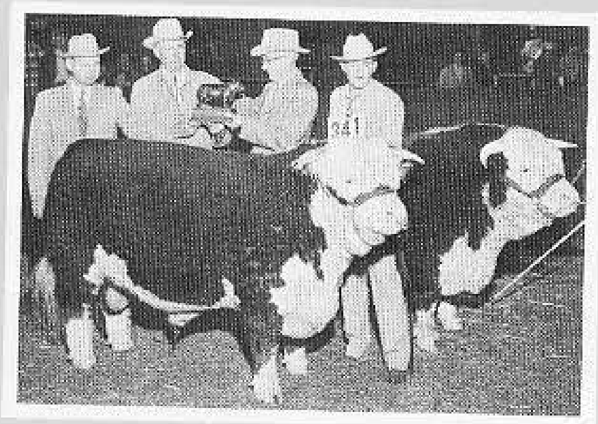
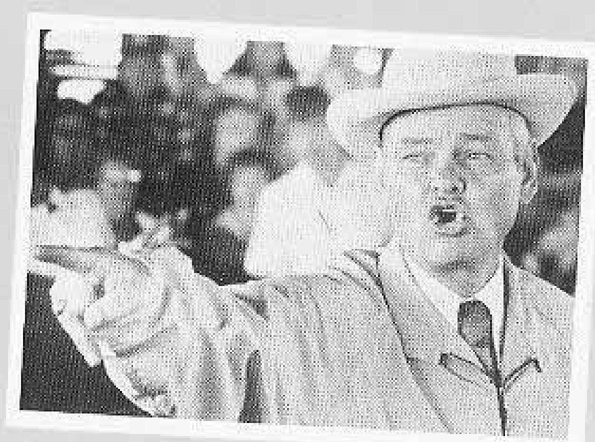


CATTLEMEN'S DAY 1987

Report of Progress 514
Agricultural Experiment Station
Kansas State University,
Manhattan
Walter R. Woods, Director



DEDICATED TO

DR. DON L. GOOD

The cover on this year's Cattlemen's Day publication depicts the career of a man that has "done it all" in the livestock industry. Don came to Kansas State in 1947. In addition to teaching assignments, he was placed in charge of the Department's beef cattle breeding herd. Successful in both assignments, he received the Outstanding Teacher award from the American Society of Animal Science in 1973, and a sample of his success in the showring is in the upper left-hand corner of the cover.

Don coached the KSU livestock judging teams from 1947 to 1966, and won 14 major contests in a 17-year span. One of those teams is on the cover (second from the top, right side.) They won at the International Livestock Exposition in Chicago, in 1950, and are shown receiving the trophy from Lord Digbee, of the Royal Agricultural Society in Great Britain. One member of that team is a banker, one a State Representative, one a rancher, and three became university faculty members. Kansas State's Miles McKee (Animal Sciences and Industry) and John Schlender (Agricultural Economics) are in the picture.

In 1966, Don Good became Head of the Department of Animal Husbandry — just in time to be faced with a massive reconstruction project. All the Department's outlying research facilities were destroyed or severely damaged by a tornado a week before he took over as head. The second picture from the top on the left shows him with the "new" Beef Cattle Teaching and Research Center shortly after its completion.

The Dairy and Poultry Science Department merged with Animal Sciences and Industry in 1977, and Don Good was named head. He's shown (lower left) in his office in Call Hall. There was still a Hereford on his desk, but note the rooster in the background!

Don has enjoyed a tremendous reputation as a livestock judge. The photo on the back cover was taken in the ring at the International Livestock Exposition in Chicago. He picked the Grand Champion steer that day, and is shown with the ring man, and A.D "Dad" Weber, former K-State Animal Husbandry head, Dean of Agriculture, and the first American to pick the Grand Champion steer at Chicago. On the lower right of the cover, Don discusses a class at Beef Empire Days at Garden City.

Animal Sciences and Industry outgrew its facilities and desperately needed more teaching and research space. Don Good marshalled university, industry, and legislative support for the 7.2 million dollar Weber Hall renovation and addition project that is scheduled for completion in August of 1987. He's shown in front of the project on the upper right corner of the cover.

Dr. Don L. Good, THANKS — from all of us!

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Contribution No. 87-309-S from the Kansas Agricultural Experiment Station.

Comparative Feeding Value of Grain Sorghum and Corn in Beef Cattle Diets

Gary Goldy, Jack Riley, and Keith Bolsen

Summary

Homozygous yellow endosperm grain sorghum had no advantage in feeding value over heterozygous yellow endosperm hybrids (P>.05). A heterozygous yellow endosperm hybrid, Funk's 550, had larger kernels (P<.001) and when dry rolled, produced more fine particles (P<.01). This may explain its trend toward improved feed efficiency, higher DM digestibility, and greater in vitro VFA production compared with the other dry processed grain sorghum hybrids tested. Our results do not support the traditional 12 to 16% price discount for grain sorghum relative to corn.

Introduction

The use of yellow endosperm grain sorghum hybrids has increased greatly. Commercial grain sorghum seed companies have claimed superior feeding values for homozygous yellow endosperm hybrids. However, the issue of endosperm type and color has become confused with seedcoat color, since yellow endosperm grain sorghum may be either heterozygous or homozygous for this trait, and may have a variety of seedcoat colors.

Kernel size may explain some of the difference among sorghum hybrids. Larger kernels with more starch and less protein may have higher digestibility and may also process more easily and efficiently than smaller, harder kernels.

We compared the relative feeding value for cattle of representative commercial grain sorghum hybrids commonly grown in Kansas. Furthermore, heterozygous and homozygous yellow endosperm grain sorghums were compared with corn. The influence of kernel size on grain processing and animal performance was also studied.

Experimental Procedures

Cattle feeding trials were conducted at the Kansas State University Beef Research Unit with four grain sorghum hybrids and one corn hybrid during the spring of 1986.

Source and Treatment of Grains. Four hybrid grain sorghums differing in pericarp and endosperm color were grown under similar dryland conditions at Manhattan in 1985. Their characteristics are shown in Table 1.1. The corn hybrid, Pioneer 3377, was obtained in 1985 from one source near Manhattan. Each grain sorghum was harvested at approximately 13% moisture and stored in steel bins until processed. High moisture DK 42Y (HM DK 42Y) was harvested at about

28% moisture and stored whole in an oxygen-limiting structure. Composite grain samples for each of the hybrids were analyzed for crude protein (CP) (Table 1.1). These values were used to formulate the experimental diets (Table 1.2).

Table 1.1. Descriptive Characteristics of Grain Sorghums Studied

Variety	Abbreviation	Crude[a] Protein	Color	
			Pericarp	Endosperm
Funk's 550	F 550	13.4	white	hetero-yellow
Cargill 70	C 70	10.3	red	hetero-yellow
Northrup-King 2778	NK 2778	12.2	red	yellow
DeKalb DK 42Y	DK 42Y	11.6	yellow	yellow

[a]% DM basis

Table 1.2. Composition of Experimental Steer Diets

Ingredient	Diets % DM Basis		
	Grain Sorghum	Corn + Urea	Corn - Urea
Sorghum grain, rolled	78.74	--	--
Corn, rolled	--	78.31	78.74
Sorghum silage	15.00	15.00	15.00
Soybean meal	3.58	3.57	3.58
Urea	--	.44	--
Limestone	1.09	1.09	1.09
Potassium chloride	.20	.20	.20
Salt	.29	.29	.29
Trace mineral premix[a]	.02	.02	.02
Tylan® premix[b]	.06	.06	.06
Rumensin® premix[c]	.02	.02	.02
Animal fat	.99	.99	.99
Vitamin A premix[d]	.01	.01	.01

[a]Contained 11% Ca, 10% Mn, 10% Fe, 10% Zn, 1% Cu, .3% I and .1% Co.
[b]Contained 10 g of tylosin per lb.
[c]Contained 60 g of monensin per lb.
[d]Contained 851,250 IU of Vitamin A per oz.

Cattle Feeding Trial. Thirty five crossbred steers averaging 905 lb. were allotted by weight in a randomized complete block design to seven treatments: 1) dry rolled (DR) F550, 2) DR C70, 3) DR NK 2778, 4) DR DK 42Y, 5) HM DK 42Y, 6) corn + urea, and 7) corn. Diet compositions are presented in Table 1.2. All diets except corn without urea were formulated to provide a minimum of 11% CP on a

DM basis (actual range was 11.2 to 13.8% CP). The corn without urea diet contained 10% CP. The grain mix in each diet contained 17 mg/lb of Rumensin® and 6 mg/lb of Tylin®, which provided 250 to 300 mg/hd/d of Rumensin and 90 to 104 mg/hd/d of Tylan. Steers were housed in individual pens with solid concrete floors. Initial and final weights were determined by the average of two weights taken on consecutive days prior to the AM feeding.

Digestibility Trial. Starting on day 22 of the feeding trial, chromic oxide, an inert marker, was fed to determine apparent digestibility. A 7-day adaption period preceded a 7-day fecal collection period. Fecal grab samples were collected twice daily, then composited and dried in a forced draft oven at 55 C, prior to being ground for chromic oxide analysis.

In Vitro Trials. Two in vitro experiments were conducted to compare the four dry grain sorghum hybrids and the HM DK 42Y. In the first experiment, we measured two-stage in vitro dry matter disappearance (IVDMD). In the second experiment, a modified continuous culture fermentation system was used to measure volatile fatty acid (VFA) production. Ten 500 ml flasks were filled to the overflow port with rumen fluid strained through one layer of cheesecloth. Fermentation flasks were infused continuously with a buffer. The five grain sorghum diets were randomly assigned in duplicate to the 10 flasks. A mixture of 6.9 g of each grain-supplement mixture and 1.7 g of sorghum silage (DM basis) was introduced into the flasks at 12-hour intervals. Effluent was removed daily, with samples taken for VFA analyses on days 5, 6, and 7 of the fermentation.

Results and Discussion

Cattle Feeding Trial. The performance of finishing steers fed the various grains is shown in Table 1.3. Dry matter intakes did not differ significantly among diets; however, consumption of the F 550 diet tended to be lowest (18 lb/d). Average daily gains were statistically similar and ranged from 3.1 to 3.5 lb. However, dry grain sorghum tended to produce lower cattle gains than HM DK 42Y or corn. Feed efficiencies ranged from 5.41 to 6.39. Although means were statistically similar, cattle fed the dry grain sorghum diets tended to have the poorest feed efficiencies, averaging 8.5% poorer (range 13.5 to 3.7%) than those on the corn diets. Efficiency on on the HM DK 42Y diet was 3.6% better than the corn diets. Steers fed dry grain sorghum diets had more difficulty switching from high moisture grain growing diets, as indicated by lower gains for the first 28 days.

During the finishing trial, we observed that steers fed the F 550 hybrid were sorting the diet; therefore, the grain portions of the dry grain sorghum diets were compared for differences in particle size (Table 1.4). In addition, a composite sample of the refused portion of the F 550 diet was compared with the original (as-fed) diet. The F 550, NK 2778, and the refused F 550 had fewer ($P<.01$) large particles (>2380 microns) than the other hybrids. The C 70 and DK 42Y sorghums had similar percentages of large particles. The refused F 550 had over twice the percentage of small particles (<1190 microns) as the original grain portion. That hybrid, as fed, had a greater ($P<.01$) percentage of fine particles than the other hybrids, and may explain why the cattle sorted that ration and tended to have lower feed intakes.

Table 1.3. Performance of Finishing Steers Fed Diets of Grain Sorghum or Corn

	Grain sorghum					Corn		
	Dry				HM[1]	(+)	(-)	
Item	F 550	C 70	NK 2778	DK 42Y	DK 42Y	Urea	Urea	SE[2]
No. steers	5	4	5	5	5	5	5	
Av. Daily Gain, lb	3.13	3.13	3.24	3.20	3.46	3.46	3.51	.19
Daily Intake[3],lb.	18.0	19.6	19.3	20.4	18.8	20.2	18.8	1.04
Feed/gain[3]	5.83	6.15	5.98	6.39	5.42	5.83	5.41	.30

[1]High moisture.

[2]Standard error of mean.

[3]DM basis.

Table 1.4. Whole Kernel Size and Dry Rolled Particle Size of Grain Sorghums Fed to Finishing Steers

	Grain Sorghum				Refused	
Item	F 550	C 70	NK 2778	DK 42Y	F 550	SE[1]
g per 100 kernels	3.39[a]	2.71[b]	2.85[b]	2.09[c]	--	.06
>2380 microns % of wt	4.31[e]	8.73[g]	5.73[f]	9.18[g]	3.12[d]	.18
<1190 microns % of wt	17.81[f]	14.56[e]	11.28[d]	12.62[d]	36.04[g]	.42

[1]Standard error of mean.

[abc]Means in the same row with different superscripts differ (P<.001).

[defg]Means in the same row with different superscripts differ (P<.01).

Table 1.4 shows the weights of 100 kernels of each hybrid. The F 550 hybrid was heaviest (3.39 g/100 kernels) and DK 42Y was lightest (2.09 g/100 kernels) (P<.001). The larger size of F 550 kernels appears to be the reason for the lower proportion of particles >2380 microns and the greater proportion of particles <1190 microns in size compared with the other grain sorghum hybrids examined.

Digestibility Trial. Apparent dry matter digestibilities were different (P<.10) among the experimental diets (Table 1.5). F 550 sorghum grain had the highest digestibility of the dry sorghum grain diets. This is consistent with the trend for improved feed efficiency on that diet (Table 1.3). Steers consuming HM DK 42Y had a 2.5% greater DM digestibility than those fed the most highly digestible dry grain sorghum (74.5 vs. 72.0%), supporting the feed efficiencies of these diets (Table 1.5). The mean digestibilities of the four dry grain sorghums, the

HM grain sorghum, and the corn diets were significantly different and were consistent with the feed efficiencies.

In Vitro Trials. Volatile fatty acid production measured with the continuous culture fermenter was not significantly different among diets (Table 1.6). The HM DK 42Y had a mean VFA production rate of 92.3 mM/ml/d compared with the dry grain sorghum diets, which ranged from 83.1 to 85.7 mM/ml/d. That trend parallels the feed efficiency and digestibility data. The IVDMD values of F 550, C 70, NK 2778, DK 42Y, and HM DK 42Y grain sorghums were 75.2, 78.1, 78.7, 82.0, and 74.4%, respectively, and are inconsistent with in vitro VFA production rates, apparent dry matter digestibilities, and feed efficiencies. This lack of correlation between the IVDMD values and the other cattle performance indexes may be due to the extra fine grinding of samples required for the procedure.

Table 1.5. Apparent Dry Matter Digestibilities (DMD) of Grain Sorghum and Corn Diets Fed to Finishing Steers

	Grain sorghum					Corn		
	Dry				HM[1]	(+)	(-)	
Item	F 550	C 70	NK 2778	DK 42Y	DK 42Y	Urea	Urea	SE[2]
DMD, %	72.0[a]	67.7[c]	69.4[bc]	69.7[bc]	74.5[a]	70.7[bc]	71.7[ab]	1.5

[1]High moisture.

[2]Standard error of mean.

[abc]Means with different superscripts differ, (P<.10).

Table 1.6. In Vitro Continuous Culture Daily VFA Production Rate of Grain Sorghum Diets Fed to Finishing Steers

	Dry Grain				High Moisture	
Item	F 550	C 70	NK 2778	DK 42Y	DK 42Y	SE[1]
VFA, mM/ml/d	85.7	83.1	83.9	83.8	92.3	4.1

[1]Standard error of mean.

KSU

Feeding Value of Wheat and Sorghum Grain as Indicated by Absorbed Nutrients

K.L. Gross, D.L. Harmon, and T.B. Avery[1]

Summary

Steers fed diets based on dry-rolled wheat or sorghum grain alone or combined (50:50) showed no differences in net portal fluxes of glucose, L-lactate, ammonia, urea, or alpha-amino nitrogen. Portal blood flow was increased in steers fed the 50:50 diet. Total volatile fatty acid flux into the portal blood tended to be lower for steers fed the sorghum grain diet, which may partially explain the lower feeding value of sorghum grain compared to wheat or the two grains combined.

Introduction

Wheat is quickly and completely fermented in the rumen. Typically, more than 90% of wheat starch disappears in the rumen, leaving very little starch available for digestion in the small intestine. Conversely, less than 50% of sorghum grain starch disappears in the rumen, thus shifting digestion postruminally. Researchers have speculated that having starch digested in the small intestine and absorbed as glucose would result in improvements in efficiency; however, no data are available to evaluate the amounts of glucose available to the animal. Mixtures of highly rumen-digestible grains with less rumen-digestible grains have improved cattle performance. Those improvements may be due to partitioning digestion over the entire gastrointestinal tract, resulting in greater overall efficiency. This study was designed to evaluate how shifting digestion postruminally influenced extent of digestion and pattern of absorbed nutrients.

Experimental Procedures

Three Holstein steers (avg. wt. 778 lbs.), surgically fitted with catheters in the hepatic portal vein, a mesenteric vein, and a carotid artery, were used to study the effect on net portal nutrient fluxes of dry-rolled wheat, dry-rolled sorghum grain, or a 50:50 mixture of the two grains in a 90% concentrate diet. Diets were 77% grain, 10% ground alfalfa hay, 3% molasses, and 10% pelleted supplement with Rumensin®, Tylan®, and chromic oxide. Diets were fed in 12 equal portions daily by an automatic feeder. A fecal grab sample was taken daily from each steer during the sampling period and used to determine total tract starch and dry matter digestibilities of the three diets. Net nutrient flux from the portal drained viscera was measured hourly for 4 hours on 3 consecutive days during each sampling period. Blood flow was determined by continuous infusion of p-aminohippuric acid.

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[1]Dept. of Surgery and Medicine.

Results and Discussion

There were no differences in dry matter intake from grain treatment (Table 2.1); however, dry matter and starch digestibility decreased linearly ($P<.01$) with increasing levels of sorghum grain.

Portal blood flow in steers fed the 50:50 diet was higher ($p<.10$) than that in steers fed either the wheat or sorghum grain diets. No differences were seen in the net portal flux of glucose, L-lactate, ammonia-nitrogen, urea-nitrogen, or alpha-amino-nitrogen, although there was a trend toward greater alpha-amino nitrogen absorption and more urea recycling in steers fed diets containing wheat. Greater rumen microbial growth on the wheat diets contributed to more urea recycling back to the rumen and greater absorption of alpha-amino-nitrogen into the portal blood. Net portal insulin production was similar for all diets. Net flux of acetate into the portal blood tended to be greater for both wheat-containing diets, and net flux of propionate was lower ($P<.10$) for the sorghum grain diet. Part of the greater net flux of acetate when steers were fed the 50:50 diet was probably due to the increased portal blood flow. Total volatile fatty acid net flux into the portal blood was 1080, 1152, and 918 mmol/h for the wheat, 50:50, and sorghum grain diets, respectively. The lower total volatile fatty acid absorption in steers fed the sorghum grain diet may help explain the lower feeding value of sorghum grain, especially since there was only a small increase in the net absorption of glucose on the sorghum-containing diets.

