Experimental Procedures

Trial 1. Forage sorghum silage (Pioneer 947) was fed to 36 individually housed calves for 84 days, beginning November 17, 1983. Eighteen calves per treatment received supplements containing either no additive (control) or $NaHCO_3$ fed at l.0% of the ration dry matter (DM) intake (approximately 43 grams per calf daily). The silages were full-fed and all calves received 1.8 lb of supplement daily (DM basis). The rations were formulated to provide 12.5% crude protein, 150 mg of Rumensin® per calf daily, and NRC recommended amounts of calcium, phosphorus, and vitamins A, D, and E.

Trial 2. Drought-stressed and irrigated whole-plant corn silages were fed to light weight yearling steers and heifers for 84 days, beginning February 9, 1984. Eight pens of four cattle were fed supplements with: 1) no additive (control), 2) $NaHCO_3$, and 3) sodium bentonite. $NaHCO_3$ was fed at 1% of the ration DM intake (about 66 grams per animal daily), and sodium bentonite, at 2% of the ration DM intake (about 132 g per animal daily). Silages were full-fed and all cattle received

[1]The sodium bicarbonate and partial financial assistance. were provided by Church and Dwight Co., Inc., Piscataway, NJ.

[2]The sodium bentonite was supplied by American Colloid Co., Skokie, IL.

1.8 lb of supplement daily (DM basis). Rations were formulated to provide 12% crude protein, 200 mg of Rumensin® per animal daily, and NRC recommended amounts of calcium, phosphorus, and vitamins A, D, and E.

Supplements in both trials were top-dressed and partially mixed with the silages in the bunk. All calves were weighed individually on two consecutive days at the start and at the end of the trials. Intermediate weights were taken at 28 and 56 days.

Results

Shown in Table 25.1 are performance results of the cattle in trial 1. The 0 to 84 days results show that $NaHCO_3$ improved rate of gain (8.8%), feed intake (2.0%), and efficiency of gain (7.5%) over the control supplement. However, the differences were not statistically significant. During days 0 to 28, the $NaHCO_3$ supplement gave an advantage in performance and during days 29 to 56, a period of extremely cold weather, $NaNCHO_3$ produced a significant response in gain and feed/gain over the control supplement. A similar response was observed a year earlier (Report of Progress 448) under comparable cold weather conditions. There was some compensating performance for cattle fed the control supplement in the final 57 to 84 days.

Shown in Table 25.2 are performance results for trial 2. In general, neither $NaHCO_3$ nor sodium bentonite supplementation gave a performance advantage over the control supplement. Cattle fed sodium bentonite gained slower ($P<.05$) and were 4.7% less efficient than those fed the control.

Table 25.1. Performance by Cattle Fed Control and $NaHCO_3$ Supplements in Trial 1

Item	Control	$NaHCO_3$
No. of Calves	18	18
Initial Wt., lb	467	467
Final Wt., lb	553	560
	0 to 28 days	
Avg. Daily Gain, lb	1.37	1.45
Avg. Daily Feed, lb[1]	9.85	9.97
Feed/lb of Gain, lb[1]	7.6	7.1
	29 to 56 days	
Avg. Daily Gain, lb	.52[b]	.83[a]
Avg. Daily Feed, lb[1]	11.86	12.25
Feed/lb of Gain, lb[1]	31.8[b]	18.6[a]
	57 to 84 days	
Avg. Daily Gain, lb	1.16	1.05
Avg. Daily Feed, lb[1]	12.87	12.85
Feed/lb of Gain, lb[1]	12.3	15.8
	0 to 84 days	
Avg. Daily Gain, lb	1.02	1.11
Avg. Daily Feed, lb[1]	11.48	11.71
Feed/lb of Gain, lb[1]	11.8	10.9

[a b]Values in the same row with different superscripts differ ($P<.05$).

[1] 100% dry matter basis.

Table 25.2. Performance by Cattle Fed Control, $NaHCO_3$, and Sodium Bentonite Supplements in Trial 2

Item	Control	$NaHCO_3$	Sodium Bentonite
No. of Cattle	32	32	32
Initial Wt., lb	482	474	476
Final Wt., lb	673	663	659
	0 to 28 days		
Avg. Daily Gain, lb	1.69	1.72	1.77
Avg. Daily Feed, lb[1]	12.66[a]	13.00[ab]	13.21[b]
Feed/lb of Gain, lb[1]	7.6	7.6	7.5
	29 to 56 days		
Avg. Daily Gain, lb	2.37	2.28	2.17
Avg. Daily Feed, lb[1]	14.75	14.98	14.96
Feed/lb of Gain, lb[1]	6.3	6.6	7.1
	57 to 84 days		
Avg. Daily Gain, lb	2.82	2.73	2.59
Avg. Daily Feed, lb[1]	15.57	15.41	15.93
Feed/lb of Gain, lb[1]	5.5[a]	5.6[a]	6.1[b]
	0 to 84 days		
Avg. Daily Gain, lb	2.28[a]	2.25[ab]	2.18[b]
Avg. Daily Feed, lb[1]	14.51	14.34	14.61
Feed/lb of Gain, lb[1]	6.4	6.4	6.7

[ab]Values in the same row with different superscripts differ ($P<.05$).

[1]100% dry matter basis.

Vacuum-Packaged Ground Beef: The Influence of Color and Educational Materials on Consumer Acceptance

N.M. Lynch, C.L. Kastner, and D.H. Kropf

Summary

Questionnaires were completed by 1750 Kansas grocery shoppers in selected Dillon's supermarkets to determine how product color and educational materials affected their purchase intent of vacuum-packaged ground beef. Half the consumers received educational materials (informed consumers). Informed consumers were more likely ($P<.0001$) to indicate a positive purchase intent for vacuum-packaged ground beef than uninformed consumers. Informed consumers were as likely to purchase the purple-red, vacuum-packaged product as the bright cherry-red product to which they are accustomed. Product color was important in their product purchase decision. Vacuum-packaged ground beef should compete favorably with the conventionally packaged product, if educational materials are provided to explain the color differences.

Introduction

Vacuum packaging (VP) can extend beef display life, reduce product loss, and lower transportation and delivery costs. Polyvinyl chloride (PVC) packaging, a conventional method for packaging beef retail cuts, allows air to contact the meat. This enhances formation of the familiar bright cherry-red color, followed by a change to an undesirable brown color after several days. When oxygen is excluded, as with VP, the natural purple-red color of freshly cut meat persists throughout display. Consumers who are used to buying bright cherry-red beef associate this color with good quality. Some studies identify beef color as the most important factor used by consumers in selecting beef at the grocery store. Few studies have focused on consumer reaction to VP beef and its purple-red color.

Consumer acceptance is essential for product success and consumer studies may prove useful in estimating product marketability. The objective of this research was to determine consumer reaction to VP ground beef. Consumer responses to grocery store surveys were used to measure the influence of color on purchase intent. Since consumer education may be a key to VP beef's success, we also examined the influence of educational materials on the purchase intent for VP ground beef.

Experimental Procedures

Questionnaires were distributed to 1750 grocery store shoppers. Consumers at nine Dillon's supermarkets in Salina, Hutchinson, and Wichita, Kansas participated. Three store locations in each city were chosen to obtain a cross section of each city's grocery shoppers. Each participant was asked to examine ground beef packaged in three forms and complete a questionnaire. The three products, presented in random order were: bright cherry-red ground beef packaged in PVC, PVC packaged beef that had turned brown, and purple-red VP ground beef.

Educational materials explaining the benefits and appearance of VP beef were presented randomly to 50% of the study participants prior to their evaluation.

Results and Discussion

Consumers who received educational materials were more likely (P<.0001) to indicate a positive purchase intent for VP ground beef than uninformed consumers. Purchase intent for bright cherry-red, PVC-packaged ground beef was lower (P<.0001) for informed consumers than for the uninformed group. Educational materials had no apparent effect (P>.10) on purchase intent for brown, PVC-packaged beef. Eighty-nine percent of the participants were over 24 years of age. Eighty percent were female, most had either finished high school (35.2%) or had some college education (30.2%). Forty-three percent were unemployed, the remainder had a variety of occupations. Participants were evenly divided among the given income brackets. Most participants were married (77%) and 47% had children. Seventy-nine percent purchase groceries at the survey store once a week or more, and 67.8% purchase beef with the same frequency. These factors had little influence on purchase intent for VP ground beef, for either the informed or uninformed group.

Mean purchase intent scores were 3.0 for bright cherry red, 3.1 for purple-red, and 5.6 for brown colored ground beef for informed consumers and 2.6, 3.8, and 5.6, respectively, for uninformed consumers (1=very definately would purchase, 7=very definitely would not purchase). These means suggested that informed consumers were as willing to purchase VP ground beef as the bright cherry-red product to which they are accustomed. Uninformed consumers were less likely to purchase the purple-red VP than the bright cherry-red, PVC-packaged product. Both groups agreed that they probably/definitely would not purchase the brown PVC-packaged product.