Table 2.1. Portal Blood Flow, Dry Matter Intake, Digestibility and Net Nutrient Flux in Steers Fed Wheat and Sorghum Grain Diets.

Item	Diet		
	Wheat	50:50	Sorghum
Dry Matter Intake, lbs	13.2	13.4	13.6
Dry Matter Digestibility, %[c]	80	77	70
Starch Digestibility, %[c]	96	92	88
Portal Blood Flow, l/h[d]	741	817	774
Net Flux, mmol/h:			
Glucose	3	22	24
L-lactate	85	107	92
Ammonia-nitrogen	209	208	201
Urea-nitrogen	-78	-58	-55
Alpha-amino-nitrogen	111	102	87
Acetate	526	605	469
Propionate[a]	481	465	353
Butyrate	31	25	33
Isobutyrate[d]	10	12	8
2-methylbutyrate[c]	9	17	24
3-methylbutyrate	7	6	17
Valerate	16	19	14
Insulin μg/h	124	123	112

Linear effect ($P<.10$)[a]; ($P<.05$)[b]; ($P<.01$)[c].

Quadratic effect ($P<.10$)[d].

Influence of Mixtures of High Moisture Corn and Dry Rolled Wheat on Finishing Performance and Carcass Characteristics[1]

B.J. Bock, R.T. Brandt, Jr.[2]
and D.L. Harmon

Summary

Dry rolled wheat and high moisture corn were fed singly and in three combinations in a 132-day finishing trial. Daily gain, feed intake, and final live weight were greatest on the 75% corn:25% wheat diet. Feed efficiencies and carcass characteristics were not affected by grain combination. Daily gain and feed intake tended to decrease as percentage of wheat in the diet increased above 25%.

Introduction

Low prices make wheat attractive in cattle finishing diets. Since it is so highly fermentable, cattlemen have believed that no more than 50% wheat could be fed in a finishing diet without causing acidosis. Ionophores have helped relieve this problem. Other methods may be used to improve wheat utilization; one is combining wheat with a slower fermenting grain, such as corn or grain sorghum. Combining grains with differing fermentation rates has led to associative effects; the combination will outperform either grain alone. However, the combination to obtain the greatest associative effect is not known. We explored the feeding value of different high moisture corn and dry rolled wheat combinations with respect to finishing performance and carcass merit.

Experimental Procedure

Ninety large frame crossbred steers averaging 804 lbs. and purchased from one ranch in Nocona, Texas, were fed 132 days on five different finishing diets at the Southwest Kansas Branch Experiment Station. Upon arrival, the steers were branded, implanted with Compudose®, dewormed with Ivomec®, and given modified live IBR, PI3, BVD, and seven-way Clostridium vaccines. Animals were allotted to pens by weight and breed type, six steers per pen. Each diet was replicated in three pens. High moisture corn (HMC) and dry rolled hard red winter wheat (DRW) were blended as follows and incorporated in 90% concentrate diets: 1) 100HMC, 2) 75HMC:25DRW, 3) 50HMC:50DRW, 4) 25HMC:75DRW, and 5) 100DRW (Table 3.1). The wheat (TAM 105) was coarsely dry-rolled prior to feeding. The high moisture corn was coarsely ground prior to ensiling and had a final moisture content of 28%. Animals were individually weighed before feeding, every 28 days. Two consecutive daily weights were used for initial and final weights. Steers were fed once daily.

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[1]The cooperation of Brookover Ranch Feedyard, Inc. was greatly appreciated.
[2]Southwest Kansas Branch Station.

Results and Discussion

Performance data are shown in Table 3.1. Final live weights on the 75HMC:25DRW diet were greater (P<.05) than liveweights on diets containing 50 and 75% wheat. Average daily gain did not differ significantly between diets from day 0 to day 26 (not shown in table). However, from day 27 through 57, average daily gain for the steers consuming the 75HMC:25DRW diet increased in comparison to steers on all other diets (P<.01). The trend continued for the remainder of the feeding period (day 57 to 132); however, the differences were not statistically significant. Over the entire 132-day feeding period, average daily gains were greater for the animals on the 75HMC:25DRW than for those on the diets containing 50 and 75% wheat (P<.05). Similarly, the 75HMC:25DRW intake was greater (P<.05) than intake of diets containing 50% or more dry rolled wheat. These differences were exhibited through all 28-day feeding periods and overall. Feed per pound of gain did not differ significantly. However, animals on 100 HMC and 75 HMC diets tended to be more efficient.

Carcass characteristics were similar across all treatments, except for hot carcass weight (Table 3.2), which paralleled the final live weights as expected. Research is in progress to determine the cause of the positive associative effects of the 75HMC:25DRW mixture, as well as the negative associative effects of the 50HMC and 25HMC diets.

Table 3.1. Composition of High Moisture Corn (HMC) and Dry Rolled Wheat (DRW) Mixtures[1,2]

Ingredient	100 HMC	75 HMC: 25 DRW	50 HMC: 50 DRW	25 HMC: 75 DRW	100 DRW
High moisture corn	80.0	60.0	40.0	20.0	0
Dry rolled wheat	0	20.0	40.0	60.0	80.0
Chopped alfalfa hay	5.5	5.5	5.5	5.5	5.5
Corn silage	5.5	5.5	5.5	5.5	5.5
Blended molasses[3]	4.5	4.5	4.5	4.5	4.5
Corn supplement[4]	4.5	3.4	2.25	1.1	0
Wheat supplement[5]	0	1.1	2.25	3.4	4.5
Net energy (gain), Mcal/100 lbs.	60.7	60.9	61.1	61.3	61.5

[1] Dry matter basis.
[2] Formulated to contain 11.5% CP, .7% Ca, .46% P and .69% K.
[3] Contained 65% corn steep liquor, 30% cane molasses and 5% whey.
[4] Contained 38.8% ground corn, 16.7% urea, 1.1% trace minimals, .7% Vitamin A, D, & E, 4.2% salt, 1% tallow, 26.8% limestone, 10.3% dicalcium phosphate, and Bovatec (30 g/ton of total diet).
[5] Same as corn supplement except 62.9% ground corn, .5% urea, 29.3% limestone, and 0% dicalcium phosphate.

Table 3.2. Finishing Performance and Carcass Characteristics of Steers Fed Mixtures of High Moisture Corn (HMC) and Dry Rolled Wheat (DRW)[a]

Item	Treatment					
	100 HMC	75 HMC: 25 DRW	50 HMC: 50 DRW	25 HMC: 75 DRW	100 DRW	SE
No. of steers	18	18	18	18	18	
Performance Data						
Initial wt., lbs.	808	803	800	805	803	5
Final wt., lbs.	1281[bc]	1308[b]	1215[c]	1211[c]	1239[bc]	28
Avg. daily gain, lbs.	3.58[bc]	3.82[b]	3.14[c]	3.07[c]	3.30[bc]	.22
Avg. daily feed intake[d], lbs.	22.17[bc]	23.55[b]	20.84[c]	20.96[c]	21.39[c]	.66
Feed/gain	6.22	6.16	6.64	6.99	6.51	.43
Carcass Data						
Hot carcass wt., lbs	778[bc]	795[b]	738[c]	736[c]	753[bc]	16
Ribeye area, in.^{2}	12.8	12.8	12.1	12.2	12.2	.3
Backfat, in.	.40	.36	.37	.31	.35	.03
Marbeling score[e]	Sm^{19}	Sm^{32}	Sm^{11}	Sm^{09}	Sm^{03}	.13
Dressing percent	61.13	61.07	60.90	60.67	61.21	.63
USDA Yield Grade	2.74	2.69	2.72	2.52	2.69	.18

[a] All reported values are least square means with 3 pens per treatment for performance data 18 animals per treatment for carcass data.

[bc] Means in a row with different superscripts differ ($p<.05$).

[d] Dry matter basis.

[e] Sm=Small; evaluated on a 100 point scale within each marbling score.

Effect of Sprouting and Weather Damage on Feeding Value of Grain Sorghum (Summary of Beef, Swine, and Poultry Trials)

Henry Turlington, Gary Allee, Jack Riley, and Ron Pope

Summary

Grain sorghum officially graded as 39% damaged (sprouted) with 10% broken kernels or foreign material was fed to beef steers, growing swine, and broilers to compare its feeding value to that of normal grain sorghum. Damaged grain constituted 0, 50, or 100% of the grain portion of the rations. Cattle performance during a 57-day finishing period was not reduced by feeding sprouted grain sorghum. However, the swine and broiler trials suggest that sprouted grain sorghum has a slightly lower energy value.

Introduction

An unusually wet fall harvest season created severe weather damage to part of the 1986 Kansas grain sorghum crop. There is only limited research data comparing the feeding values of damaged (especially sprouted) grain and normal grain. These trials were conducted to provide current information on feeding sprouted grain sorghum to beef, swine, and poultry.

Experimental Procedures

Weather-damaged grain sorghum (Funks 522DR) was purchased from one Southeast Kansas source for use in all three trials. Visual observation suggested sprout damage as high as 80%; however, official grading by the Kansas State Grain Inspection Department indicated: 55.5 lb test weight, 11.8% moisture, 39% damaged kernels, and 10% broken kernels and foreign material. Remarks included "badly weathered" and "distinctly discolored." The normal, non-damaged grain sorghum was Cargill 70, produced at one location in Northeast Kansas, and was used for that portion of all grain sorghum mixtures not coming from the damaged grain.

Cattle trial: Eighteen Angus crossbred steers averaging 758 pounds were allotted by weight to three dietary treatments. Six steers were individually fed each diet for 57 days to closely monitor palatability and intake. The diets (DM basis) were 79.2% sorghum grain, 15% corn silage, and 5.8% supplement. Damaged grain constituted 0, 50, or 100% of the grain sorghum portion.

Swine trial: Sixty Yorkshire or crossbred growing pigs averaging 91.7 pounds were allotted by weight and breed to three dietary treatments. There were four replicates (pens) for each treatment, five pigs per pen. The trial ran 4 weeks. Diets are shown in Table 4.1. Sprouted grain sorghum constituted 0, 50, or 100% of the grain portion.

Table 4.1. Composition of Diets for Growing Pigs[a]

Ingredients, %	Normal Grain	1/2 Damaged 1/2 Normal	Damaged Grain
Milo, ground	79.4	39.7	--
Sprouted milo, ground	--	39.7	79.4
Soybean meal, 44%	18.2	18.2	18.2
Dicalcium phoshate	1.0	1.0	1.0
Limestone	.8	.8	.8
Salt	.4	.4	.4
Trace Minerals	.5	.5	.5
Vitamins	.15	.15	.15

[a]Diets calculated to contain 15% C.P., .65% Lys, .65% Ca, .55% P.

Broiler trial: One hundred twenty-six Cornish broiler chicks with an initial average weight of 93 g were allotted by weight to three dietary treatments. There were six replicates (pens) of each treatment, with seven chicks per pen. The trial ran 6 weeks. Diets are shown in Table 4.2. Again, sprouted grain constituted 0, 50, or 100% of the grain portion.

Table 4.2. Compositon of Treatments for Broilers[a]

Ingredients, %	Normal Grain	1/2 Damaged 1/2 Normal	Damaged Grain
Milo, ground	54.2	27.2	--
Sprouted milo, ground	--	27.2	54.2
Soybean meal, 44%	38.4	38.4	38.4
Soybean oil	3.0	3.0	3.0
DL-methionine	.3	.3	.3
Dicalcium phosphate	2.0	2.0	2.0
Limestone	1.0	1.0	1.0
Salt	.5	.5	.5
Trace minerals	.1	.1	.1
Vitamins	.5	.5	.5

[a]Diets calculated to contain 21.7% C.P., .56% Met, .96% Ca, and .78% P.

Results and Discussion

Cattle trial: Steers fed 50 or 100% sprout-damaged grain sorghum were not adversely affected. Results are summarized in Table 4.3. Although gain and efficiency were slightly better on the diets that contained damaged grain, the differences were not statistically significant (N.S.). There were no indications of depressed intake or reduced palatability with the weathered grain. This trial suggests that sprouted and weather damaged grain sorghum can be used in beef cattle finishing diets without depressing growth and efficiency.

Table 4.3. Effect of Sprouting and Weather Damage on Feeding Value of Grain Sorghum - Cattle Trial

Item	Normal Grain	1/2 Damaged 1/2 Normal	Damaged Grain
No. Individually Fed	6	6	6
Initial Wt., lb.	757	762	755
Final Wt., lb.	929.8	944.7	941.0
Total Gain, lb.	172.8	182.7	185.6
Daily Gain	3.03	3.21	3.26
Daily D.M. intake, lb.	21.33	21.10	22.30
Feed/Gain	7.04	6.57	6.84

Swine trial: Average final weight of growing pigs on test was 145.4 lb. There were no differences (P>.10) for daily gain, intake, or efficiency (F/G) among the three treatments (Table 4.4) for the 4 week trial. However, feed intake was increased about 10% in diets containing sprouted grain. Thus, F/G became somewhat poorer (N.S.) for the sprouted grain diets. These data suggest that sprouted grain sorghum had a lower energy value than regular grain sorghum, but the pigs compensated by eating enough more to maintain constant gain.

Table 4.4. Effect of Sprouting and Weather Damage on Feeding Value of Grain Sorghum - Swine Trial [a]

Item	Normal Grain	1/2 Damaged 1/2 Normal	Damaged Grain
Average Daily Gain, lb.			
day 0-14	1.83	1.78	1.74
day 0-28	1.92	1.96	1.87
Average Daily Feed Intake, lb.			
day 0-14	5.70	6.09	5.84
day 0-28	6.24	6.98	6.92
Feed/Gain			
day 0-14	3.17	3.43	3.36
day 0-28	3.29	3.58	3.70

[a]No treatment means among each item were significantly different, P>.10.

Broiler trial: Average final weight of chicks was 2059 g. Chick growth rate was similar ($P>.10$) among the three diets after 6 weeks on test (Table 4.5). Feed intake increased ($P<.10$) on the 50% sprouted grain sorghum diet but decreased at the 100% level. Efficiency responded in a parallel manner, becoming slightly poorer with 50% sprouted grain, but remaining unchanged at the 100% level. These responses also suggest that the sprouted grain is slightly lower in energy. When sprouted grain was 50% of the grain, chicks maintained their rate of gain by increasing their feed intake. But when 100% sprouted grain was fed, chick performance decreased slightly (N.S.), possibly because of reduced feed palatability.

Table 4.5. Effect of Sprouting and Weather Damage on Feeding Value of Grain Sorghum - Broiler Trial

Item	Normal Grain	1/2 Damaged 1/2 Normal	Damaged Grain
Average Daily Gain, g			
day 0-14	34.2	32.9	32.9
day 0-28	44.2	43.0	42.3
day 0-42	47.5	47.1	45.8
Average Daily Feed Intake, g			
day 0-14	49.8	49.8	46.8
day 0-28	83.6	83.0	77.9
day 0-42	105.2[ab]	108.1[a]	101.8[b]
Feed/Gain			
day 0-14	1.45	1.52	1.42
day 0-28	1.89	1.94	1.84
day 0-42	2.22	2.30	2.22

[ab]Treatment means within row with different superscripts differ significantly, $P<.10$.

When examined together, the swine and broiler trials suggest that sprouted grain sorghum had a slightly lower energy value than normal grain sorghum. Growing pigs were able to maintain nearly constant gain when it made up 50 and 100% of the grain by increasing feed intake. In that case, the poorer feed efficiency we observed would be expected. Chicks responded similarly to pigs when sprouted material was 50% of the grain source; however, slightly reduced performance might be expected when sprouted grain sorghum comprises 100% of the grain source, possibly because of poor palatability.

Raw Soybeans as a Protein Source for Growing Cattle

Scott Anderson[1] and Robert T. Brandt, Jr.[2]

Summary

A 60-day growth trial with 170 exotic crossbred steers (avg. wt. 626 lbs) was conducted to assess the value of raw soybeans in silage-based diets. Protein supplements were based on 1) urea, 2) urea plus soybean oil (SBO), 3) soybean meal (SBM), 4) SBM plus SBO, 5) rolled (RSB), and 6) whole (WSB) soybeans. Soybean oil was added to treatments 2 and 4 in amounts equivalent to that contributed from raw soybeans. Total diets were 11.5% crude protein. Steers fed SBM gained faster ($P<.05$) and consumed more feed than those fed RSB or WSB. However, SBO added back to the SBM diet resulted in performance similar to that of steers fed RSB or WSB ($P=.47$). This suggests that the protein value of SBM and raw soybeans was similar, but that small increments (less than 2% of diet dry matter) of soybean lipid inhibited ruminal diet digestion and(or) utilization. There was no advantage for rolling raw soybeans vs. feeding them whole ($P=.45$). Costs of gain were urea < raw soybeans < soybean meal.

Introduction

Economic pressures have renewed interest in the feeding value of raw soybeans for cattle. Limited data exist on their value for growing calves. Additionally, comparisons have not separated protein from fat responses. Our study measured 1) the protein value of raw soybeans, 2) potential interactions between protein and lipid in raw beans, and 3) the influence of rolling raw soybeans.

Experimental Procedures

One hundred-seventy, mixed, exotic, crossbred steer calves (avg. wt. 626 lbs) were blocked by initial weight to four replicates for a 60-day growth trial (October 30 to December 29, 1986). All steers had received routine vaccinations, were dewormed (Ivomec®), ear-tagged, and implanted (Compudose 200®).

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Steers were full-fed a silage diet for 2 weeks before the experimental diets were started. Six dietary treatments (four pens per treatment) were: 1) urea, 2) urea plus soybean oil (SBO), 3) soybean meal (SBM), 4) SBM plus SBO, 5) rolled (RSB), and 6) whole raw soybeans (WSB). Diets (Table 5.1) were 83% corn silage and were formulated to contain (dry basis) 11.5% crude protein, .40% calcium, .25% phosphorus, 1.1% potassium, 70 ppm zinc, .2% ammonium sulfate, and .25% salt. Soybean oil was added to the urea and SBM basal diets in amounts equal to that supplied by the raw soybeans. All diets contained 71% TDN (calculated). RSB and WSB diets contained 10.47% raw soybeans (dry basis). Dry ingredients were incorporated into supplements and blended with silage, molasses, soybeans, and(or) soybean oil at feeding time. RSB were rolled to break each soybean seed.

Steers were fed once daily from a truck-mounted mixer-feeder. Initial and final weights were the average of weights on two consecutive days before feeding.

Results and Discussion

During the first 26 days of the trial, steers fed SBM gained faster and more efficiently ($P<.05$) than those fed urea (Table 5.2). Gains and feed conversions for cattle fed RSB or WSB were intermediate to those for cattle fed urea and SBM. Feed consumptions were similar ($P>.05$) in this period, although adding only 1.87% soybean oil to the SBM diet reduced intake by 4.5%.

For the entire feeding period, steers fed SBM gained faster ($P<.05$) and consumed more dry matter than those fed RSB or WSB. However, SBO addition to the SBM diet resulted in daily gains and feed conversions similar to RSB or WSB ($P>.05$).

Soybean oil addition reduced gain 4.2 and 6.3% for steers fed urea and SBM, respectively. Similarly, SBO reduced feed consumption of urea and SBM diets by 2.4 and 4.4%. Greater percentage reductions in performance for SBM vs. urea diets from SBO addition suggest a toxic effect on ruminal microorganisms, rather than a physical inhibition of feed substrate attachment.

No apparent benefit resulted from rolling raw soybeans. Dry matter intake was numerically lower, yet feed conversion was slightly higher for WSB vs. RSB. Feed efficiency data suggest no antinutritional factors in raw soybeans for cattle beyond potential inhibition of ruminal diet digestion by the lipid fraction.

We noted that whole soybeans swelled when they were mixed with silage. When raw soybeans were placed in tap water, they swelled to 3 to 4 times their original size. Thus, the reduced consumption of WSB diets may be related to increased physical fill.

Table 5.1. Composition of Diets[1]

Ingredient	Treatment				
	Urea	Urea + SBO	SBM	SBM + SBO	RSB or WSB
	%				
Corn silage	83.00	83.00	83.00	83.00	83.00
Urea	1.27	1.27	-	-	-
Soybean meal	-	-	8.56	8.56	-
Raw soybeans	-	-	-	-	10.47
Cane molasses	4.00	2.00	4.00	2.13	4.00
Soybean oil	-	2.00	-	1.87	-
Ground corn	10.57	10.57	3.55	3.55	1.66
Dicalcium phosphate	.29	.29	.09	.09	.01
Limestone	.17	.17	.27	.27	.33
Salt	.25	.25	.25	.25	.25
Ammonium sulfate	.20	.20	.20	.20	.20
Potassium chloride	.17	.17	-	-	-
Vit. A, D, E premix	.03	.03	.03	.03	.03
Trace mineral premix	.05	.05	.05	.05	.05
Ration cost[2]					
$ per ton, as fed	27.76	30.20	31.72	34.02	29.00

[1]Dry basis.
[2]Based on $20/ton corn silage, $4.60/bushel soybeans and $165/ton soybean meal.

Table 5.2. Performance and Cost of Gain for Growing Steers Fed Different Protein Sources

Item	Urea	Urea SBO	SBM	SBM + SBO	RSB	WSB	SE[a]
Number steers	28	28	29	28	29	28	
Initial wt, lb	625	628	625	626	627	624	1
Final wt, lb	780	778	791	782	776	775	7
Daily gain, lb							
0 - 26 days	2.78^{f}	2.76^{f}	3.20^{d}	3.11^{de}	2.88^{ef}	2.86^{ef}	.12
27 - 60 days	2.37	2.21	2.36	2.14	2.12	2.19	.14
0 - 60 days	2.55^{gh}	2.44^{h}	2.72^{g}	2.55^{gh}	2.45^{h}	2.47^{h}	.10
Daily feed, lb[b]							
0 - 26 days	16.60	16.53	17.10	16.33	16.48	15.92	.34
27 - 60 days	17.18^{d}	16.45^{de}	17.35^{d}	16.58^{de}	16.35^{de}	15.87^{e}	.40
0 - 60 days	16.90^{d}	16.50^{de}	17.23^{d}	16.48^{de}	16.40^{de}	15.88^{e}	.32
Feed/gain							
0 - 26 days	6.03^{e}	6.02^{e}	5.35^{d}	5.26^{d}	5.72^{de}	5.57^{de}	.22
27 - 60 days	7.25	7.59	7.43	7.81	7.66	7.30	.41
0 - 60 days	6.65	6.80	6.35	6.47	6.68	6.43	.24
Cost of gain[c]							
$ per lb of gain	.237	.263	.259	.282	.249	.240	

[a]Standard error.

[b]Dry matter.

[c]Feed costs.

[def]Means in a row with unlike superscripts differ ($P<.05$).

[gh]Means in a row with unlike superscripts differ ($P<.10$).

KSU

Influence of Ionophore Addition to a High-Concentrate Diet on Net Nutrient Absorption in Steers

D.L. Harmon, K.L. Gross, and T.B. Avery[1]

Summary

Feeding the ionophores monensin and lasalocid in a high-concentrate diet resulted in gut tissues utilizing less glucose. Monensin caused less urea to be recycled. The new, experimental ionophore (ICI 139603) resulted in an increased net absorption of acetate. Thus, ionophores may differ in how they execute their effects on feed efficiency.

Introduction

The ionophore antibiotics, monensin (Rumensin®) or lasalocid (Bovatec®), are common ingredients in most feedlot diets. Their major benefit is an increase in feed efficiency. A new ionophore (ICI 139603)[2] has recently been tested. Preliminary reports indicate that it is effective at about one-third the concentration of monensin and lasalocid. Previously, we have studied how monensin influences nutrient absorption and utilization. The present experiment was conducted to compare the effects of monensin, lasalocid, and ICI 139603 on the rate at which nutrients are absorbed into the portal circulation.

Experimental Procedures

Three Holstein steers (554 lbs avg. wt.) surgically fitted with hepatic portal and mesenteric venous catheters and an elevated carotid artery were used to evaluate changes in absorbed nutrients when ionophores were added to an 85% concentrate diet. The diet included 15% chopped alfalfa plus cracked corn and supplement to supply 11.5% crude protein, .6% calcium, and .4% phosphorus. Treatments were control (no ionophore), monensin (230 mg/head/day), lasalocid (240 mg/head/day), or ICI 139603 (82 mg/head/day). Animals were fed in 12 portions daily (every 2 hours) using an automatic feeding system.

Arterial and portal blood samples were taken at 4 hourly intervals on 3 consecutive days during each sampling period. Blood flow was determined by continuous infusion of p-aminohippuric acid. Nutrient absorption was estimated by measuring the amount of various nutrients in blood supplying the gut, and measuring the same nutrients in blood draining from the gut.

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Results and Discussion

Ionophores did not affect feed intake or portal blood flow (Table 6.1). Ionophore feeding tended to decrease the utilization of glucose by gut tissues (negative values indicate utilization of a nutrient rather than absorption), consistent with previous experiments. No changes were seen in net absorption of L-lactate, ß-hydroxybutyrate, or ammonia-nitrogen. Monensin feeding decreased the recycling of urea-nitrogen, an effect that appears to be consistent. Net absorption of alpha-amino-nitrogen (total amino acids) tended to be less with ICI 139603, but overall net absorption was not significantly affected by ionophores. Acetate absorption was not affected by monensin or lasalocid, but was increased by ICI 139603. No changes were seen in any of the other volatile fatty acids from feeding ionophores. The changes in net glucose absorption are consistent with previous experiments with monensin, as is the decrease in urea recycling. Ionophores generally cause the production of less acetate and more propionate during ruminal fermentation. Since volatile fatty acid absorption is not consistent with the changes in ruminal fermentation, our results suggest that interrelations between gut metabolism and ruminal fermentation may influence absorbed nutrients.

Table 6.1. Influence of Ionophore Addition to a High-Concentrate Diet on Feed Intake, Portal Blood Flow, and Net Nutrient Absorption in Steers

Item	Control	Monensin	Lasalocid	ICI 139603
Intake (lbs. dry matter)	11.5	11.5	12.0	12.1
Portal blood flow, liter/h	705	684	603	688
		Net absorption, mmol/h		
Glucose	-24	-7	-4	-16
L-Lactate	74	68	60	80
B-hydroxybutyrate	44	51	62	60
Ammonia-nitrogen	144	168	162	202
Urea-nitrogen[a]	-87	-36	-72	-92
Alpha-amino-nitrogen	204	179	185	149
Acetate[b]	421	404	442	547
Propionate	441	393	332	411
Isobutyrate	7	8	5	9
Butyrate	47	40	55	40
2-methylbutyrate	9	15	7	15
3-methylbutyrate	2	5	4	2
Valerate	13	10	10	12

[a] Monensin vs Lasalocid, ICI 139603 ($P<.10$).
[b] ICI 139603 vs Monensin, Lasalocid ($P<.10$).

KSU

Effects of Rumensin® Ruminal Delivery Devices[1] in Grazing Cattle on Subsequent Feedlot Performance

Jack G. Riley, Bob Cochran, and Ron Pope

Summary

Rumensin® Ruminal Delivery Devices put in place 76 days prior to steers entering a feedlot resulted in an average reduction in daily dry matter intake of 3.6% and a small 1.8% increase in daily gain during a controlled 28-day feeding phase. All steers were fed an 85% concentrate feedlot diet fortified with 30g/ton of Rumensin® and 10g/ton of tylan®.

Introduction

A ruminal device that would deliver a daily dose of Rumensin® during grazing should yield all the advantages of Rumensin without the problem of daily supplement feeding. However, if the device is still active when cattle are placed in the feedlot, will Rumensin in the feedlot ration still work? We designed this experiment to answer that question.

Experimental Procedures

Sixty steers from one ranch that had been used in an early-intensive stocking, native range grazing trial to evaluate the Rumensin Ruminal Delivery Device (RRDD) were selected to go directly from the grazing project to the Beef Research Unit for a 28-day feedlot trial. All steers had been implanted with Compudose.® Half of the cattle (30) received a RRDD at the beginning of the 76-day grazing phase, whereas the other 30 served as controls.

The 60 steers were weighed individually after an overnight stand without feed and water at the conclusion of the grazing trial (July 15, 1986) and this shrunk weight served as the initial weight for the feedlot study. The steers were blocked by weight and allotted to five pens of control steers and five pens with RRDD's. Each pen contained six steers. Composition of the final daily diet (DM basis) was 79% sorghum grain, 15% sorghum silage, and 6% supplement. The supplement was formulated to provide 30g/ton of Rumensin and 10g/ton of Tylan when mixed with the complete diet. Cattle were fed ad libitum twice daily and at the end of the 28-day adaptation trial, individual weights were taken prior to the morning feeding (August 12).

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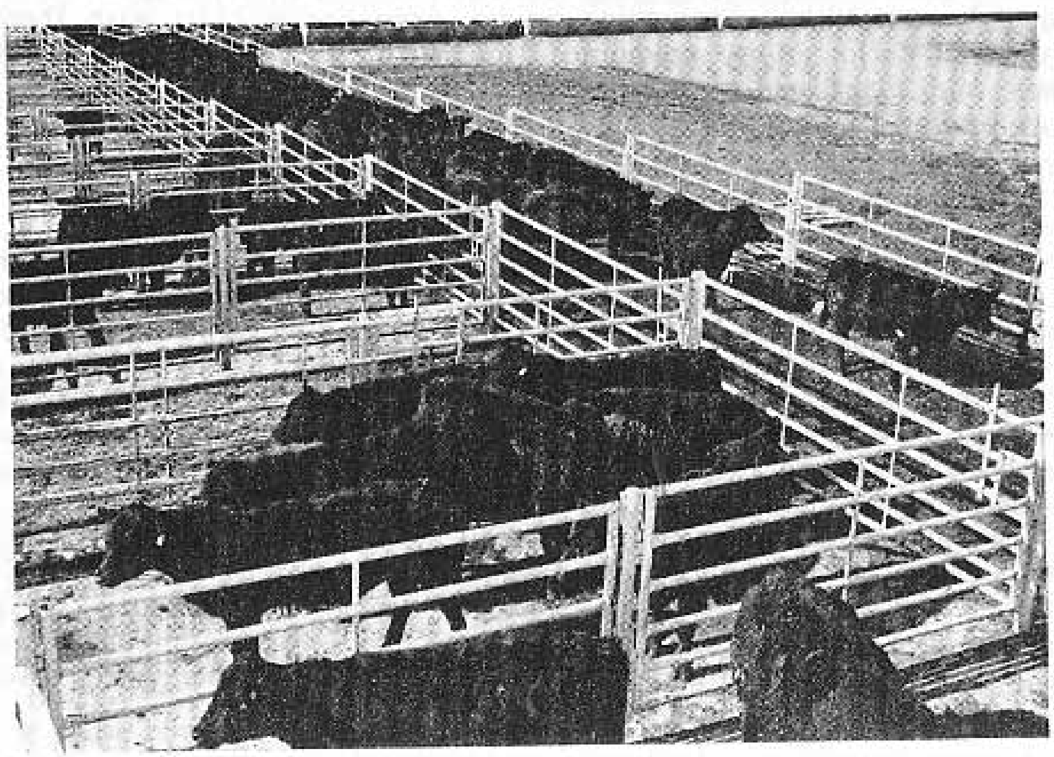
[1]Rumensin® Ruminal Delivery Devices, Compudose® and partial financial assistance provided by Eli Lilly Co. Appreciation is expressed to Dr. Cal Parrott for assistance with the trial.

Results

Table 7.1 summarizes the cattle performance on the two treatments. Steers with the RRDD consumed an average of 3.6% less daily dry matter and showed an average 1.8% increase in daily gain. Results of this trial suggest that RRDD's given as recently as 76 days prior to going into a feedlot will not decrease feedlot performance, even though the supplement contains the normally recommended level of Rumensin.

Table 7.1. Effect of Ruminal Delivery Devices on Feedlot Performance

Item	Control	RRDD
Length of trial, d.	28	28
Number steers	30	30
Initial Wt., lb.	838.7	842.6
Final Wt., lb.	945.5	951.7
Gain, lb.	106.9	109.1
ADG, lb.	3.82	3.89
Feed Intake (DM), lb.	18.44	17.78
Feed/Gain (DM basis)	4.83	4.57



Effects of Trenbolone Acetate[1] and Zeranol Implants on Performance, Carcass, and Meat Traits of Young Bulls and Steers

R.D. Johnson and M.E. Dikeman

Summary

Implanting young bulls and steers with trenbolone acetate and zeranol (Ralgro®) resulted in increased slaughter weights and carcasses that tended to have more marbling than those of control bulls. Furthermore, steaks from both implanted bulls and implanted steers tended to have less detectable connective tissue. Control bulls had larger scrotal circumferences and heavier testicle weights than implanted bulls. Other secondary sex characteristics were not affected, but in these bulls slaughtered at an average age of 13.6 months, sexual development was minimal. Implanting steers with trenbolone acetate and zeranol resulted in performance and carcass and meat quality slightly superior to control bulls.

Introduction

Natural or synthetic estrogen or testosterone sources used to improve performance and efficiency in steers have also been used in bulls to overcome some of the drawbacks of feeding intact males, including aggressive behavior; dark, coarsely textured lean; excess masculinity; reduced marbling and quality grade; and decreased palatablity. Implanting young, prepubertal bulls with trenbolone acetate and zeranol followed by reimplantation with zeranol after puberty may improve carcass and meat traits over nonimplanted bulls, while attaining sensory-panel ratings similar to those of implanted steers.

Experimental Procedures

Twenty Polled Hereford bulls from the Kansas State University Cow-Calf Unit with an average frame score of 3.6 were randomly assigned to one of three treatments shortly after birth. Five calves remained as nonimplanted controls (CB). Nine were implanted with 140 mg of trenbolone acetate (TBA) and 36 mg of zeranol at about 1 mo. and reimplanted with both compounds 10 wk later. When these nine calves were 21 wk of age, the TBA implant was removed by scalpel. These bulls (IB) were reimplanted with zeranol alone every 10 wk until slaughter. The remaining six calves (IS) were castrated at about 3 wk of age and implanted with TBA and zeranol every 10 wk until slaughter. The calves were weaned at 7 mo. of age. After weaning, the calves were brought to the Kansas State University Beef Research Unit and fed a standard finishing diet until slaughter. Scrotal circumference was measured at 8 and 13 mo. Hip height and masculinity were evaluated at 12 and 13 mo., respectively. The cattle were slaughtered at an

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[1]Trenbolone acetate is a synthetic testosterone. It is currently being evaluated by the Food and Drug Administration as a commercial implant.

average age of 13.6 mo. Testicle weights were taken at slaughter, and carcass masculinity (size of jump muscle, crest, and pizzle eye), along with USDA yield and quality grades, were determined 24 hr postmortem. The wholesale rib was removed at 24 hr postmortem and aged in a cooler for 7 d. Two 1-inch steaks were removed (12th rib region) from each rib and stored frozen (-20 C). Both steaks were thawed and cooked; a trained sensory panel evaluated one steak, whereas Warner-Bratzler shear force was measured on the other.

Results and Discussion

At 13 mo. of age, the IS tended (P=.07) to be less masculine than either bull group. Scrotal circumferences were lower (P<.05) for IB than for CB at both 8 and 13 mo. (Table 8.1). The IB and IS groups tended (P=.07) to have higher slaughter weights. There were no differences among treatments for feed efficiency or average daily gain (Table 8.2). Hot carcass weights, dressing percentages, carcass maturity scores, and marbling scores were similar among treatment groups. The IS tended to have more fat thickness, smaller ribeyes, and higher yield grades than CB, but these differences were not statistically significant. Also, CB had heavier (P<.05) testicles than IB (Table 8.3). There were no differences among treatment groups for lean firmness, lean texture, lean color, or the presence of heat ring (Table 8.4). A trained sensory panel found no significant differences in flavor intensity, juiciness, overall tenderness, or myofibrillar tenderness, and Warner-Bratzler shear values did not differ between steaks from the three treatments. However, the IB and IS groups tended (P=.14) to have less connective tissue than CB (Table 8.5).

Implanting young bulls near birth with TBA plus zeranol and then zeranol alone after about 5 mo. of age reduced (P<.05) scrotal circumferences and tended (P=.14) to produce ribeye steaks with less connective tissue than steaks from CB. For small-framed cattle such as were used in this trial, the implanting scheme of trenbolone acetate and zeranol early in life and then zeranol alone later may counteract some of the problems associated with feeding bulls for meat production. This scheme may optimize the performance advantages and improve carcass and meat traits of bulls. Additionally, the steers seemed to perform exceptionally well with the combination of TBA plus zeranol from near birth until slaughter.

Table 8.1. Hip Height and Masculinity Characteristics for Control Bulls and Implanted Bulls and Steers

Item	Control Bulls	Implanted Bulls	Implanted Steers
Hip Neight at 12 Mo., in.	47.7[c]	46.6[c]	44.9[d]
Masculinity Score at 13 mo.[1]	3.2[a]	3.0[b]	2.3
Scrotal Circumference at 8 mo., cm.	25.9[a]	20.9[b]	--
Scrotal Circumference at 13 mo., cm.	38.8[a]	34.5[b]	--

[1]Scores of 1 to 5: 2=slightly masculine, 3=moderately masculine, 4=masculine.
[ab]Means in the same row with different superscript letters differ (P<.05).
[cd]Means in the same row with different superscript letters differ (P<.10).