Consumers who received educational materials, which indicated that the brown colored beef was less fresh than either bright cherry-red or purple-red beef, were no less willing to purchase the brown ground beef than the uninformed consumers. This may be because consumers already associate the brown product with loss of freshness and undesirability.

The mean purchase intent scores may support the hypothesis that consumers associate color with freshness and, consequently, their intent to purchase. Consumers agreed (73.8%) that color influenced their purchase intent. The two single most important factors to the participants when selecting ground beef were color (35%) and amount of fat (37.6%). The current 'health and fitness' trend may have increased consumer awareness regarding fat content, making it the most important factor to many consumers when making purchase decisions.

Demographic and buyer behavior characteristics, study date, store, city, and time of testing did not appear to affect purchase intent for VP ground beef. Thus, a single, well-designed consumer education program may be effective in marketing VP ground beef to all target market segments. Although these conclusions only represent Kansas grocery store shoppers and other shoppers with similar characteristics, we believe these findings may represent the country as a whole. If this is true, vacuum-packaged ground beef can be effectively sold to the consumer.

Vacuum-Packaged Versus Conventionally Packaged Ground Beef: The Influence of Packaging on Consumer Acceptance and Flavor Characteristics

N.M. Lynch, C.L. Kastner, J.F. Caul[1] and D.H. Kropf

Summary

Vacuum-packaged ground beef was compared to a conventionally packaged (polyvinyl chloride) product to determine consumer flavor and aroma preferences. In addition, flavor characteristics were described and quantified by a trained panel. Consumer panels slightly preferred the cooked beef flavor of the conventionally packaged product and the raw aroma of the vacuum-packaged product. Conventionally packaged samples displayed for 3 days and then cooked were slightly less beefy, less fresh, more stale, slightly less bloody/serumy, slightly less sour, and had less of a metallic mouth feel than vacuum-packaged samples stored 12 days and cooked. Throughout display, flavor of the vacuum-packaged samples was more consistent than that of the conventionally packaged samples. Based on flavor and aroma characteristics, vacuum-packaged ground beef should compete favorably in the marketplace.

Introduction

Vacuum packaging (VP) of beef offers many potential benefits to both the consumer and the processor. VP can improve product acceptability and consumer perception of freshness and quality, extend display life, reduce product loss, and lower transportation and delivery costs. These benefits are due to slower growth of spoilage bacteria and the exclusion of air, which slows the formation of the undesirable brown color. However, it is not well known if flavor differences resulting from vacuum packaging affect consumer preference.

This study attempted first, to determine consumer flavor and aroma preferences and second, to develop descriptors and describe the cooked flavor of VP ground beef and ground beef packaged conventionally in polyvinyl chloride (PVC).

Experimental Procedures

Beef trim was obtained within 72 hours postmortem from the Kansas State University meat laboratory. Conventionally packaged PVC samples were ground, packaged, and displayed 3 days. VP samples were ground, packaged, and displayed 12 days. Once packaged, samples were displayed under continuous natural fluorescent lighting in a commercial type display case. Samples contained approximately 18% fat. Uniform patties of unseasoned ground beef were pan broiled in an electric skillet and served immediately for flavor testing.

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[1]Department of Foods and Nutrition.

Fifty-eight untrained judges (KSU students, staff, and faculty) participated in a triangle test. Each panelist was given three unidentified samples, two alike and one different (for example, 2 PVC and 1 VP). Panelists were asked to identify the "different" sample on the basis of cooked beef flavor.

Fifty-three untrained judges participated in a preference test. First, each judge was given two unidentified samples (1 PVC and 1 VP). Each panelist was asked to score his/her like or dislike of the beef flavor of each sample (1=dislike extremely, 8=like extremely). Then, each judge sniffed two unidentified raw samples (1 PVC and 1 VP) and indicated (yes or no) if they would cook the product based on its raw aroma.

A trained flavor-profile panel was used to evaluate the flavors associated with cooked VP and PVC ground beef. Samples were evaluated at selected times during display to evaluate the effect of display time on flavor profiles. Each panelist was given several bites of each sample and asked to indicate the intensity of the beefy, fat, fresh, stale/off, bloody/serumy, sweet, bitter, and salty tastes; oily, metallic, and astringent mouthfeels; and oily/fatty, beefy, stale, and astringent aftertastes present in each sample. After each sample was evaluated, the panelists discussed their scoring, providing a word description to supplement the scale score.