Table 8.2. Performance of Control Bulls and Impanted Bulls and Steers

Item	Control Bulls	Implanted Bulls	Implanted Steers
Weaning Wt., lb.	453	481	471
Slaughter Wt., lb.	1055[a]	1139[b]	1134[b]
Average Daily Gain, lb.	3.1	3.4	3.5
Feed/Gain (DM basis)	5.2	5.4	5.2

[ab]Means in the same row with different superscript letters differ (P<.07).

Table 8.3. Carcass Characteristics of Control Bulls and Impanted Bulls and Steers

Item	Control Bulls	Implanted Bulls	Implanted steers
No. of animals	5	9	6
Hot carcass wt., lb	641	685	675
Dressing percent	60.7	60.1	59.5
Carcass maturity	A^{55}	A^{53}	A^{52}
Marbling score	$Slight^{82}$	$Small^{00}$	$Small^{07}$
Fat thickness, in.	.34	.41	.46
Ribeye area, in^2	13.2	12.9	12.6
Ribeye area, in^2/cwt.	2.07	1.89	1.89
Yield grade	1.9	2.3	2.5
Testicular wt., gram	398[a]	294[b]	--
Jump muscle and crest score[1]	1.5	1.6	1.3

[1]Scores of 1 to 6: 2=barely evident, 3=slightly prominent, 4=moderately prominent.
[ab]Means in the same row with different superscript letters differ (P<.05).

Table 8.4. Ribeye (Longissimus) Quality Characteristics for Control Bulls and Implanted Bulls and Steers

Item	Control Bulls	Implanted Bulls	Implanted Steers
Lean Firmness[1]	5.9	5.8	6.4
Lean Texture[2]	4.3	4.9	5.6
Lean Color[3]	4.3	4.1	4.0
Heat Ring[4] (dark coarse band)	1.0	1.0	1.1

[1]Scores of 1 to 8: 5=slightly firm, 7=firm.

[2]Scores of 1 to 8: 4=slightly coarse, 5=slightly fine.

[3]Scores of 1 to 9: 3=light cherry red, 4=cherry red.

[4]Scores of 1 to 5: 1=none, 2=slight.

Table 8.5. Taste Panel Evaluation and Warner-Bratzler Shear Values of the Ribeye (Longissimus) for Control Bulls and Imlpanted Bulls and Steers

Item	Control Bulls	Implanted Bulls	Implanted Steers
Flavor Intensity[1]	6.1	6.3	6.3
Juiciness[1]	6.1	6.3	6.4
Connective Tissue Amount[2]	6.7	7.1	7.2
Myofibrillar Tenderness[3]	5.4	6.2	6.4
Overall Tenderness[3]	5.8	6.4	6.5
Warner-Bratzler Shear, kg.	4.0	3.4	3.3

[1]6=Slightly intense or slightly juicy 7=very intense or very juicy.

[2]6=Slightly amount, 7=practically none.

[3]Scores of 1 to 8: 5=slightly tender, 6=moderately tender.

Effects of Pneumo-Guard H® and Vitamin E on Gain and Health of Stockers Purchased as Steers and Bulls[1,2]

Frank Brazle[3]

Summary

Pneumo-Guard H® and injectable Vitamin E did not improve cattle gain or reduce treatments required per animal during a 29-day receiving trial. Stockers purchased as steers gained faster (P<.001) and required fewer (P<.001) treatments per animal than bulls castrated on arrival.

Introduction

Research has shown Vitamin E to be involved in animals' immunological response to disease. Therefore, one objective of this study was to determine if injectable Vitamin E would affect the gain and health of newly arrived cattle. One of the most important disease organisms in newly purchased cattle is *Pasteurella hemolytica*. Therefore, the second objective was to evaluate Pneumo-Guard H® in reducing sickness in newly arrived stockers.

Experimental Procedures

One thousand, mixed breed, steer and bull calves and yearlings were purchased over a 60-day period in the fall from 12 local sale barns in southeast Kansas. The cattle were processed within 24 hours of arrival at the feedlot. They were vaccinated for IBR, BVD, PI_3, and 7-way blackleg; dewormed with Tramisol®, and treated for external parasites with Tiguvon®. Horns were tipped and bulls were castrated with a knife. All cattle were individually weighed and visually evaluated for body condition and apparent breed type. The cattle were randomly allotted to treatment at processing. The experimental design was a 2x2 factorial arrangement. Five hundred stockers were vaccinated at arrival for *Pasteurella hemolytica* with Pneumo-Guard H® and re-vaccinated 3 to 4 weeks later. Five hundred cattle were injected with 10 ml (2500 IU) of Vitamin E.

The cattle were started on 5 lbs of whole shelled corn and .5 lb of 34% protein supplement containing 300 mg Bovatec® per head daily, plus free choice hay consisting of 50% prairie grass and 50% alfalfa. During the 29-day receiving period, the cattle were pulled when they appeared sick and were treated.

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[1]Funding support is appreciated from Norden Laboratories, Inc., Lincoln, NE, the developers of Pneumo-Guard®, and to Hoffmann-LaRoche, Nutley, NJ, the makers of Vitamin E.
[2]Appreciation is extended to Richard Porter, Reading, KS for providing the cattle and collecting the data.
[3]Extension Livestock Specialist, Southeast Kansas.

Treatment was continued until visual appearance improved or body temperature returned to normal. Choice of medications was determined by the local veterinarian and producer.

Results and Discussion

Neither Pneumo-Guard H® nor a single injection of 2500 IU of Vitamin E had any effect on 29-day gain or health of newly purchased stockers (Table 9.1 and 9.2). However, other research has suggested a benefit from daily supplementation of Vitamin E to stressed stockers. Cattle purchased as steers gained faster ($P<.001$) and required fewer treatments per animal than bulls castrated on arrival (Table 9.3). The fleshiness or body condition scores (1=extremely thin, 9=very fat) of the cattle affected gain and health. In the present trial, cattle with scores of 4 to 5 were in average stocker condition, while those scored 3 were relatively thin and those scored 6 were moderately fleshy. In both steers and bulls, daily gain during the 29-day receiving period was reduced with increasing body condition, whereas the treatments required per head increased with higher condition (Table 9.4).

Cattle with lighter starting weights had lower ($P<.05$) daily gains and required more treatments per animal during the first 29 days (Table 9.5). In general, the larger breed types gained faster during the 29-day receiving period than the smaller framed cattle. Apparent breed types involving dairy-, Brahman-, and European-crosses, and Angus cattle required fewer ($P<.05$) treatments per animal, whereas Hereford and Hereford Angus-cross stockers required the greatest number of treatments (Table 9.6).

Table 9.1. Effects of Pneumo-Guard H® on Gain and Health of Newly Arrived Stockers

Item	Pneumo-Guard	Control
No. Head	500	500
Daily Gain, lb	2.61	2.64
% Cattle Treated	25.9	27.4
Treatments Required/Animal	.76	.76
No. Dead	8	5

Table 9.2. Effects of Injectable Vitamin E on Gain and Health of Stockers

Item	Vitamin E Injection	Control
No. Head	500	500
Daily Gain, lb	2.60	2.65
Treatments Required/Animal	.77	.74
No. Dead	6	7

Table 9.3. Effects on Gain and Health of Stockers Purchased as Either Steers or Bulls

Item	Steers	Bulls
No. Head	660	327
Average Wt., lb	550	526
Daily Gain, lb	2.43[a]	1.51[b]
Treatments Required/Animal	.55[a]	2.22[b]
No. Dead	9	5

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

Table 9.4. Effects of Body Condition on Gain and Health of Stockers Purchased as Steers or Bulls

	Body Condition Score			
Item	3	4	5	6
Daily Gain, lb:				
Steers	2.93[a]	2.45[a]	2.25[b]	2.10[b]
Bulls	1.71[a]	1.69[a]	1.46[ab]	1.18[b]
Treatments Required/Animal:				
Steers	.14[c]	.87[d]	.48[cd]	.98[d]
Bulls	1.30[a]	2.45[ab]	2.07[ab]	3.04[b]

[ab]Means in the same row not sharing the same superscript are different (P<.005).
[cd]Means in the same row not sharing the same superscript are different (P<.05).

Table 9.5. Effects of Starting Weight on Gain and Health of Stockers

Item	<400	400 to 500	500 to 600	600 to 700	>700 lb
No. Head	63	274	376	226	48
Daily Gain, lb	1.71[a]	1.75[a]	1.99[b]	2.00[b]	2.16[b]
Treatments Required/ Animal	2.14[a]	1.89[ab]	1.25[bc]	.98[c]	.13[d]

[abcd]Means in the same row not sharing the same superscript are different ($P<.05$).

Table 9.6. Effects of Breed Type on Gain and Health of Stockers[1]

Item	Angus	Black Holstein Cross	Hereford	Hereford-Angus Cross	Other Dairy	Brahman Cross	Exotic Cross
No. Head	315	19	167	224	24	51	114
Daily Gain, lb	2.33[b]	2.63[ab]	2.33[b]	2.27[b]	3.09[a]	3.10[a]	2.42[b]
Treatments Required/Animal	.74[b]	1.19[ab]	1.75[a]	1.43[a]	.18[b]	.36[b]	.77[b]

[1]Apparent breed type was based on visual appraisal.

[abcd]Means in the same row not sharing the same superscript are different ($P<.05$).

Efficacy of DEPO-MGA® in Feedlot Heifers[1]

Jack G. Riley, Ron Pope, and Larry O'Neill

Summary

Three levels of melengestrol acetate (30, 60, and 90 mg) injected subcutaneously as a liquid (DEPO-MGA®) in the ear of heifers yielded high performance results comparable to feeding 0.5 mg of MGA per head daily. Heifers fed 0.5 mg MGA daily gained 6% faster and were 11% more efficient than heifers not receiving MGA. This study will be pooled with trials from 13 other locations in the U.S. to determine if further development and FDA clearance of DEPO-MGA® will be pursued by the Upjohn Company.

Introduction

Melengestrol acetate (MGA®) is a synthetic progestogen currently marketed by Upjohn as MGA-200® and MGA-500® premixes with label claims for estrus suppression, increased weight gain, and improved feed efficiency in heifers fed for slaughter. Currently approved formulations of MGA require daily oral administration in the feed. Oral administration has several limitations: 1) separate feed formulations are required if both steers and heifers are being fed; 2) because MGA is not approved for steers, it prevents feeding of mixed pens of steers and heifers for optimum performance; 3) FDA regulations prohibit dietary MGA in combination with several other popular feed additives; 4) MGA must be withdrawn from feed 48 hours prior to slaughter; and 5) additional premix storage and record keeping are required. A long-acting injectable formulation of MGA would remove these limitations.

Upjohn has developed a long-acting injectable liquid MGA formulation, called DEPO-MGA® and is conducting efficacy studies with feedlot heifers at 14 locations in the United States. Kansas State University conducted two of these trials; one at the Southwest Kansas Branch Station, and one at the Beef Research Unit in Manhattan, which is summarized in this report.

Experimental Procedures

Ninety non-pregnant, yearling, British and British crossbred heifers purchased locally were used. The experiment consisted of three weight replicates of heifers on each of the five treatments: 1) control (no MGA); 2) MGA fed at 0.5

[1]DEPO-MGA® and partial financial support provided by Upjohn Co., Kalamazoo, MI. Appreciation is expressed to Mr. Thomas Schriemer, Clinical Research Coordinator.

mg/hd/d; 3) 0.5 ml DEPO-MGA (30 mg melengestrol acetate); 4) 1 ml DEPO-MGA (60 mg melengestrol acetate); and 5) 1.5 ml DEPO-MGA (90 mg melengestrol acetate). These dosages were selected by Upjohn to refine the estimates of optimum dosage and were based on two preliminary studies. The appropriate volume of DEPO-MGA was injected subcutaneously in the back of the left ear using an 18 gauge x 1.5 inch needle. Direction of needle insertion was from the ear tip toward the base, with the drug deposited near the base of the ear. The heifers had not been implanted previously and implants were not used in this study. The final diet (D.M. basis) was 15% corn silage, 79.2% dry rolled sorghum grain, and 5.8% supplement. No attempt was made in our study to monitor estrus activity, since the heifers were confined in small pens with concrete flooring. However, estrus suppression data will be collected at five of the other trial locations. The 103-day trial began August 7 and ended November 18, 1986.

Results and Discussion

Table 10.1 summarizes heifer performance on the five treatments. Growth and feed efficiency were quite acceptable for all treatments; however, the control heifers gained the slowest (3.0 lb/hd/d) and were the least efficient (7.85 lb feed DM/lb gain). Heifers fed 0.5 mg MGA/hd/d gained 6% faster and were 11% more efficient than controls. All three DEPO-MGA treatments improved gain and efficiency compared to the controls and results were quite comparable to those with oral MGA. There were no differences in quality or yield grades of heifers among the five treatments. DEPO-MGA appears to be an acceptable alternative to feeding MGA. However, further development of this product will depend upon the combined results from all 14 locations.

Table 10.1. Efficacy of DEPO-MGA in Feedlot Heifers Fed 103 Days

Item	Control	Fed MGA	DEPO-MGA Injected		
		0.5 mg/hd/d	30 mg	60 mg	90 mg
No. steers	15	15	15	15	15
Initial wt, lb	718.4	719.8	720.1	720.8	720.5
Final wt, lb	1027.4	1047.4	1050.3	1055.3	1043.8
Gain, lb	309.0	327.6	330.2	334.5	323.3
Daily gain, lb	3.00[a]	3.18[b]	3.21[b]	3.25[b]	3.14[ab]
Intake (DM), lb	23.56[a]	22.24[b]	23.23[a]	23.01[a]	22.87[ab]
Feed/gain (DM/lb)	7.85[a]	6.99[b]	7.24[b]	7.08[b]	7.28[b]

[ab]Means in same row with different superscripts are different ($P<.05$); however final conclusions will depend upon statistical analysis of pooled data from all 14 locations.

Compudose® vs Ralgro®/Synovex-S® or Synovex-S®/Synovex-S®Reimplant Programs for Finishing Yearling Steers[1]

Scott B. Laudert[2] and Robert W. Lee[3]

Summary

Three field trials were conducted with finishing yearling steers to compare the performance of cattle receiving Compudose® or Ralgro®/Synovex-S® and Synovex-S®/Synovex-S® reimplant combinations. No differences were found between Compudose and the reimplant programs in cattle daily gain, feed efficiency, or cost of gain. Compudose retention was 97.5% in the 1317 head implanted. Synovex-S implant site abscess rate ranged from 5.7 to 15.4%.

Introduction

Implant companies continually modify and redesign applicators and implants with the intent of improving product response and acceptance. Development of the SX-10 implant gun by Syntex Animal Health, Inc., and Elanco Products Company's washing of Compudose® implants to remove surface estrogen and coating them with an antibiotic prior to packaging are examples.

Limited research has been conducted with Compudose and Synovex-S® since these modifications have taken place. Thus, these trials were conducted to compare steer performance using these improved products under commercial cattle feeding conditions.

Experimental Procedures

Three field trials were conducted to compare Compudose with Ralgro and/or Synovex-S reimplant programs for finishing yearling steers in three commercial feedlots. Steers receiving Compudose were implanted only once at the beginning of each trial.

In trial 1, the reimplant program included an initial Ralgro followed by a Synovex-S. In trials 2 and 3, the reimplant program consisted of an initial Synovex-S followed by another Synovex-S. The second implant was administered approximately midway through the feeding period in all trials.

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[1] Appreciation is expressed to Brookover Feedyards and Brookover Ranch Feedlot, Garden City, KS and to Supreme Feeders, Liberal, KS for providing cattle and facilities.

[2] Extension Livestock Specialist, Southwest Kansas.

[3] Current Address - Brookover Ranch Research Center, P.O. Box 917, Garden City, KS 67846.

Upon arrival, the cattle were alley sorted into two treatment pens in groups of 20, 3 and 5 head, respectively, in trials 1, 2 and 3. This procedure was repeated three times at each feedyard, resulting in three pen replicates in each trial. Once the cattle in each pair of treatment pens were sorted, individual pen weights were taken and this weight was used as the on-test weight. Assignment of implant treatment to the cattle replicate pens was done at random.

After sorting and weighing, all cattle were processed in accordance with standard feedlot operating procedures. Implants were administered by a skilled technician familiar with their application. Within each trial, all cattle were fed and managed similarly according to standard operating procedures of the feedlot.

At the completion of each trial, cattle in replicate pens were weighed and slaughtered on the same day. Total cattle pen weight minus 4% pencil shrink was used as the final weight. At slaughter, cattle on the Compudose treatment were checked for implant retention. Cattle in trials 2 and 3 were inspected for Synovex-S implant site abscesses at time of reimplanting and at slaughter.

Performance data are reported on a "deads out" basis for rate of gain, feed consumption, feed conversion, and cost of gain. The data were statistically evaluated using Analysis of Variance.

Results and Discussion

Individual trial results are reported in Tables 11.1, 11.2, and 11.3. A three-trial summary is presented in Table 11.4. No differences ($P \geq .4$) were found between implant treatments for steer daily gain, feed consumption, feed conversion, or cost of gain in trials 1, 2, and 3, involving 2645 cattle.

Carcass traits were not different between treatment groups in trial 1 (Table 11.1). Compudose implanted steers tended to grade higher (58.7 vs 49.6% choice), than Synovex-S implanted steers in trial 3 (Table 11.3).

In trial 2, feed consumption 7 days prior to and after reimplanting was slightly lower in the Synovex-S group relative to the Compudose cattle (Table 11.2).

Rate of Synovex-S implant site abscesses was 13.9% for the initial implant and 15.4% for the reimplant in trial 2, and 6.6% for the initial implant and 5.7% for the reimplant in trial 3.

Compudose implant retention was 98.9, 97.1, and 95.6%, respectively, in the three trials.

Table 11.1. Comparison of Compudose and Ralgro/Synovex-S Reimplant Programs for Finishing Yearling Steers, Trial 1

Item	Compudose	Ralgro/Synovex-S
No. Pens	3	3
No. Steers	654	653
Initial Wt., lb	687	690
Final Wt., lb	1090	1095
Days on Feed	149	149
Daily Gain, lb	2.71	2.72
Daily Feed (as-fed), lb	23.74	23.85
Feed/Gain (as-fed)	8.76	8.76
Cost of Gain, $/cwt	50.86	50.86
Dressing Percentage	62.9	63.1
Percent Choice	80.2	82.0
Yield Grade 4's, %	3.3	2.3
Liver Abscesses, %	8.3	11.0
Compudose Retention, %	98.9	----

Table 11.2. Comparison of Compudose and Synovex-S/Synovex-S Reimplant Programs for Finishing Yearling Steers, Trial 2

Item	Compudose	Synovex-S/Synovex-S
No. Pens	3	3
No. Steers	209	209
Initial Wt., lb	655	656
Final Wt., lb	1038	1044
Days on Feed	136	136
Daily Gain, lb	2.83	2.87
Daily Feed (as-fed), lb	24.56	24.64
Feed/Gain	8.68	8.59
Cost of Gain, $/cwt	48.79	48.60
Daily Feed Consumption:		
7 Days Before Reimplanting, lb	24.28	24.12
7 Days After Reimplanting, lb	24.83	23.90
Implant Site Abscesses:		
Initial Implant, %	1.0	13.9
Reimplant, %	----	15.4
Compudose Retention, %	97.1	----

Table 11.3. Comparison of Compudose and Synovex-S/Synovex-S Reimplant Programs for Finishing Yearling Steers, Trial 3

Item	Compudose	Synovex-S/Synovex-S
No. Pens	3	3
No. Steers	460	460
Initial Wt., lb	638	637
Final Wt., lb	1132	1135
Days on Feed	159	159
Daily Gain, lb	3.11	3.14
Daily Feed (as-fed), lb	22.71	23.27
Feed/Gain, (as-fed)	7.30	7.41
Cost of Gain, $/cwt	43.81	44.37
Percent Buller Days	1.23	0.51
Buller Head Days	890	370
No. Treated	38	23
Percent Treated	8.26	5.00
Hospital Head Days	1037	567
Death Loss, %	1.09	0.43
Dressing Percentage	63.2	63.7
Percent Choice	58.7	49.6
Liver Abscesses, %	5.5	4.2
Liver Flukes, %	3.5	2.4
Implant Site Abscesses:		
Initial Implant, %	0.4	6.6
Reimplant, %	----	5.7
Compudose Retention, %	95.6	----

Table 11.4. Three-Trial Summary of Compudose vs Reimplant Programs for Finishing Yearling Steers

Item	Compudose	Reimplant[1]
No. Pens	9	9
No. Steers	1323	1322
Avg. Initial Wt., lb	660	661
Avg. Final Wt., lb	1087	1091
Avg. Days on Feed	148	148
Avg. Daily Gain, lb	2.88	2.91
Avg. Daily Feed (as-fed), lb	23.67	23.92
Avg. Feed/Gain, lb	8.22	8.22
Avg. Cost of Gain, $/cwt	47.66	47.78

[1]Ralgro/Synovex-S reimplant program for 3 pens and Synovex-S/Synovex-S reimplant program for 6 pens.

Compudose® Compared with Synovex-H® for Finishing Yearling Heifers[1]

Scott B. Laudert[2]

Summary

Feedlot heifers implanted once with either Compudose® or Synovex-H® performed similarly, with daily gains of 3.16 vs 3.27 lbs, respectively. Compudose retention in the ear was 97.5%. Implant site abscess rate was 2.5% for Compudose and 13.7% for Synovex-H.

Introduction

Compudose® was recently approved for use in feedlot heifers. This trial was conducted to compare the performance of heifers implanted with Compudose® and Synovex-H® under commercial feeding conditions.

Experimental Procedures

One hundred fifty-two predominately British and British cross heifers averaging 697 lbs were randomly assigned by breed type to either Compudose or Synovex-H implant treatments. Both implant brands were administered subcutaneously in the middle third of the ear by a skilled technician familiar with their application. Each heifer was individually identified, weighed, and implanted at the time of initial processing. All animals were fed in the same pen and managed similarly.

All heifers were slaughtered after a 111-day feeding period. Individual carcass weights were divided by the average dressing percentage of the group (63.1%) to estimate individual live slaughter weights. Least squares means procedures were used to analyze the gain data, with initial heifer weight employed as a covariate.

Results

Results are presented in Table 12.1. No difference (P=.32) in heifer daily gain was found between the two implants over the 111-day trial. These results should not be extrapolated to heifers fed for greater lengths of time, however. Compudose retention was 97.5%. Implant site abscess rate was 2.5% for Compudose and 13.7% for Synovex-H.

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[1] Appreciation is expressed to Grant County Feeders, Ulysses, KS for supplying cattle and facilities and to National Beef Packers, Liberal, KS for slaughter assistance.

[2] Extension Livestock Specialist, Southwest Kansas.

Table 12.1 Compudose vs Synovex-H Implants for Finishing Yearling Heifers

Item	Compudose	Synovex-H
No. Heifers	79	73
Initial Wt. lb	691	703
Final Wt. lb	1041	1066
Daily Gain, lb	3.16	3.27
Implant Site Abscess %	2.5	13.7
Compudose Retention, %	97.5	--

Effects of Preweaning and Postweaning Implants on Suckling, Growing, and Finishing Steer Performance[1] -A Three Trial Summary-

D.D. Simms,[2] T.B. Goehring, R.W. Lee,[3]
R.T. Brandt, Jr.[4] S.B. Laudert,[5] and G.L. Kuhl

Summary

Over 500 crossbred steers were used in three trials to compare lifetime implant strategies and to study the effects of implanting during the suckling period on performance in the growing and finishing periods. Contrary to previous research, implanting in the suckling period did not increase suckling gain. Implanting in the growing period increased ($P<.05$) average daily gain, and the implant response in the growing period was not influenced by suckling implant treatment.

Steers implanted twice during the finishing period had similar finishing gains regardless of prior implant treatment. Steers implanted only once during the finishing phase gained less ($P<.05$) than those implanted twice, and while their gains were higher than those of control steers, the difference was small ($P>.05$). Implanting steers in the finishing phase tended to improve feed conversion but again the difference was not statistically significant. All implant treatments increased ($P<.05$) lifetime average daily gains and total gain, and there was no difference among implant combinations. Implant treatments increased lifetime gains by 30 to 54 lbs.

Because implanting in the suckling period did not reduce cattle performance during the growing and finishing periods, there appears to be no basis for discounting the price of previously implanted cattle. Additionally, this study emphasizes the importance of reimplanting cattle during long finishing periods.

Introduction

While numerous implanting trials have been conducted, few have studied the long-term effects of implanting during the suckling and growing periods on performance in the finishing period. Some research has indicated that implanting in the suckling period reduces performance during the finishing phase. Our trials were

[1] Appreciation is expressed to International Minerals and Chemical Corp. for funding support of this research; to Tom Stewart, Weskan and Joe Thielen, Dorrance for providing cattle and assisting in data collection; to County Extension Agricultural Agents Keith VanSkike, Norton, Kallon Scheef, Wallace, and Del Jepsen, Russell; and to Pat Burton, IMC, for their assistance.
[2] Extension Livestock Specialist, Northeast Kansas.
[3] Formerly Beef Research Scientist, Southwest Kansas Experiment Station.
[4] Beef Research Scientist, Southwest Kansas Experiment Station.
[5] Extension Livestock Specialist, Southwest Kansas.

conducted to study the impact of suckling- and growing-phase implants on finishing and lifetime performance.

Experimental Procedures

Approximately 100 suckling, exotic crossbred, steer calves on each of five Kansas ranches were assigned at branding (1 to 2 months old) to receive either no implant (Control) or a 36 mg Ralgro® implant. Non-shrunk weights were taken at branding and weaning. Following weaning, the calves were managed and allotted to various implant treatments for the growing and finishing periods as follows:

Trials 1 and 2. In both trials, calves at one ranch were weaned and backgrounded for approximately 1 month before being shipped to the Southwest Kansas Experiment Station. Calves at another ranch were weaned and shipped directly to the station. The steers were on a "warm-up" ration at the experiment station for 30 to 60 days before the growing period started. They remained at the station for the finishing phase.

Trial 3. Calves were placed on the growing trial at weaning and remained at the ranch until they were shipped to the KSU Beef Research Unit at Manhattan shortly before starting the finishing phase.

In each trial, calves were allotted by suckling implant treatment and weight at branding to implant treatments for the growing period as shown in Table 13.1. Also shown are implant treatments for the finishing phase.

Non-shrunk weights were taken at the beginning of the growing period. Beginning (end of growing period) and ending weights for the finishing period were the average of two weights taken on consecutive days after an overnight stand without feed and water. During finishing, the steers were fed in pens of 5 to 10 steers each.

The growing period lasted 59, 63, and 142 days for trials 1, 2, and 3, respectively. The days from branding to the end of the growing period and length of the finishing period were 276 and 121 (Trial 1), 306 and 147 (Trial 2), and 357 and 126 (Trial 3), respectively. Reimplanting occurred on day 56 of the finishing period in all trials. All implants were 36 mg. Ralgro placed subcutaneously near the base of the ear.

Results and Discussion

Suckling Phase: Data in Table 13.2 are the combined results of all three experiments. Implanting at branding time (1 to 3 months of age) did not improve average daily gain up to weaning. Most other research indicates that implanting during the suckling period significantly increases weight gains. Calves in trials 1 and 2 had a warmup period prior to the start of the growing phase. In those trials only, implanting during the suckling phase increased ($P<.05$) average daily gain from branding to the start of the growing period.

Table 13.1. Experimental Design of the Long-Term Implant Trial

No. Steers	No. Pens[1]	Phase Suckling	Growing	Finishing
79	11	-[2]	-	- -[3]
78	11	-	-	+ +
97	11	-	+	+ +
97	11	+	-	+ +
65[4]	8	+	+	+ -
96	11	+	+	+ +

[1] Number of pens (5 to 10 steers each) per treatment in the finishing phase.

[2] - = no implant, + = implanted.

[3] A second implant, when used, was given after 56 days on feed.

[4] This implant combination was not evaluated in Trial 3.

Growing Phase: For the three trials combined, calves receiving an implant in the growing phase gained faster (P<.05) than non-implanted controls (Table 13.2). However, it should be noted that when Trial 2 was analyzed alone, there was no significant benefit from the implant.

Prior suckling implant treatment did not influence average daily gain in the growing phase. Calves receiving an implant in both the suckling and growing periods had a higher (P<.05) average daily gain from branding to the end of the growing period than controls, as shown in Table 13.2.

Finishing Phase: All steers implanted twice in the finishing phase gained faster (P<.05) than controls and steers not reimplanted. Steers not reimplanted gained only slightly faster (P>.05) than controls. This emphasizes the importance of implanting twice during a long finishing period. All implant treatment groups tended to have better feed conversions than controls, although differences were not statistically significant.

Steers that were not implanted prior to the finishing period gained essentially the same during finishing as steers that had received 1 or 2 implants prior to the finishing period. Correspondingly, steers receiving two implants prior to the finishing period had similar feed conversions to steers not receiving prior implants.

Table 13.2. Effects of Implant Combinations on Steer Performance during the Suckling and Growing Periods

Average Daily Gain, lb[1]	Implant Treatment[2]			
	- -	- +	+ -	+ +
Branding to Weaning	1.83		1.84	
Branding to Start of Growing Period[3]	2.04[a]		2.10[b]	
Growing Period[4]	2.19[a]	2.31[b]	2.10[a]	2.32[b]
Branding to End of Growing Period	1.97[a]	1.98[ab]	1.99[ab]	2.03[b]

[1] Least-squares means.
[2] Implant treatment in the suckling and growing phase, respectively.
[3] Trials 1 and 2. Those trials included a 30 to 60-day warm-up period prior to the growing phase.
[4] Trial x implant treatment interaction ($P<.05$).
[ab] Values with different superscripts in the same row differ ($P<.05$).

Lifetime Performance: Lifetime average daily gain was increased ($P<.05$) by all implant combinations. Furthermore, final weight was increased ($P<.05$) over controls in all treatments in which cattle were implanted twice during finishing. There were no differences in cattle gains from branding to slaughter or in final weights among any of the implant combinations. According to these data, implanting during the suckling phase does not reduce subsequent performance if implanting is repeated. Moreover, these trials indicate the importance of implanting twice during a long finishing period.

Table 13.3. Effects of Implant Combinations on Steers Performance[1] during the Finishing Period and on Lifetime Performance

Item		Lifetime Implant Treatment					
	Suckling and Growing Periods	- -[2]	- -	- +	+ -	+ +	+ +
	Finishing Period	- -[3]	+ +	+ +	+ +	+ -	+ +
Finishing Period:							
Average daily gain		2.85[a]	3.22[b]	3.15[b]	3.17[b]	2.97[a]	3.10[b]
Feed/gain		7.2	6.5	6.7	6.9	7.1	6.8
Dry matter intake		20.6	21.2	21.2	21.2	21.3	21.1
Final weight		1147[a]	1202[b]	1190[b]	1195[b]	1175[ab]	1201[b]
Lifetime:							
Average daily gain		2.22[a]	2.34[b]	2.32[b]	2.32[b]	2.29[b]	2.34[b]
Total gain		985[a]	1039[b]	1030[b]	1030[b]	1015[b]	1036[b]

[1] Least square means, expressed in lbs.
[2] The first sign refers to suckling implant treatment, the second, growing.
[3] The first sign refers to implant treatment at the start of finishing, the second to treatment at day 56 of finishing.
[ab] Values with different superscripts in the same row differ ($P<.05$).

Detection of Elastin, Collagen, and Cartilage Particles in Ground Beef by Enzyme Digestion and Sensory Analysis

G.Whipple, J.B.Axe, S.Goll, and C.Kastner

Summary

An enzyme digestion technique was developed using a proteolytic enzyme concentrate to quantitate connective tissue particles in ground beef samples, which had been formulated to contain various amounts of connective tissue. Replicate samples were also evaluated by a taste panel to quantify detectable connective tissue particles. Results for the laboratory enzyme technique and the taste panel were highly correlated. Therefore, the enzyme digestion technique can be used to estimate total connective tissue in ground beef and those particles that are detected upon chewing.

Introduction

The meat industry uses many processing techniques to reduce the amount of perceivable connective tissue in ground beef. However, the industry needs a rapid, inexpensive, simplified laboratory method for quantitating connective tissue in ground beef. Several enzymes from plant and microbial sources digest both muscle fiber proteins and connective tissue proteins. Some of those enzymes are more selective against one type of protein than another. We wanted to find an enzyme that would digest the muscle fiber (myofibrillar protein) and leave connective tissue structures intact, allowing measurement of elastic and collagenous connective tissue particles, cartilage, and bone. Such a method could be used to help prevent ground beef containing detectable connective tissue from reaching the consumer.

Experimental Procedures

In Phase 1, we found the most effective enzyme system to be the HT proteolytic enzyme.[1] The remainder of the assays were carried out as follows: Stock solution was prepared in 128 F water to contain 163 Northrup units per ml. Twenty-five gm of ground beef were placed in a 250 ml flask with 100 ml of enzyme solution and incubated with agitation for 30 min in a 128 F water bath. Flask contents were filtered on screen cloth (250 μm mesh openings) and the residue was rinsed with 250 ml of 5% NaCl, followed by 250 ml of distilled water. The residue was scraped from the screen cloth, weighed (Phases 1 and 2 only) and spread on plexiglass. Connective tissue particles 3mm or larger were removed, counted, and weighed.

In Phase 2, the enzyme digestion procedure was implemented on ground beef samples containing 0, 6, 8, and 10% added connective tissue. Data were treated statistically to estimate repeatability and sensitivity of the technique.

[1] Miles Laboratories Inc., Biotech Products Division, Elkhart, IN 46514.

In Phase 3, we determined what type of connective tissue was actually perceivable upon chewing. Only samples to which cartilage was added contained hard particles that were detectable upon chewing. Based on those results, coarsely ground (0.5 inch plate) cartilage with collagen attached was added at levels of 0, 3, 6, and 9% to coarsely ground (0.5 inch plate) beef. All treatment batches were formulated to 22% fat. Finally, all treatment samples were reground through a 0.125 inch plate and samples were analyzed by both the enzyme digestion technique and the taste panel. Hard particles were detected by pressing the index finger through the residue from enzymatic digestion. When detected, the hard particles were removed, counted, and weighed. Using forceps, soft connective tissue particles were also removed, counted, and weighed.

For the taste panel analysis, thawed patties (one 4 oz. patty per treatment) were cooked at 250 F for a total of 3.0 minutes. The taste panel consisted of six trained members. The technique involved chewing each treatment sample normally and recording the number of hard particles detected. Panelists were also asked to pass another sample through their incisors and count the number of hard particles.

Results and Discussion

From preliminary study results, we concluded that digesting samples with HT proteolytic concentrate (128 F for 30 min) was the most effective way to digest muscle fiber protein and leave connective tissue intact. That process allowed for differentiation, separation, and quantitation (both by count and weight) of connective tissue particles.

Total residue weight, connective tissue particle count, and particle weight for various levels of added connective tissue in Phase 2 were statistically analyzed. For total residue weight, no differences ($P>.05$) were observed among the four treatments; however, there were differences ($P<.05$) for particle count and weight. High correlations were seen between percent added connective tissue and the connective tissue particle weight (0.888) and count (0.924), and also between particle weight and particle count (0.906). These high values indicate that the enzyme digestion technique is highly repeatable and that either particle count or weight could be used to indicate the amount of particulate connective tissue in a sample.

Among the treatments (0, 3, 6 and 9% added connective tissue) in Phase 3, there were no differences ($P<.05$) for hard particle count, soft particle count, total particle count, and soft particle weight. However, weights of hard particles and total particles were different ($P>.05$).

Emphasis was placed on the hard particle count in the taste panel analysis because hard particles detected upon enzyme digestion were the only ones which affected taste panel perception. Figure 14.1 illustrates the mean hard particle counts for normal chewing, incisor detection, and enzyme digestion. For each detection method, differences were significant ($P<.05$) among the means for each treatment.

The correlation coefficient between normal chewing hard particle count and incisor hard particle count was 0.998. The correlation of enzyme hard particle count with normal chewing and incisor hard particle counts were 0.985 and 0.980, respectively. Thus, the enzyme digestion technique of ground beef can be used successfully as a quality control method for estimating the total amount of connective tissue and hard connective tissue particles detected upon chewing.