Results and Discussion

Consumer taste panels detected a difference ($P<.01$) in the cooked beef flavor between VP and PVC-packaged samples. Preference evaluation indicated that panelists liked the flavor of the PVC-packaged product over the VP product, but by only a small amount. These consumers liked both products. Based on raw aroma, these consumers would be more likely to cook the VP product.

Throughout display, the flavor of the VP samples was more consistant than that of the PVC samples. After 3 days of display, cooked PVC samples were slightly less beefy, less fresh, more stale, slightly less bloody/serumy, slightly less sour, and had less of a metallic feeling in the mouth than 12-day-old, cooked VP samples. Three-day-old PVC samples had no lingering metallic or astringent feelings in the mouth as did the VP samples. Fatty, sweet, and salty tastes; oily and astringent mouthfeelings; and lingering oily, beefy, and stale tastes were similar in both products.

It appears that VP ground beef has a more stable flavor profile, but one that is different from that of the PVC-packaged ground beef to which consumers are accustomed. Although consumers detected flavor and aroma preference differences, these differences were small. Based on flavor and aroma characteristics, VP ground beef should compete favorably in the marketplace.

Effects of Ralgro® Implants from Birth to Slaughter on Carcass and Meat Traits of Young Bulls

J.A. Unruh, D.G. Gray, and M.E. Dikeman

Summary

Implanting young bulls with Ralgro® from birth to slaughter maintained performance similar to nonimplanted bulls, increased quality grade and carcass fatness, delayed carcass masculinity development, decreased hide weight and thickness, and improved some meat palatability traits. Our results indicate that implanting young bulls with Ralgro® from birth to slaughter improves the traits cited most often by beef packers as reasons for discriminating against young bulls for meat production.

Introduction

Carcasses from young bulls are frequently inadequately finished and have lower quality grades at live and carcass weights than desired by packers. Also, bulls are often rejected from boxed beef fabrication because of dark and coarsely textured lean, excessive fullness and thickness of the neck, and large ribeye, round, and jump muscles. In addition, the thick and heavy hides of bulls are economically unattractive and are related to difficulties in skinning and hide curing procedures. Implanting with Ralgro® from near birth until slaughter has been indicated as a possible method of reducing some of these problems, while retaining many of the advantages of feeding young bulls.

Experimental Procedures

Thirty-six of 72 Simmental bulls were implanted (I) with 36 mg Ralgro® at birth and at average intervals of 84 days until slaughter. The remaining 36 bulls were nonimplanted controls (C). Calves were weaned at 7.7 months and placed on an 85% concentrate diet until slaughter at a commercial packing plant[1]. Bulls were slaughtered at 12.0, 13.8, 15.7, and 17.4 months of age. At slaughter, hide samples from the forehead were cleaned and frozen. Later, these samples were trimmed to a constant area, weighed, and dermis thickness was measured. Carcass masculinity (size of crest, jump muscle, and pizzle eye) and USDA quality and yield grade data were obtained at 24 hr. postmortem. The wholesale ribs were shipped to KSU where two 1 in.-thick steaks from the 12th rib region were removed 7 days postmortem for Warner-Bratzler shear force determinations and taste panel evaluations.

[1]Appreciation is extended to Roode Packing Co., Fairbury, Nebraska for their cooperation in slaughtering these bulls.

Results

Slaughter and carcass weights and dressing percentages were similar (P>.10) for I and C bulls (Table 28.1). Measures of carcass fatness (fat thickness, marbling score, and yield grade) were greater (P<.05) for I than for C bulls. Skeletal maturity was greater (P<.05) for C bulls, but lean maturity was greater for I bulls. As a result, overall maturity was similar (P>.10) for I and C bulls. Hide weight and dermis thickness (hide connective tissue layer) were less (P<.05) for I than C bulls. Thus, implanting may reduce the frequently cited skinning and curing problems of thick, heavy bull hides.

Indicators of carcass muscling and masculinity (ribeye area, jump muscle and crest) showed that I and C bulls had similar (P>.10) means at 12.0 months, C bulls had greater (P<.05) means at 13.8 months, and I and C bulls had similar (P>.10) means at 15.7 and 17.4 months of age (Table 28.2). These data suggest that muscle growth and maturation of young bulls is delayed by implanting with Ralgro® from birth to slaughter, since C bulls reached a muscle and masculinity development plateau by 13.8 months and I bulls reached their development plateau by 15.7 months of age.

A trained taste panel found that ribeye steaks from I bulls had less (P<.05) connective tissue but similar (P>.10) flavor intensity and juiciness compared to C steaks (Table 28.3). Ribeye myofibrillar and overall tenderness ratings indicated that I bulls at 12.0 and 13.8 months were more tender (P<.05) than C bulls at 13.8 and 17.4 months of age (Table 28.2). Although not significant (P>.10), I bulls tended to have lower (more tender) Warner-Bratzler shear values (Table 28.3).