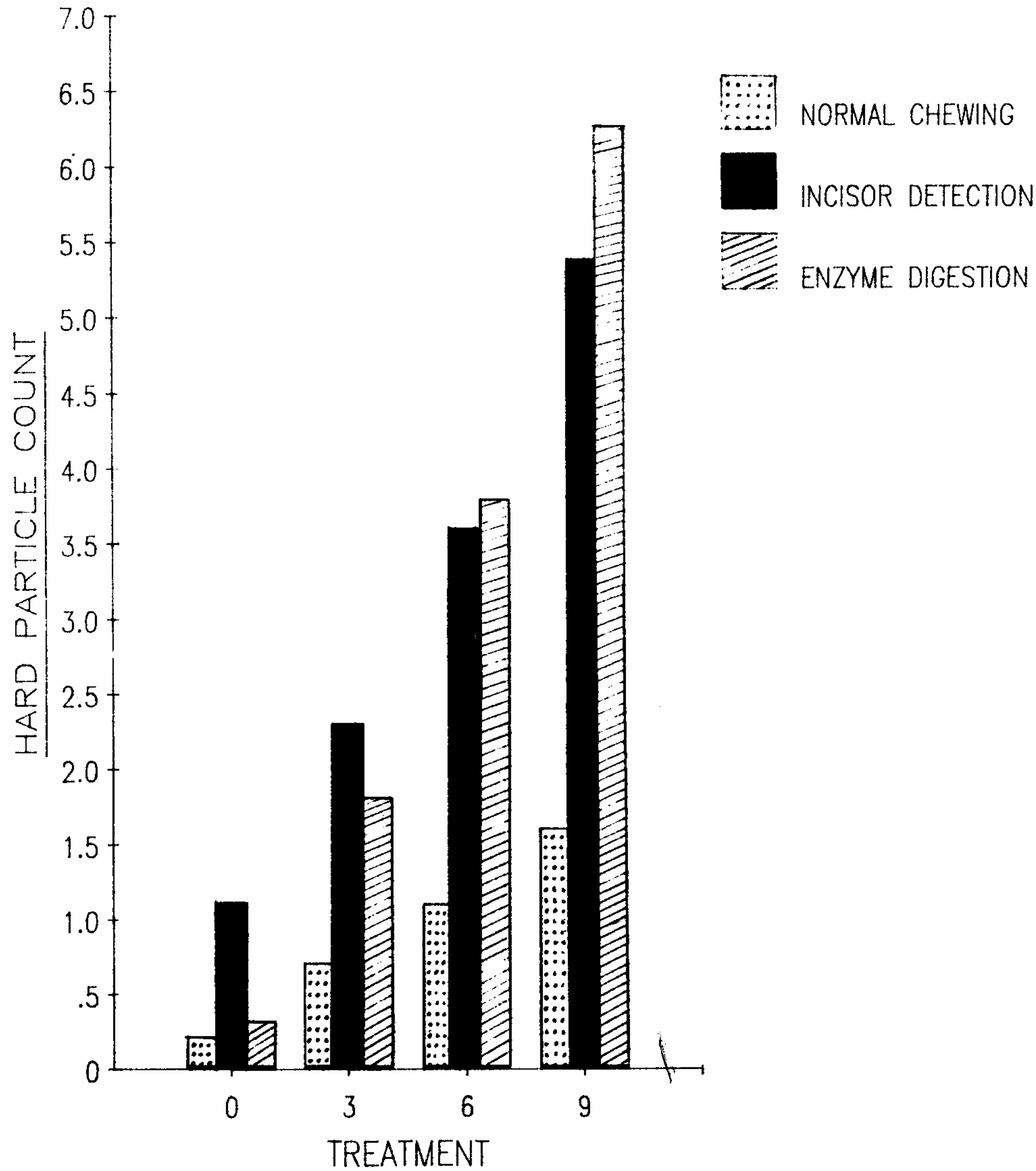

Figure 14.1. Mean values of hard particle count for normal chewing, incisor detection and enzyme digestion. Treatments are added percentage levels of connective tissue. All means for each detection method differ significantly (P<.05).

Color Formation and Retention in Fresh Beef

D.H. Kropf, M.C. Hunt, and Dorly Piske

Summary

We conducted two studies in response to a severe problem with ground beef color encountered by beef fabricators and retailers. We concluded that: (1) Loss of muscle chemical-reducing capability upon grinding, with subsequent color deterioration, results from both the mechanical effect of grinding and incorporation of oxygen into the beef. (2) Flat, thin, surface muscles from beef carcasses retain more ability to bloom (turn bright red) if they are removed by hot boning or after a relatively short chill period.

Introduction

To the purchaser, meat color is an important quality consideration. Our distribution, packaging, and marketing system for fresh meat is organized to present bright red meat to the purchaser. The preferred bright red color, especially for beef cuts and ground beef, is a result of oxymyoglobin, and purchasers consider lack of this color to be a sign of product deterioration. Such discolored meat is usually sold at a substantial discount.

Oxidation is a common but undesirable kind of color deterioration in beef cuts, trim, and ground product. Fresh beef muscle has a chemical-reducing capacity that slows oxidation, but is gradually lost. The loss is more rapid when muscle is exposed to oxygen. Current processing-packaging-marketing systems expose beef and beef trim to oxygen for various times prior to coarse grinding and vacuum packaging. A high level of oxygen exposure and diffusion of oxygen into the muscle is detrimental, when they occur before vacuum packaging. Holding trim for long times or using a high proportion of the carcass surface muscles that have had maximal surface exposure to air are likely to cause degraded color in the finished product.

Much of the ground beef currently marketed is coarsely ground and vacuum packaged in oxygen-impermeable (keeper) casing, then finely ground at the supermarket. Such beef may fail to "bloom" or turn bright red, causing a serious problem for the industry.

We conducted two studies to help understand this problem.

Experimental Procedures

Study 1. Three beef carcasses, grading U.S.D.A. High Good or Choice and weighing 650 to 750 lbs were used. Semimembranosus muscle was removed from each chilled side. Meat from one side was vacuum packaged immediately to minimize oxygen diffusion into the muscle. It was placed in an isolation hood for cutting and ground twice through a 1/8 inch plate. A nitrogen atmosphere was maintained, with oxygen at 0.1% or less. Semimembranosus muscle from the other side was cut and ground in air with other conditions being similar.

Ground beef from both sides was placed in oxygen impermeable bags, vacuum packaged, and stored for either 7 or 14 days prior to a display study. After storage, product was unpackaged, finely ground, and re-packaged in polyvinyl chloride.

The polyvinyl choride-wrapped product was displayed under 90 foot candles G.E. Natural fluorescent lighting for 24 hours per day at 4 C. Color was evaluated at the beginning of display (0 time) and after 1, 3, and 5 days of display by four panelists. Scoring was to the nearest 0.5 point on the K.S.U. beef color scale (1=very bright red, 3=slightly dark red or brown, 5=extremely dark red or brown). Reflectance data were taken with a Hunterlab D-54 reflectance spectrophotometer at the same times and percent metmyoglobin was calculated.

Study 2. Three beef carcasses grading Good or Choice and weighing 600 to 700 lbs. were used. Cutaneous trunci and adductor muscles were hot-boned from one side of each carcass within 2 hours postmortem, ground, vacuum packaged, and stored for either 7 or 14 days. After storage, the muscle was ground through a 1/8 inch plate and repackaged in polyvinyl chloride film.

The same muscles from the other chilled carcass sides were removed 48 hours postslaughter and handled in the same manner as the hot-boned muscle. Display conditions were similar to those of Study 1.

Results and Discussion

Study 1. Samples cut and ground in a nitrogen atmosphere had slightly less brown metmyoglobin ($P<.05$) and a slightly brighter red ($P<.05$) visual color (Table 15.1). We conclude that the loss of muscle-reducing capabilities results from both the incorporaton of oxygen into the meat and the physical effects of grinding.

Study 2. The cutaneous trunci is a flat, thin, surface muscle into which oxygen can diffuse easily while the carcass is intact. The muscles that were removed within 2 hours (hot) and ground prior to being placed in a 1% oxygen atmosphere had less metmyoglobin at all evaluation times after repackaging. This suggests a higher level of chemical-reducing activity in the hot-boned muscles, since their exposure to oxygen is minimized.

Very little visual difference was noted between hot and cold boning for cutaneous trunci before display and after 1 day of display (Table 15.2). However, after display for 3 to 5 days, color tended to be brighter for the muscle removed hot. The adductor, a muscle located deep in the beef round, was not affected by hot versus chilled boning.

These results suggest that removing surface muscles from the carcass before or early in chilling can minimize exposure to oxygen.

Table 15.1. Effect of Cutting and Grinding Muscle in Air Versus Nitrogen on Display Color and Metmyoglobin Reducing Capacity

Trait	Air	Nitrogen
Metmyoglobin, %[a]	24.2[y]	20.2[x]
Visual Color Score[ab]	2.76[y]	2.59[x]

[a] Average of all display times.

[b] 2 = bright red, 3 = slightly dark red or brown.

[xy] Means in the same row with different superscript letter are different ($P<.05$).

Table 15.2. Effect of Hot Versus Cold Removal of Beef Cutaneous Trunci Muscle on Visual Color[a] during Display

Time, days	Visual color[a] Hot	Cold
0	1.62[x]	1.49[x]
1	1.88[x]	2.00[x]
3	2.58[x]	3.03[x]
5	3.34[x]	3.80[y]

[a] Visual color: 1 = very bright red, 3 = slightly dark red or brown, 5 = extremely dark red or brown.

[xy] Means in same row with different superscripts are different ($P<.05$).

Measurement of the Binding Properties of Meat Used in Restructured Beef Products

S.J. Goll and C.L. Kastner

Summary

The dried weight of the material washed from meat surfaces by distilled water closely paralleled the binding strength between meat particles as measured by tensile strength testing. Sponges added to meat pieces during mixing were a poor estimation of protein extraction and binding strength.

Introduction

Processing meat pieces into restructured products that resemble intact roasts, steaks, and chops is a popular way of merchandising less valuable portions of a carcass. Mixing (massaging or tumbling) meat pieces brings soluble proteins to the surface. Adding salt enhances that protein extraction. The extracted, creamy, tacky proteins coat the meat particles, and upon cooking, will bond the meat particles together. The proper amount of extracted protein is important; either too much or too little will cause the meat particles to bind poorly.

For adequate quality control of restructured products, a method for measuring binding proteins is essential. Since a fast, reliable measurement does not exist, our objective was to evaluate techniques for the rapid quantitation of extracted proteins in a mixed meat system.

Experimental Procedures

Four A-maturity steers (two USDA Choice, two USDA Good) were slaughtered at the KSU meat laboratory. One side of each carcass was hot boned (HB) 1 hr postmortem and the other conventionally cold boned (CB) 24 hr after slaughter following chilling at 37 F. The clod and inside round from each side were removed, trimmed of all visible fat and heavy connective tissue, and ground through a three-hole kidney plate that yielded large, irregular chunks (3.7 x 1.8 cm). We formulated three batches intended to produce high, intermediate, and low levels of protein extraction. Salt aids in protein extraction, and HB meat yields more extractable protein than CB meat. Thus, for the high binding level (H) batch we added 2% salt to HB meat. The intermediate level (I) was achieved by adding salt to CB meat, and the low level (L) was obtained by using CB meat with no added salt. The batches were mixed for 15 minutes in a Hobart mixer equipped with a dough hook.

Two techniques were then used to measure the differences in extracted protein.

The sponge technique: We theorized that a dried cellulose sponge placed with the meat pieces during mixing would take up the extracted proteins in proportion to how meat particles were coated by those proteins. Therefore, six preweighed, 1-inch cubes of dried sponge were added to each meat batch for the 15-min mixing cycle. The sponges were then removed, weighed wet, and weighed again after drying for 24 hr. The initial dry weight of the sponge was subtracted from both weights. All dried sponges were analyzed for percent crude protein.

The rinse technique: We also theorized that the protein brought to the surface by mixing could be washed from the meat pieces using water and vigorous agitation. Therefore, three 50-gm samples of meat pieces were randomly selected from the mixing bowl before (control) and after the 15-min mixing cycle.

The samples were placed in flasks and 100 ml of distilled water were added to each flask. The flasks were corked and placed on a shaker table for 1 minute. The flask contents were then strained through cheese cloth and the fluid was collected. Three 10 ml samples of this fluid were placed in preweighed aluminum trays, dried for 24 hr, and weighed. The remaining fluid was saved for crude protein analysis. Dry matter and protein content of extracts from unmixed meat were subtracted, so that results represented only material brought to the meat surface during mixing.

After the extracted protein was measured, the three meat batches were stuffed individually into 6.5 inch diameter prestuck casings and pressure clipped with a polyclip machine to create restructured "roasts". The roasts were steam cooked in a Vortron smokehouse for 45 min @ 130 F then 45 min @ 150 F, and held at 180 F until an internal temperature of 145 F was reached.

Physical test of binding: An Instron Universal Testing Machine was used to measure the strength of binding between the cooked meat pieces. One such measure was a compression test, in which a 1.0 inch diameter x 1.0 inch long core of cooked, restructured roast was placed between two compression plates and compressed 75% of its height (0.75 inch on the first stroke) and then decompressed. A graph of force vs. distance traveled resulted. Then a second compression was run. The ratio of the area under the first graph divided by the area under the second graph estimated the cohesiveness of the meat pieces. Higher values represent greater cohesion.

The tensile strength test involved measuring the force required to pull apart a strip of finished roast 1.0 in wide x 0.25 in thick. The force required was an estimate of the cohesion between meat pieces and was recorded from a curve as the height of the peak at the breaking point.

Results and Discussion

Table 16.1 shows that roasts made from HB and CB muscle with added salt (H and I) had greater tensile strengths (more extracted protein) than L roasts. Therefore, the differences that we attempted to create in binding were partially achieved. Because of the similarity of means and magnitude of standard deviations, compression testing does not clearly separate differences in binding strength.

The sponge method (wet or dry) does not appear to absorb the protein proportionally to meat binding (Table 16.1). The amount of crude protein absorbed by sponges was inverse to tensile strength measures. This appeared to be due to different rates of moisture penetration into and evaporation out of the sponge among treatments, which reduced the reliability of this technique.

Dried weight of fluid from the rinse technique may be useful for measuring extracted protein (Table 16.1). The dry weight means for H and I are similar, but greater than those for L. This trend corresponds to tensile strength measures. The percent protein means do not appear to follow the same trend as do tensile strength means. Even though the percent protein means appear to have a reversed trend, based on the magnitude of the standard deviations, those means are likely not statistically different.

The rinse technique shows the most potential for use as a measure of extracted protein and binding strength of restructured products. However, more research should be done to determine its validity and application in other meat systems, which differ in particle size, ingredients, and restructuring methodology.

Table 16.1. Measurements of Meat Binding Properties by Treatment

Measures	Binding Level[a]		
	High (H)	Intermediate (I)	Low (L)
Physical Force			
Compression[b] (kg)	5.90 ± 0.97	5.17 ± 0.74	4.65 ± 0.87
Tensile strength[c] (kg)	0.41 ± 0.11	0.36 ± 0.15	0.09 ± 0.05
Sponge			
Wet Weight[d] (gm)	5.28 ± 0.76	2.42 ± 0.15	4.42 ± 0.57
Dry Weight[e] (gm)	1.04 ± 0.10	0.55 ± 0.04	0.76 ± 0.08
Protein[f] (%)	56.38 ± 5.77	66.84 ± 3.37	76.67 ± 5.22
Rinse			
Dry Weight[g] (mg)	88.58 ±14.37	70.78 ±20.94	34.75 ±12.88
Protein[h] (%)	0.67 ± 0.08	0.77 ± 0.11	0.82 ± 0.10

[a] High = HB with salt; Intermediate = CB with salt, Low = CB without salt.
[b] Area under 1st curve-Area under 2nd curve.
[c] Peak height of the curve.
[d] Weight of the sponge after mixing minus initial sponge weight.
[e] Weight of the sponge after mixing and drying minus initial sponge weight.
[f] Crude protein percentage of sponge after mixing and drying.
[g] Residue in 10 gm. rinse from mixed meat minus residue in 10 gm rinse from unmixed meat.
[h] Crude protein percentage of 10 ml of supernatant after rinsing.

Effects of Energy Level and Lasalocid on Productivity of Fall-Calving, First-Calf Heifers[1]

Terry Goehring, Larry Corah, and Jim Higgins[2]

Summary

Fall-calving, first-calf heifers (136 head) were fed TDN levels approximating 85% or 100% of NRC recommendations, with or without 200 mg/hd/day lasalocid. Those fed the recommended diet gained more weight from 130 days prepartum to calving and showed more improvement in condition score before calving than those on the low-energy diet. After calving, the group fed the recommended energy level lost less weight and condition and had better reproductive performance than the low-energy group. The only effect of lasalocid was to improve calf performance in the low-energy group.

Introduction

Dietary energy is the most expensive nutrient for the beef cow herd and is a major determinant of productivity. Ionophores such as lasalocid increase the efficiency of energy metabolism. Thus, supplementing beef cows with an ionophore may improve energy utilization and decrease feed costs. This research was conducted to determine the effects of two energy levels with and without lasalocid on productivity of first-calf heifers.

Experimental Procedures

Approximately 110 days before calving, 136 crossbred (Angus, Hereford, Brangus), first-calf heifers were assigned to four nutritional treatments: two levels of energy with and without lasalocid. Precalving diets were calculated to provide either 9.3 lbs of TDN per day or 11.0 lbs of TDN. Those levels represent 85 and 100%, respectively, of the NRC recommendation for a 725-750 lb heifer to gain 1.9 lbs/day during the last trimester of pregnancy. For approximately 130 days postcalving, diets were calculated to provide 11 or 13 lbs TDN (increased slightly above 85 and 100% of NRC recommendations, respectively, because of weather stress). Two supplements were formulated for each energy treatment to provide 0 or 200 mg lasalocid per head daily.

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[1]Appreciation is expressed to Hoffmann-LaRoche for supplying lasalocid (Bovatec®) and partial financial support.
[2]Department of Statistics.

The heifers calved between July 25, 1985 and January 2, 1986. Milk production was determined by the weigh-suckle-weigh method and milk samples were collected when calves born in a given month reached an average of 60 and 90 days of age. Postpartum performance was evaluated only on the 124 heifers nursing a calf for the duration of the trial. Heifers were inseminated artificially at the first observed estrus postcalving, and those returning to estrus were allowed two additional inseminations. Heifer-calf pairs were weighed off trial when: 1) conception occurred, 2) heifers had been inseminated three times, or 3) no signs of estrus had occurred by 120 days postpartum. The heifers were maintained in drylots both pre- and postcalving. A statistical technique (regression analysis) was used to estimate what weights 2 weeks precalving and condition scores at calving would have been, if heifers had been on their respective diets 90 or 130 days.

Results and Discussion

The main effects of energy level and lasalocid on precalving heifer performance are presented in Table 17.1. Heifers fed the recommended energy level gained .13 lb more per day (P=.08) than heifers fed the low energy level. Energy level had no effect on heifer weight at 2 weeks precalving or condition score at calving when estimated and compared at 90 days on trial. However, regression estimates for 130 days on trial showed that heifers fed the recommended energy level would have been 42 lbs heavier (P<.001) and would have had .4 units higher condition score (P<.01) than heifers fed the low energy level. Thus, reducing energy intake by 15% would be expected to influence heifer weight and body condition changes precalving but only after a prolonged precalving feeding period. Energy level had no influence on hip height or pelvic area changes precalving, calf birth weight, calving difficulty score, or gestation length (Table 17.1). Neither lasalocid nor the energy level x lasalocid combinations influenced data described above.