Our study indicates that implanting young bulls from birth to slaughter improves the traits cited most often by packers as reasons for discriminating against using young bulls in the boxed beef and retail trade. Large-framed bulls implanted with Ralgro® could be used in consumer-preferred lean beef production systems by feeding them to about 14 months of age (as opposed to 12 months for C bulls) before increased carcass masculinity becomes apparent. Implanting would also improve carcass quality.

We speculate that implanting small and medium-framed bulls with Ralgro® from birth to slaughter may provide a production option preferable to castrates in some marketing systems. With beef packers' current desire to slaughter heavier cattle, implanting small and medium-framed bulls with Ralgro®, as opposed to castration, allows for greater performance and heavier, more desirable carcasses. In addition, implanting retards masculinity development and improves carcass quality and fatness compared to nonimplanted bulls.

Table 28.1. Carcass Characteristics of Ralgro®-implanted and Control Bulls

Item	Implant	Control
No. of Bulls	36	36
Slaughter Wt., lb	1188	1199
Hot carcass Wt., lb	719	730
Dressing Percentage	60.3	60.9
Fat Thickness, in	.20[c]	.14[d]
Skeletal Maturity	A-59[c]	A-49[d]
Lean Maturity	A-49[c]	A-60[d]
Marbling Score	Slight 54[c]	Slight 24[d]
Yield Grade	1.9[c]	1.5[d]
Hide Weight, gm/cm[2a]	1.77[c]	1.94[d]
Dermis Thickness, in[a]	.45[c]	.52[d]
Pizzle Eye Size[b]	3.4	3.7

[a]Forehead hide sample, approximately 64 in^2.

[b]Scores of 1 to 7: 2 = moderately small, 3 = slightly small and 4 = slightly large.

[cd]Means in the same row with different superscripts differ (P<.05).

Table 28.2. Treatment x Slaughter Age Interaction Means of Ralgro®-implanted and Control Bulls

	Slaughter Age, in Months							
	12.0		13.8		15.7		17.4	
Item	Implant	Control	Implant	Control	Implant	Control	Implant	Control
No. of Bulls	9	9	9	9	9	9	9	9
Carcass:								
Ribeye Area, in^2	11.5[c]	11.9[c]	13.2[d]	15.3[e]	14.5[e]	14.4[e]	14.2[de]	14.7[e]
Jump Muscle[a]	1.9[c]	2.2[c]	2.0[c]	3.2[d]	3.2[d]	3.4[d]	3.3[d]	3.7[d]
Crest[a]	2.1[c]	2.2[c]	1.8[c]	3.1[d]	3.4[d]	3.0[d]	3.5[d]	3.5[d]
Sensory Panel:								
Myofibrillar Tenderness[b]	6.4[e]	5.9[cde]	6.4[e]	5.4[c]	6.0[cde]	6.3[de]	6.1[de]	5.8[cd]
Overall Tenderness[b]	6.5[e]	6.0[cde]	6.4[e]	5.5[c]	6.0[cde]	6.3[de]	6.1[de]	5.8[cd]

[a]Scores of 1 to 6: 2=barely evident, 3=slightly prominent and 4=moderately prominent.

[b]Scores of 1 to 8: 5=slightly tender, 6=moderately tender and 7=very tender.

[cde]Means in the same row with different superscripts differ (P<.05).

Table 28.3. Evaluations of Ribeye (Longissimus) by Sensory Panel and Warner-Bratzler Shear Values for Ralgro®-implanted and Control Bulls

Item	Implant	Control
No. of Steaks	36	36
Flavor Intensity[a]	6.2	6.2
Juiciness[a]	6.4	6.3
Connective Tissue Amount[a]	6.6[b]	6.3[c]
Warner-Bratzler Shear, lb	6.6	7.1

[a]6=slt. intense, slt. juicy or slight; 7=very intense, very juicy or practically none.
[bc]Means in the same row with different superscripts differ ($P<.05$).

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How Does Ralgro® Work?

Zeranol is a naturally occurring estrogen originally derived from corn mold, and is sold under the tradname, Ralgro®. The compound is formulated into implants to be placed under the skin at the base of the ear. That allows the active ingredient to be released slowly over time. Ralgro improves growth rate by up to 0.25 lb per day, and feed efficiency by 8 to 10 percent. It accomplishes this by stimulating the pituitary gland to produce extra growth hormone, prolactin, and cortisol. Those compounds, in turn, increase the rate at which the animal produces protein. Increased protein synthesis accounts for the increased gain and feed efficiency. Because Ralgro works completely different from products like Rumensin® or Bovatec® -- compounds that modify the rumen fermentation -- their effects are additive when combined.

Ralgro is safe -- less toxic than aspirin. It is not a carcinogen, as shown by monkey tests at 27,000 times the dose for cattle, for 10 years. There has never been a residue violation with Ralgro implants in over 12 years of use. However, since Ralgro is an estrogenic compound, it should not be used in young cattle that might later be chosen for breeding.

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The Manhattan Weather in 1983 and 1984

L. Dean Bark[1]

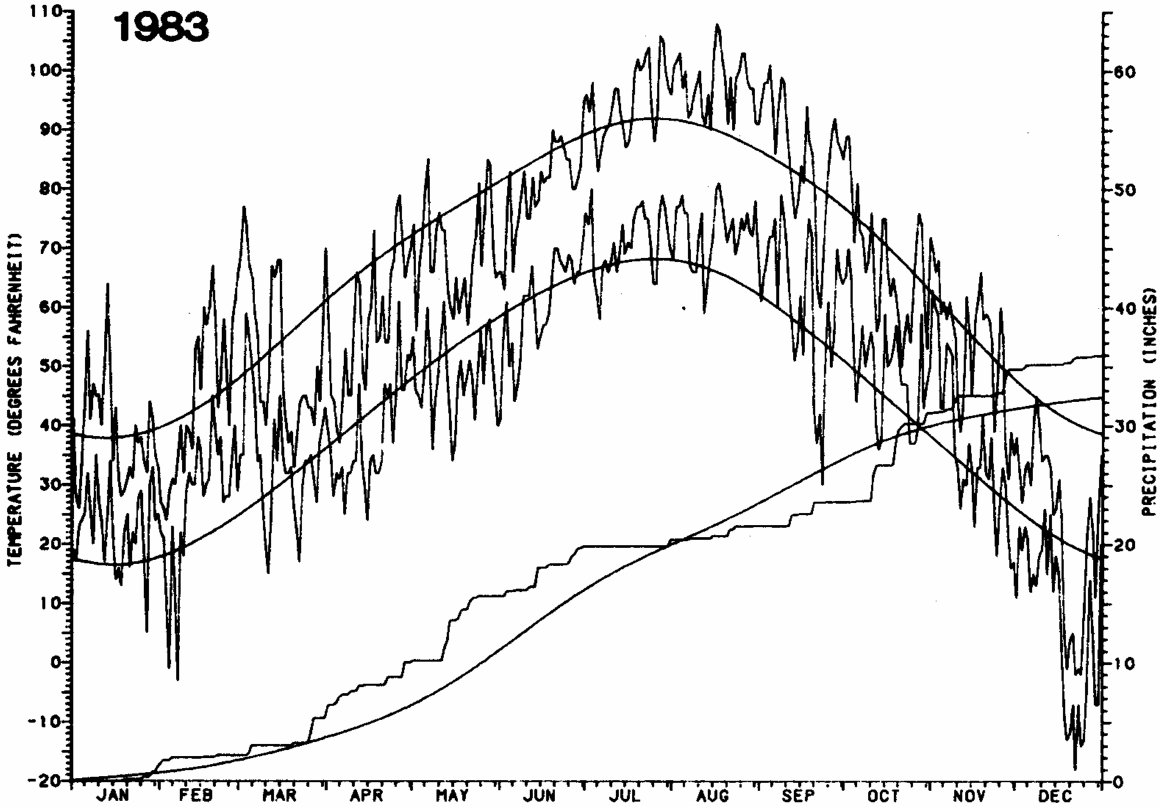
The charts of the daily weather drawn by the KSU computer indicate what occurred in the past two years. The three smooth curves in each diagram represent the average conditions at Manhattan based on 70 years of records from the files of the Agricultural Experiment Station's Weather Data Library. The top two curves show the average maximum and minimum temperatures occurring throughout the year. They reach a low point in mid-January and climb to a peak in mid-July. The bottom smooth curve indicates the average accumulative precipitation during the year. Starting at zero on January 1, it increases during the year and ends at the average annual rainfall. It climbs steeply during mid-year when precipitation is greatest on the average, and less steeply at the beginning and end of the year.

Actual daily values now can be compared with these average curves. They show which times of the year deviated the most from average conditions and allow a comparison of 1983 with 1984. On the precipitation curve, a horizontal section indicates a dry period and a vertical section means rain occurred that day.