Heifer weight and condition changes postcalving are described in Table 17.1. At 130 days postcalving, heifers fed the recommended energy level weighed 37 lbs more (P<.05) and had .5 unit higher condition score (P<.001) than heifers fed the low energy level. This was a function of combined precalving energy effects followed by weight and condition loss (-30 lbs and -.3 units) during lactation among cows fed the low energy level. Postcalving weight and condition losses may have been minimized by the addition of lasalocid; however, treatment differences were usually nonsignificant.

The combined effects of energy level and lasalocid on milk production and calf performance were significant or approached significance at 60, 90, and 130 days postpartum (Table 17.2). Lasalocid supplementation to the low energy diet increased calf weight and average daily gain at 90 and 130 days, whereas supplementation to the recommended diet did not. Milk production response paralleled calf gain data. Calves nursing heifers fed the recommended diet weighed approximately 11 lbs more at 60, 90, and 130 days than those nursing cows fed either of the low energy diets (All P<.10). This advantage in weight gain was associated with a slight increase in milk production among cows fed the recommended level of energy.

Table 17.1. Least-Squares Means for Heifer Performance for Main Effects of Energy and Lasalocid

Item	Main Effects: Energy, % of NRC requirement 85%	100%	Lasalocid -	+
Initial wt, lb	722	719	720	721
Precalving days on trial	108	109	109	108
Precalving ADG, lb	1.74	1.87	1.80	1.83
Heifer wt two weeks precalving, lb[1]				
90 days on trial	882	884	882	887
130 days on trial	935[a]	977[b]	953	959
Condition score at calving[1,2]				
90 days on trial	5.2	5.3	5.3	5.2
Change from initial	.02	.12	.15	.07
130 days on trial	5.4[c]	5.8[d]	5.7	5.5
Change from initial	.18[e]	.37[f]	.29	.25
Hip height, in				
At calving	46	46	46	46
Change from initial	1.1	1.2	1.2	1.1
Pelvic area, cm^2				
Precalving	279.7	281.9	279.3	282.3
Change from initial	57.1	61.9	60.7	58.3
Calf birth wt, lb	60.3	62.3	61.4	61.2
Calving difficulty score[3]	1.3	1.4	1.4	1.3
Gestation length, days[4]	279	280	280	279
Cow wt, lb				
130 days postcalving	790[e]	827[f]	796	823
Change from calving[5]	-30.0[c]	0[d]	-20.0	-9.5
Body condition score[2]				
130 days postpartum	5.0[a]	5.5[b]	5.2	5.4
Change from calving	-.3[c]	0[d]	-.3[e]	-.1[f]

[1] Heifer weight and condition score data at 90 or 130 days on trial were estimated and compared by regression analysis.
[2] 1 = emaciated to 9 = obese.
[3] 1 = unassisted to 2 = hand assistance.
[4] Evaluated on 46 head.
[5] As determined from weights and body condition evaluation by 24 hr and 130 days postpartum.
[ab] Uncommon superscripts within a main effect differ (P<.001).
[cd] Uncommon superscripts within a main effect differ (P<.01).
[ef] Uncommon superscripts within a main effect differ (P<.05).

Percentage milk fat was not influenced by the individual nor combined effects of energy and lasalocid at 60 or 90 days (data not presented). Milk protein was .2% ($P<.05$) and .1% ($P=.14$) higher at 60 and 90 days, respectively, in milk samples from heifers fed recommended vs low energy diets.

A 15% reduction in energy intake from a level considered adequate decreased ($P<.05$) cycling activity by 18 percentage units during the 120 days when estrus was detected (Table 17.3). That reduction in cycling activity contributed to a 25 percentage unit decrease ($P<.01$) in overall pregnancy rate. The days from calving to first estrus (postpartum interval) did not differ between energy levels; however, if estrus detection had continued indefinitely, the postpartum interval of heifers fed the low energy level would probably have been longer and would have varied more about the mean in comparison with heifers fed the recommended energy level. Although heifers fed the recommended energy level maintained weight and condition score (5.5), 22% had not cycled by 120 days, which lead to a 74% overall pregnancy rate. Thus, fall-calving, first-calf heifers with a condition score of 5 at calving probably need to gain weight and condition during lactation for optimum reproductive performance. This study suggests that the level of energy recommended by NRC for postpartum heifers is too low for fall-calving heifers and dramatically illustrates the limitation of using NRC recommendations as absolute values. Additionally, results of a statistical analysis of the reproductive data (see pg. 55 in this report) suggest that a conditon score of 6 at calving is required for optimum postpartum reproduction in fall-calving, first-calf heifers.

Fertility, expressed as days to conception, inseminations per conception, and first-service or overall conception rates did not differ between energy levels (Table 17.3). Neither lasalocid nor the energy level x lasalocid combinations influenced reproductive performance described above.

Table 17.2. Least-Squares Means for Milk Production and Calf Weights on Various Days Postcalving for Combined Effects of Energy and Lasalocid

	Combined Treatments			
Item	LE-C	LE-L	HE-C	HE-L
60 Days				
24 hr milk, lb	11.2	12.3	13.2	12.0
Calf wt, lb	132	142	148	144
Calf ADG, lb	1.14	1.23	1.28	1.23
90 Days				
24 hr milk, lb	10.8	11.9	12.5	12.3
Calf wt, lb	165[ac]	185[d]	187[b]	183[d]
Calf ADG, lb	1.14[ce]	1.30[d]	1.3[d]	1.28[f]
130 Days				
Calf wt, lb	230[a]	252[b]	258[b]	253[b]

[ab]Uncommon superscripts within a main effect differ ($P<.01$).
[cd]Uncommon superscripts within a main effect differ ($P<.05$).
[ef]Uncommon superscripts within a main effect differ ($P<.10$).

Table 17.3. Least-Squares Means and Percentages for Reproductive Data for Main Effects of Energy and Lasalocid[1]

Item	Main Effects			
	Energy		Lasalocid	
	LE	HE	C	L
Cycling activity by 120 days postpartum, %	60[c] (36/60)	78[d] (50/64)	70 (45/64)	68 (41/60)
First-service conception rate, %[2]	54 (19/35)	65 (32/49)	64 (29/44)	54 (22/40)
Overall conception rate, %[3]	88 (28/32)	98 (45/46)	95 (40/42)	92 (33/36)
Overall pregnancy rate, %[4]	49[a] (28/57)	74[b] (45/61)	64 (40/62)	59 (33/56)
Interval from calving to:				
First estrus, days	69	63	63	69
Conception, days	77	71	71	77
Inseminations/conception	1.4	1.3	1.3	1.4

[1] Values in parenthesis were used in calculating percentages. Six cows were not given the opportunity for three inseminations and were excluded from overall conception and pregnancy rate calculations.

[2] Number conceiving to first insemination/number inseminated.

[3] Number conceiving by third insemination/number inseminated.

[4] Number conceiving by third insemination/number on trial.

[ab] Uncommon superscripts within a main effect differ ($P<.01$).

[cd] Uncommon superscripts within a main effect differ ($P<.05$).

Factors Predicting the Probability of Estrus and Pregnancy

Terry Goehring, Larry Corah, and Jim Higgins[1]

Summary

A statistical analysis was used to determine which live animal traits are useful in predicting reproductive performance in first-calf heifers. Heifer condition score at calving and change in condition score postcalving, calving difficulty score, and milk production were related to the probability of estrus and pregnancy. Condition score at calving had the greatest impact and, to a great extent, moderates the influence of the other traits.

Introduction

Numerous research trials have identified nutritional, environmental, management, health and genetic factors that influence reproductive performance of beef females. Since the impact of a given factor is often herd-specific and complexly interrelated with other factors, it is difficult to predict the reproductive performance of a beef cow herd. This report is the result of a statistical analysis to determine the probability of estrus and pregnancy using data from first-calf heifers.

Experimental Procedures

Data were collected in a trial evaluating the effects of energy level and lasalocid on productivity of first-calf heifers (see pg. 50 in this report). This analysis capitalized on natural variation between individual heifer-calf performance as modified by nutritional treatments. A logistic multiple regression procedure was used to find which live traits influenced the probability of estrus and pregnancy by 120 days postcalving. Variables considered initially included heifer weight and condition score changes pre- and postcalving, condition score at calving, calving difficulty score, heifer backfat thickness precalving, and milk production and calf weights at 60 days postcalving. Mean, minimum, and maximum values of those characteristics are presented in Table 18.1. The analysis measured how much each characteristic contributed to the model's accuracy and eliminated or retained those variables accordingly.

Results and Discussion

Information was collected on about 100 heifers; 35 anestrus and 65 estrus, 41 open and 57 pregnant. Preliminary analyses indicated that condition score at calving, calving difficulty score, and condition score at calving were of value in predicting both estrus and pregnancy. Milk production was significant when it was

[1] Department of Statistics.

above or below the mean. Intercepts and regression coefficients for the variables selected in the analyses (Table 18.2) were used in calculating the predicted probabilities of estrus and pregnancy (Table 18.3).

The impacts of individual characteristics were largely a function of their associated regression coefficient. Condition score at calving had the greatest impact on the probability of estrus and pregnancy and, to a great extent, moderated the influence of the other characteristics. For example, if calving difficulty score and condition score change postcalving were held constant, milk production had progressively less impact on reproductive performance as condition score at calving was increased. Additionally, calving difficulty had a greater negative impact on reproductive performance in nutritionally stressed (low condition score) heifers. This seems logical, since a heifer in good condition (condition score 6) at calving has more body reserves available for production or accommodation to a stress such as calving difficulty. Finally, an increase in condition score postcalving will offset, to some degree, the negative influence of calving difficulty, heavy milk production, and/or a low condition score at calving.

These models are useful only for data within the range of those collected. However, certain broad conclusions can be reached. Numerous genetic and non-genetic factors influence the incidence and severity of calving difficulty. Therefore, use of genetic information compiled by breed associations, careful attention to breed complementarity, and proper heifer development should be considered when attempting to minimize calving difficulty in a herd. Since milk production influences reproductive performance, the interrelationship of milk production and available feed resources also must be considered. Finally, heifer/cow condition scores should be evaluated several times throughout the year in order to use feed economically but not sacrifice reproductive performance.

Table 18.1. Values of Continuous Variables Initially Included in Logistic Regression Models Predicting the Probability of Estrus or Pregnancy

Variable	Mean	Minimum	Maximum
Wt. Change Prepartum, lb	167	46	269
Condition Score Change Prepartum[1]	.1	-1	1.3
Condition Score at Calving[1]	5.3	4	7.7
Calving Difficulty Score[2]	1.3	1	3
Backfat 90 d on Trial, in	.25	.12	.71
Milk Production at 60 d, lb	12.3	2.6	25.3
Calf Wt. at 60 d, lb	146	90	243
Wt. Change Postpartum, lb	4	136	145
Condition Score Change Postpartum[1]	-.11	-1.7	1.2

[1]Body condition scores: 1 = emaciated to 9 = obese.
[2]Calving difficulty scores: 1 = unassisted to 3 = mechanical assistance.

Table 18.2. Logistic Regression Modesl[1] Predicting the Probability of Estrus or Pregnancy

Variable	Estrus RC[2]	Estrus P	Pregnancy RC[2]	Pregnancy P
Condition Score at Calving	2.35	.0001	1.55	.001
Calving Difficulty Score	-.73	.04	-.71	.04
Condition Score Change Postpartum	1.20	.01	.90	.03
Milk category[3]	-.52	.05	-.45	.06

[1] Intercepts of the models predicting estrus and pregnancy were -10.4 (P=.0006) and -6.8 (P=.006), respectively.
[2] Regression coefficient.
[3] Categorized and coded into the model as below (-1) and above (1), respectively, the mean level of milk production at 60 d.

Table 18.3. Predicted Probabilities[1] of Estrus and Pregnancy for Certain Values of the Variables Selected by the Logistic Regression Model

Condition Score[2] at Calving	Calving Difficulty[3] Score	Change in Conditon Score Postpartum[2]	Milk Category[4]	Predicted Probability Estrus	Predicted Probability Pregnancy
4.0	1.0	1.0	1	.25	.31
4.0	1.0	1.0	-1	.49	.52
5.0	1.0	1.0	1	.77	.68
5.0	1.0	1.0	-1	.90	.83
5.0	1.0	-1.0	1	.25	.25
5.0	1.0	-1.0	-1	.48	.45
5.0	3.0	1.0	1	.46	.34
5.0	3.0	1.0	-1	.70	.56
6.0	1.0	.5	1	.95	.86
6.0	1.0	.5	-1	.98	.94
6.0	1.0	-.5	1	.85	.72
6.0	1.0	-.5	-1	.94	.86
6.0	2.0	.5	1	.91	.76
6.0	2.0	.5	-1	.97	.87

[1] Predicted probability = (natural logarithm of a)/(1 + natural logarithm of a). where a = Intercept + RC x condition score at calving + RC x change in condition score postpartum + RC x milk category + RC x calving difficulty score.
[2] 1 = emaciated to 9 = obese.
[3] 1 = unassisted to 3 = mechanical assistance.
[4] -1 = below and 1 = above, the mean level of milk production at 60 d.

Relationship of Age at Puberty and Postpartum Interval to Estrus in Angus x Hereford and Brahman x Hereford Females

D.J. Patterson, L.R. Corah, J.R. Brethour,[1] and W.R. Negus[1]

Summary

Records of age at puberty (AAP) and postpartum interval to estrus (PPI) for heifers calving first at 2 years of age were used to determine the relationship between the two reproductive parameters. In Brahman x Hereford (BxH) females, there was no relationship between AAP and PPI. In Angus x Hereford (AxH) females, PPI increased as AAP decreased. The data suggest that heifers heavier at weaning reach puberty younger, but PPI may be longer following their first calving. Heifers larger at weaning may need to be managed differently to improve performance during the first postpartum period.

Introduction

Numerous studies have dealt with age at puberty (AAP) and factors affecting the postpartum interval (PPI) in beef cattle; however, none has shown whether the two parameters are related. With this objective, we analyzed available data to determine whether a relationship exists between AAP and PPI.

Experimental Procedures

Records of AAP and PPI for heifers calving first at 2 years of age were used. Two biological types were represented in the original data set: 148 Angus x Hereford (AxH) and 148 Brahman x Hereford (BxH) females. Of these, 121 AxH and 97 BxH entered breeding herds following their first calf. After heifers were weaned, and continuing through their first breeding season, heifers within each breed group were assigned in a factorial design to one of two energy levels (high or low) and to one of two weight groups (heavy or light).

Puberty was determined by heifers meeting three criteria: 1) behavioral estrus, 2) presence of a palpable corpus luteum, and 3) rise in serum progesterone above 1 ng/ml. At the end of their first breeding season, heifers were transferred from drylot to pasture and nutritional treatments were discontinued. Postpartum interval length was defined as the period from calving to first observed estrus. A summary of the first year's puberty data was published in the 1986 Cattlemen's Day Report, whereas the postpartum data are presented on page 60 of this report.

[1]Fort Hays Branch Experiment Station.

Results and Discussion

Table 19.1 summarizes average ages at puberty and postpartum intervals for the various breed, energy level, and weight groups involved. Data were analyzed within breed and included only records for which both AAP and PPI were available. Pearson correlation coefficients between AAP and PPI were r=-.12 (P=.20) for AxH and r=.05 (P=.71) for BxH females. Eliminating animals from the analyses that experienced dystocia yielded correlations of r=-.27 (P=.02) for AxH and r=.06 (P=.65) for BxH heifers. Analysis of variance indicated that PPI among AxH heifers (n=73) was influenced most by weight at the start of the trial (P=.01), and not energy level (P=.23) or energy level x weight group interaction (P=.48). After weight group was accounted for, the correlation between AAP and PPI for AxH heifers was -.19 (P=.11). Hence, although there was a negative relationship between AAP and PPI among AxH females, no such relationship was found for BxH heifers.

Table 19.1. Age at Puberty and Postpartum Interval to Estrus Summary[1]

Energy Level[2] and Weight Group	Beginning Weight (lbs)	Age at Puberty (days)	Weight at Puberty (lbs)	PPI Length (days)
		Angus x Hereford		
Low Target Wt. Light group	442	365	543	80.1
Low Target Wt. Heavy group	516	358	564	90.5
High Target Wt. Light group	436	376	592	78.5
High Target Wt. Heavy group	504	348	590	84.3
		Brahman x Hereford		
Low Target Wt. Light group	426	328	540	77.4
Low Target Wt. Heavy group	502	348	571	74.4
High Target Wt. Light group	431	340	598	75.9
High Target Wt. Heavy group	505	338	613	79.2

[1] Least squares means.
[2] Heifers had been nutritionally manipulated so that they weighed 55% (low energy) or 65% (high energy) of their expected mature weight at the start of their first breeding season.

Calving and Reproductive Performance of Angus x Hereford and Brahman x Hereford Heifers Fed to Prebreeding Target Weights

D.J. Patterson, L.R. Corah,
J.R. Brethour,[1] and W.R. Negus[1]

Summary

The effect of heifer development on first calving and subsequent reproductive performance was evaluated in Angus x Hereford (AxH) and Brahman x Hereford (BxH) females. Heifers were fed to reach either 55% or 65% of their projected mature body weight by the start of their first breeding season. After breeding, the heifers were managed as a typical commercial range beef cow herd.

Angus x Hereford heifers developed to the higher prebreeding target weights: 1) were heavier ($P<.05$) at calving; 2) had larger ($P<.05$) total precalving pelvic areas; and 3) had higher ($P<.05$) average postcalving body condition scores. Precalving pelvic areas were also greater ($P<.05$) among BxH females developed to the higher prebreeding target weight. Angus x Hereford heifers fed to the low target weight experienced 23.5% more calving problems (52.3 vs 28.8%). Only 11.3% of the BxH heifers required assistance at calving, and calving difficulty was not related to nutritional level. Postpartum interval to estrus (PPI) was longer among low target AxH heifers, but not in BxH heifers. Calf weaning weight was not affected by heifer development; however, weights were heavier for calves raised by the BxH heifers.

These data suggest that differences in weight and condition prior to first breeding persist through to the heifer's first calving and postpartum period.

Introduction

Properly managed replacement heifers must exhibit estrus and conceive early during their first breeding season, then continue developing until they are rebred following their first calf. Choosing a correct target weight for the beginning of the first breeding season, therefore, becomes critical.

We evaluated reproductive performance of two different biological types of beef females fed to reach target percentages of their projected mature body weight by the start of their first breeding season. The first year's reproductive data (puberty and pregnancy) were published in the 1986 Cattlemen's Day Report. The present report includes calving and postpartum data, weaning weight data, and fall pregnancy rates.

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[1]Fort Hays Branch Experiment Station.

Experimental Procedures

A project was designed in the fall of 1984 to evaluate the effects of breed cross and heifer development as affected by nutrition on lifetime productivity and reproductive performance. The trial began with 148 F_1 AxH and 148 F_1 BxH heifer calves from ranches throughout Kansas, east-central Colorado, and north-eastern Oklahoma.