The 1984 chart shows a very cold week in January with temperatures below zero. Such periods are hard on livestock operations--requiring extra energy and creating problems with shelter and shipping. February and March were quite mild, while April and May were cool and rainy. By the end of June, Manhattan had received almost its average total rainfall for the year. During the summer months, temperatures were not far from normal, except for a few hot days in July and August. There was little rain during these months. The showers that did occur were too small to be of much benefit. Although temperatures averaged about normal during the remainder of the year, the chart shows that this average resulted from alternating short cold and warm periods. Such rapid changes in temperature can produce stress in humans and livestock. Precipitation was heavier than usual in the fall of 1984. This benefited soil moisture reserves, but it was too late to save the corn and soybeans that dried up in the summer.

Compared to 1983, the temperatures were less extreme and precipitation was about 8 inches greater in 1984. Unfortunately, the timing of the extra precipitation interferred with both spring and fall plantings and did not occur during the peak growing season. Some plantings were delayed to the point that the crops did not mature before the first freeze. There were more heavy rains in 1984 than in 1983. These downpours produced flooding and erosion in northeast Kansas. Some severe storms also produced considerable hail damage.

[1] Department of Physics.



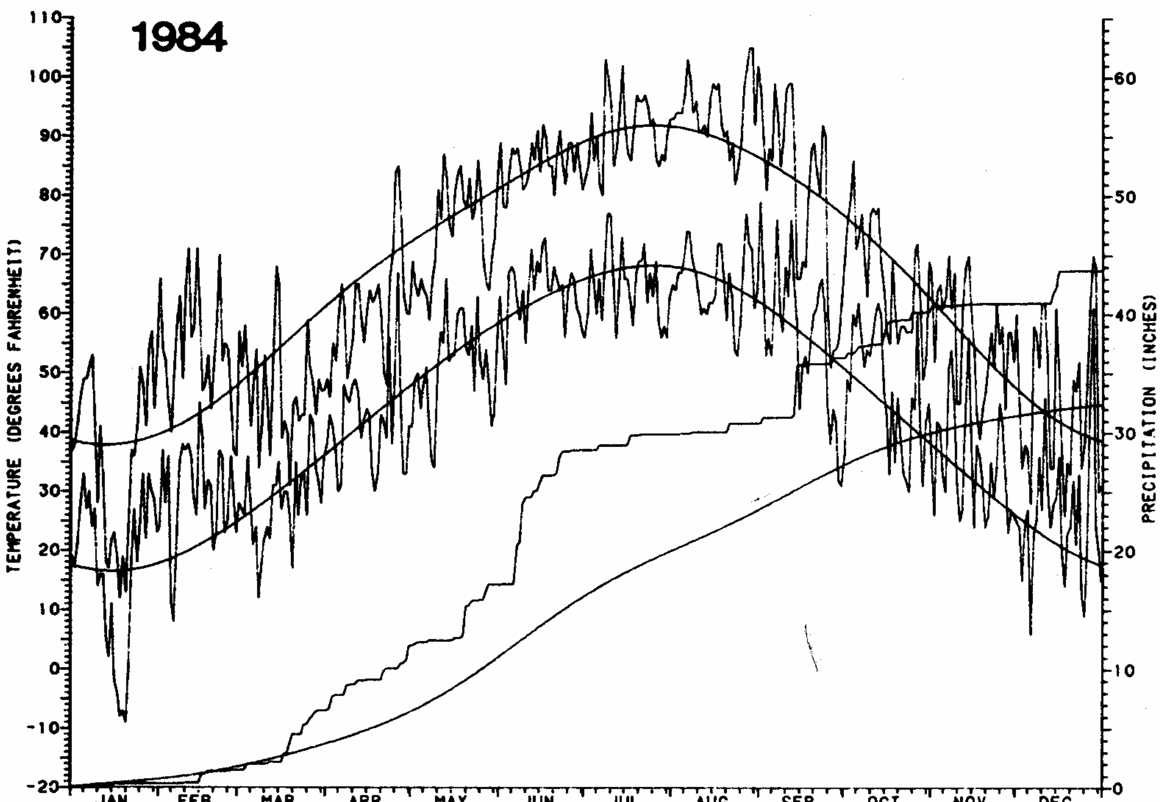


Figure 29.1. 1983 and 1984 graphical weather summary for Manhattan, Kansas. From the Kansas Agricultural Experiment Station Weather Data Library.

Acknowledgments

Listed below are individuals, organizations and firms that have contributed to our beef research programs through financial support, product donations or services. We appreciate your help!

A.H. Robins Co..	Richmond, VA
Allflex Tag Co.	Culver City, California
American Colloid Co.	Skokie, Illinois
American Cyanamid Company	Princeton, New Jersey
American Hoechst Corporation	Somerville, New Jersey
A.O. Smith Harvestore Products, Inc.	Arlington Heights, Illinois
Bayvet Div., Cutler Labs, Inc.	Shawnee, Kansas
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Diamond Shamrock	Cleveland, Ohio
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Ecco Ranch	Buffalo, Kansas
Elanco Products Company Division of Eli Lilly	Indianapolis, Indiana
Enns & Wilson Building Systems	Manhattan, Kansas
Excel Corporation	Wichita, Kansas
Fourth National Bank	Wichita, Kansas
Glenkirk Farms	Maysville, Missouri
Harneds	Wichita, Kansas
Hoffmann-LaRoche, Inc.	Nutley, New Jersey
Iowa Beef Processors	Holcomb, Kansas
IMC Chemical Group, Inc.	Terre Haute, Indiana
International Stock Food, Inc.	Waverly, New York
JBS Polled Herefords	Hillsboro, Texas
Kansas Bull Test	Manhattan, Kansas
Konza Prairie Research Natural Area	Div. of Biology, KSU
Livestock & Meat Industry Council, Inc. (LMIC)	Manhattan, Kansas
Mankato Packing Plant	Mankata, Kansas
Merck & Company, Inc.	Rahway, New Jersey
Micro Chemical, Inc.	Amarillo, Texas
Wilson Morehead	Manhattan, Kansas
Miraco Manufacturing	Drinnell, Iowa
Moorman Mfg., Co.	Quincy, Illinois
New Breeds Industry Inc.	Manhattan, Kansas
Pioneer Hi-Breds Int., Inc. Microbial Genetics Div.	Des Moines, Iowa
Rhone-Poulenc Chemical Co.	Atlanta, Georgia
Roode Packing Co.	Fairbury, Nebraska
Roskamp Manufacturing Co.	Cedar Falls, Iowa
Silopress, Inc.	Sioux City, Iowa
Smith Kline Animal Health Products	Philadelphia, Pennsylvania
Steiner Impl., Inc.	Sabetha, Kansas
Sunflower Packing Co.	York, Nebraska
Syntex Agri-Business, Inc.	Des Moines, Iowa
Temple Tag Co.	Temple, Arizona
The Upjohn Company	Kalamazoo, Michigan
Triple "F" Feeds	Des Moines, Iowa
Wingert Stock Farms	Ottawa, Kansas

The Livestock & Meat Industry Council, Inc.

Dear Friends:

The Livestock and Meat Industry Council, Inc., is a unique way to promote the growth and development of our industry. One way to help yourself and the LMIC is through a "Charitable Remainder Trust." Frequently an individual or couple wishes to make a gift of property, but feels unable to give up the income produced by the property. In the case of agricultural land, income can vary with weather and markets. There is little opportunity to diversify risks, and the return can represent a relatively low percentage of the land's value--particularly when the owner's share is reduced by management fees and tenant shares. At the same time, such owners may hesitate to sell because the proceeds will be reduced by taxation of past appreciation and these proceeds unavailable for reinvestment. These problems can be overcome by making a gift of the property itself, to fund a trust that pays income for the lifetime of one or two recipients--usually including the donor. At the death of the last beneficiary, the assets remaining in the trust are used for the charitable purpose chosen by the donor. Some advantages include:

1. **Annual income can be increased,** since the trust must have a stipulated maximum payout rate of at least 5% of the value of assets in trust. In many circumstances that will exceed the current return.

2. **Capital gains tax is completely avoided** when a charitable remainder trust is funded with appreciated long-term property, both when the gift is made and when the trustee sells the property in order to reinvest. Through this double protection, the full amount realized from the sale continues to earn for the life income recipients, undiminished by taxation.

3. **A substantial income tax charitable deduction results** from the transfer to the trust, decreasing the liability due to other income sources.

4. **Tax savings** from use of the deduction depend on the donor's income level.

5. **Professional management** of the assets in trust is a potentially important advantage for the life-income recipients.

6. **The estate tax charitable deduction** is 100% of the value of assets in trust for the estate of a single life income reicipient, or the survivor of two beneficiaries.

Other types of trusts are available. Many times the income from the trust is greater than the earning power of the property. Please let me know if you should be interested in hearing more about a trust and its advantages.

Sincerely,

Calvin L Drake

Calvin L. Drake, Executive Vice President

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