At the start of the trial, heifers within each breed group were randomly allotted to one of two nutritional treatments based on origin and birth date. Within each treatment, heifers were divided into light (below average) and heavy weight (above average) groups based on initial weight. Two nutritional treatments were designed to allow both light and heavy heifers to reach either 55% or 65% of their projected mature body weight by the start of spring breeding. Frame scores were used to predict mature weights. Nutritional treatments began December 5, 1984 and continued through June 29, 1985. Following a 45-day AI period, the heifers were transferred to the Fort Hays Branch Experiment station for a 35-day natural service cleanup period. Heifers failing to become pregnant were removed from the herd.

Heifers were maintained on native pastures through the fall. Winter supplementation included range cubes (20% crude protein) and cane hay. All heifers were supplemented at the same rate and were maintained as a group on summer native range.

Prior to calving, heifers were divided by breed group and relocated to one of two 30-acre calving pastures. Sheltered areas were available at both sites and heifers calved on pasture, except in cases of dystocia.

Following calving and through day 45 of the breeding season, heifers were observed at 4 to 6-hour intervals during daylight hours to determine postpartum estrus. Sterilized bulls with marking harnesses were used to aid in estrus detection. Blood samples were taken 7 days following observed estrus from each heifer; progesterone levels over 1 ng/ml of serum confirmed cycling.

Sterilized bulls were replaced by intact Hereford bulls May 20, at which time a 70-day natural service breeding period began. Cows were pregnancy checked, weighed, and condition scored in October. Calves were weaned in November.

Results and Discussion

Table 20.1 summarizes pre- and postcalving weights, precalving pelvic areas, and postcalving body condition scores of the 131 AxH and 102 BxH heifers that calved. Precalving weights for both breed groups were greater ($P<.05$) among heifers fed to the higher prebreeding target weights, with differences ($P<.05$) also seen between weight groups within treatment among the BxH heifers. Differences in precalving pelvic areas ($P<.05$) paralleled precalving weights for both breed groups. In addition, postcalving weights and body condition scores were greater ($P<.05$) for AxH heifers developed to the higher prebreeding target weight.

Table 20.1. Pre- and Post-calving Summary of Heifer Weights, Pelvic Areas, and Body Condition Scores[1]

Energy Level and Weight Group	No. Calved (No.)	Precalving[2] Weight (lbs)	Precalving[2] Pelvic Area (sq cm)	Postcalving Weight (lbs)	Postcalving Body Condition Score[3]
		Angus x Hereford			
Low Target Wt.[4] (55%)	65	834^{A}	221.7^{A}	768^{A}	4.4^{A}
Light group	32	829	222.8	770	4.5
Heavy group	33	839	221.7	767	4.3
High Target Wt. (65%)	66	897^{B}	229.0^{B}	822^{B}	5.0^{B}
Light group	34	885	229.1	803	5.0
Heavy group	32	908	228.8	840	5.1
Total	131	864	225.4	795	4.7
		Brahman x Hereford			
Low Target Wt. (55%)	49	906^{A}	230.3^{A}	886	4.9
Light group	24	880^{a}	227.9	861^{ac}	4.9
Heavy group	25	932^{bc}	231.8	911^{bcd}	5.0
High Target Wt. (65%)	53	946^{B}	238.3^{B}	904	5.2
Light group	27	913^{cb}	234.5	877^{cab}	5.3
Heavy group	26	978^{d}	241.1	930^{db}	5.1
Total	102	926	234.5	895	5.1

[1]Least squares means.

[2]Weights and measurements taken January 15, 1986.

[3]Body condition scoring scale: 1=thin, to 9=obese.

[4]Nutrition was manipulated so that heifers weighed 55 or 65% of their expected mature weight at the start of their first breeding season.

[AB]Means with different superscripts within column and breed group differ (P<.05).

[abcd]Means with different superscripts within column and breed group differ (P<.05).

Table 20.2 provides averages for gestation length, birth weight, calving ease, calf death loss, and weaning weight. Of the total number of calvings, 89% resulted from artificial insemination using semen from a single Hereford sire. Cleanup bulls were half brothers to the AI sire. Thus, variation from sire was not included in the statistical analysis. No differences occurred between treatment groups regarding average gestation length or birth weight among calves born to heifers of either breed.

Calvings requiring assistance were nearly doubled ($P<.05$) among AxH heifers developed to the lower prebreeding target weight. Factors contributing to the increased incidence of dystocia included body condition score at calving and precalving pelvic areas, both of which differed ($P<.05$) between high and low groups (Table 20.1). In addition, dystocia occurred more frequently ($P<.05$) among births involving male calves and calves with heavier birth weights.

Although pre- and postcalving weights and body condition scores differed between high and low target BxH heifers, there were no differences in the incidence of dystocia. Furthermore, there was less dystocia among BxH than AxH females (11.3 vs 40.5%). This may be partially explained by larger precalving pelvic areas and lighter calf birth weights in relationship to cow weight.

There were no differences in calf loss attributable to breed, treatment, or weight groups. Nor were there any differences within breed regarding calf weaning weight. Weaning weights were heavier ($P<.05$), however, among calves raised by the BxH heifers.

Table 20.3 summarizes postpartum reproductive and rebreeding performance for both breed groups. A higher ($P<.05$) percentage of high target weight AxH females had cycled by the start of spring breeding compared to their low target contemporaries. In addition, heifers in the light-weight groups showed more rapid returns to estrus than those in the heavier-weight groups, based on percent cycling by day 21 of the breeding season.

AxH heifers that were assigned, based on weaning weight, to the low target-weight treatment group exhibited a trend toward longer postpartum intervals to estrus (85.3 vs 81.4) and reduced ($P<.05$) fall pregnancy rates. Similar differences were not seen in the BxH heifers.

The trend toward shorter postpartum intervals among the BxH heifers may have been due to the reduced incidence and severity of dystocia, and increased precalving weight and body condition. Fall pregnancy rates of the BxH heifers showed improvement over the previous year's results, suggesting that problems with cyclicity and subsequent pregnancy occur largely in their first year.

These data illustrate the importance of establishing target weights for use in heifer development, since those targets influence calving and subsequent reproductive performance, especially in the first postpartum reproductive cycle.

Table 20.2. Calving and Weaning Summary[1]

Energy Level and Weight Group	Gestation Length[2] (days)	Birth Weight (lbs)	Incidence of Dystocia[3] (No.)	(%)	Calf Death Loss[4] (No.)	(%)	Weaning Weight[5] (No.)	(lbs)
			Angus x Hereford					
Low Target Wt.[6] (55%)	281.9	70.9	34/65	52.3[A]	4	6.2	60	386
Light group	281.8	70.6	16/32	50.0[a]	1	3.1	30	382
Heavy group	282.2	71.3	18/33	54.5[a]	3	9.1	30	390
High Target Wt. (65%)	281.4	73.3	19/66	28.8[B]	3	4.5	61	392
Light group	281.4	72.6	10/34	29.4[b]	2	5.9	32	388
Heavy group	281.4	74.0	9/32	28.1[b]	1	3.2	29	397
Total	281.7	72.3	53/131	40.5	7	5.3	121	389
			Brahman x Hereford					
Low Target Wt. (55%)	282.3	70.3	6/49	12.2	1	2.0	47	454
Light group	282.8	69.1	2/24	8.3	1	4.2	23	446
Heavy group	281.7	71.5	4/25	16.0	-	--	24	461
High Target Wt. (65%)	282.8	71.3	6/53	11.3	3	5.7	50	450
Light group	282.8	69.8	1/27	3.7	1	3.7	26	442
Heavy group	282.8	72.7	5/26	19.2	2	7.7	24	459
Total	282.6	70.8	12/102	11.8	4	3.9	97	452

[1] Least squares means.
[2] Based on breeding and calving dates, 125 of 131 AxH heifers and 82 of 102 BxH heifers conceived during the 45-d artificial insemination period; therefore, 207 of 233 calves born were half sibs. Breeding dates were unavailable for 7 heifers that conceived during the natural service cleanup period.
[3] Calving difficulty scores: 1=normal unassisted delivery, 2=hand pull, 3=mechanical puller, 4=cesarean section, 5=abnormal presentation.
[4] Of total death losses, 8 occurred at parturition, and 3 within 7d following calving. One BxH and three AxH heifers were removed from the trial for abandoning their calves.
[5] Calves were weaned Nov. 13, 1986.
[6] See footnote 4, table 20.1.
[AB] Means with different superscripts within column and breed group differ (P<.05).
[ab] Means with different superscripts within column and breed group differ (P<.05).

Table 20.3. Postpartum Reproductive and Fall Pregnancy Summary[1]

Energy Level and Weight Group	Number of Animals	Percent cyclicity: Breeding Season Day 1 (%)[2]	Breeding Season Day 21 (%)	Breeding Season Day 45 (%)	PPI[3] (days)	Fall Pregnancy Rate (%)[4]
		Angus x Hereford				
Low Target Wt. (55%)	60	15.0^{A}	81.7	90.0	85.3	85.0^{A}
Light group	30	23.3^{a}	90.0^{a}	93.3	80.1^{a}	93.3^{a}
Heavy group	30	6.7^{b}	73.3^{b}	86.7	90.5^{b}	76.7^{b}
High Target Wt. (65%)	61	32.8^{B}	91.8	98.4	81.4	93.4^{B}
Light group	32	40.6^{c}	100.0^{a}	100.0	78.4^{a}	96.9^{a}
Heavy group	29	24.1^{ad}	82.8^{b}	96.6	84.3^{ab}	90.0^{a}
Total	121	24.0	86.8	94.2	83.0	89.3
		Brahman x Hereford				
Low Target Wt. (55%)	47	8.5	61.7	91.5	75.9	91.5
Light group	23	4.3	52.2^{a}	91.3	77.4	95.7
Heavy group	24	12.5	70.8^{b}	91.7	74.4	87.5
High Target Wt. (65%)	50	2.0	60.0	84.0	77.6	92.0
Light group	26	0.0	50.0^{a}	80.8	75.9	92.3
Heavy group	24	4.2	70.8^{b}	87.5	79.2	91.7
Total	97	7.5	60.8	87.6	76.7	91.8

[1]Least squares means.

[2]Breeding season began May 20, 1986.

[3]Average postpartum interval lengths represent only females exhibiting estrus by day 45 of the breeding season.

[4]Cows losing calves were removed from the herd.

[AB]Means with different superscripts within column and breed group differ ($P<.05$).

[abc]Means with different superscripts within column and breed group differ ($P<.05$).

Effects of MGA[1] and Prostaglandin on Estrus Induction and Synchronization in Cows and Heifers[2]

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Summary

Four trials were conducted to evaluate the effectiveness of Melegestrol Acetate (MGA®) and prostaglandin (PGF) in inducing and synchronizing estrus.

In trial 1, treated heifers were fed MGA for 7 days and given a PGF injection on either the first or last day of MGA feeding. The 7-day estrus response was higher (P<.01) for treated heifers than untreated controls.

In trial 2, treated cows were fed MGA for 7 days and given a PGF injection on the last day of MGA feeding or 13 days after the last day of MGA feeding. The 7-day estrus response was also higher (P<.01) in treated cows.

In trial 3, 59 cows were fed MGA for 7 days followed by a PGF injection, and exposed to bulls for 66 days. The MGA-PGF treatment was ineffective in synchronizing estrus and hastening conception.

In trial 4, feeding MGA for 7 days successfully synchronized estrus in cycling cows, but first service conception rates were reduced by 10% in the Kansas study and by 16% in a four state study.

Introduction

Estrus synchronization increases the number of females that can be inseminated or mated naturally during a short period, thus increasing the number of cows bred early in the breeding season or making artificial insemination (AI) more practical. Some synchronization products are costly and others require large amounts of labor. Melegestrol Acetate (MGA®), an orally active progestin, has traditionally been used to suppress estrus and increase gain and efficiency in feedlot heifers. It is inexpensive (2 to 3 cents per day) and easy to administer. Research in the 1960's showed MGA successfully synchronized estrus. However, at

[1] MGA is a progestational steroid that is approved for use in feedlot heifers and is marketed by the Upjohn Company.

[2] Sincere appreciation is expressed to Joe Thielen and Family, Dorrance, Ks for providing cattle, facilities, and management for Trials 1 and 2; to Gardiner Angus Ranch, Ashland, Ks for providing the bulls used in Trial 3; and to R. L. Dickinson, Dickinson Simmentals, Gorham, Ks for providing cattle, facilities and management for Trial 4.

that time MGA was fed for 16 to 18 days, which tended to impair first service conception rates. Recent research has shown that feeding MGA for 7 to 9 days combined with a prostaglandin (PGF) injection, synchronizes and induces estrus without lowering first service conception rates below satisfactory levels. Progestin administered prior to the breeding season also increases cyclicity in some non-cycling females, particularly heifers.

We conducted four trials, three with artificial insemination (AI) and one with natural mating, to determine the effectiveness of combined MGA feeding and PGF injection for estrus synchronization.

Experimental Procedures

Trial 1: One hundred seven crossbred heifers were allotted to 1) untreated control, 2) 7 days of MGA feeding (0.5 mg/head/day) with a PGF injection (5 ml Lutalyse[5]) on the last day (MGA-PG7), and 3) 7 days of MGA feeding with a PGF injection on the first day (PG1-MGA). The MGA was incorporated into 1 lb of ground milo.

Heifers were heat checked three times daily and those detected in estrus were inseminated approximately 12 hours later. Heifers were AI'd for 21 days followed by exposure to clean-up bulls for 50 days. Pregnancy and conception rates were determined by fetal aging via rectal palpation.

Trial 2: One hundred forty-nine crossbred cows were allotted to 1) untreated control, 2) PGF injection given 13 days after 7 days of MGA feeding (MGA-13-PG), and 3) PGF injection given on the last (7th) day of MGA feeding (MGA-PG7). All cows were on pasture. Because of previous problems with inadequate MGA consumption on lush spring pasture, treated cows were gathered into a small lot and given MGA (0.66 mg/head/day), incorporated into 2 lb of ground milo and fed in bunks.

Cows were heat checked three times daily and those detected in estrus were inseminated approximately 12 hours later. Synchronized cows were AI'd for 7 days while control cows were AI'd for 21 days. All cows were exposed to clean-up bulls for 130 days. Pregnancy and conception rates were determined by fetal aging via rectal palpation.

Trial 3: This trial was conducted to determine if naturally mated cows treated with MGA + PGF (MGA-PGF, n=59) conceived earlier in the breeding season than naturally mated non-synchronized cows (Control, n=119). MGA (0.75 mg/head/day) was fed in 1.5 lb cubes daily for 8 days. The PGF injection (5 ml Lutalyse) was given on the last day of MGA feeding. Prior to the breeding season, all 178 Hereford and Angus x Hereford cows had blood samples taken 10 days apart. Cows with less than 1 ng/ml serum progesterone at both bleedings were considered non-cycling. Cows were weighed and condition scored prior to allotting to treatment.

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[5]Lutalyse is a prostaglandin developed and marketed by the Upjohn Company.

Because three equal sized pastures (about 640 acres each) were available, MGA-PGF cows were kept in one pasture and control cows were split into two equal groups (n=approx. 60), one group per pasture.

During the 66-day breeding season, each group (two control, one MGA-PGF) was exposed to two yearling Angus bulls. Bulls were fitted with chin ball markers for the first 7 days of the breeding season so cycling activity could be checked.

To determine breeding activity, each group of cows was checked for at least 1 hour each morning and evening during the first 7 days of the breeding season. Any cows observed being bred or marked were recorded. Date of conception was estimated by fetal aging via rectal palpation.

Trial 4: One hundred cows were allotted to 1) untreated control (n=29), or 2) 7 days of MGA feeding (0.5 mg/hd/day) with a PGF injection on the last day (MGA-PG7, n=71). Cows were AI'd after estrus detection for 21 days. First service conception rates were based on 7-day estrus response in treated cows and 21-day estrus response in the control cows.

This same experiment was conducted at 3 other locations in the United States as part of a four-state project with a total of 397 cows and heifers being involved in an identical experimental design.

Results and Discussion

Trial 1: Results shown in Table 21.1 indicate that the 7-day estrus response was higher ($P<.01$) for both groups of treated heifers than for untreated controls. Degree of synchrony, first service conception rates and overall pregnancy rates were similar across all three groups. Both combinations of MGA and PGF were successful in synchronizing estrus. The PG1-MGA treated group had a slightly higher first service conception rate than the other two groups.

Table 21.1. Effect of MGA and PGF on Reproductive Parameters of Heifers

Treatment	No. Heifers	Estrus Response[1] 7-day	Estrus Response[1] 21-day	Degree of Synchrony[2]	1st Service Conception Rate[3]	Overall Pregnancy Rate[4]
PG1-MGA	15	12/15=80%[b]	14/15=93.3%	6/12=50.0%	7/12=58.3%	15/15=100%
MGA-PG7	52	37/52=71.2%[b]	50/52=96.2%	17/37=45.9%	14/37=37.8%	47/52=90.4%
Control	40	13/40=32.5%[a]	38/40=95%	-----	19/38=50%	35/40=87.5%

[ab]Numbers within columns with different superscripts differ ($P<.01$).
[1]Estrus response = females in estrus/number treated.
[2]Degree of synchrony = number in estrus in peak 24 hr/number in estrus.
[3]Conception rate = number conceived to AI/number inseminated.
[4]Overall pregnancy rate = number conceived during the total breeding season/number treated.

Trial 2: Results in Table 21.2 indicate that the 7-day estrus response was higher (P<.01) for both groups of treated cows than for the untreated controls. The average days postcalving, degree of synchrony, conception rates and overall pregnancy rates were similar across all three groups.

The low percentage of treated cows showing estrus within 7 days was attributed to the low percentage of cows cycling. Only about 21% of control cows cycled within 21 days.

Table 21.2. Effect of MGA and PGF on Reproductive Parameters of Cows

Treatment	No. Cows	Days Postcalving 5/27/86	Estrus Response[1] 7 day	Estrus Response[1] 21 day	Degree of Synchrony[2]	1st Service[3] Conception Rate	Overall[4] Pregnancy Rate
MGA-PG7	52	69.7	19/52=36.5%	----	8/19=42.1%	12/19=63.2%	49/52=94.2%
MGA-13-PG	49	72.2	20/49=40.8%	----	12/20=60.0%	9/20=45%	46/49=93.9%
Control	48	71.4	5/48=10.4%	10/48=20.8%	-----	4/10=40.0%	46/48=95.8%

[ab]Numbers within columns with different superscripts differ (P<.01).
[1]Estrus response = females in estrus/number mated.
[2]Degree of synchrony = number in estrus in peak 24 hr period/number in estrus.
[3]Conception rate = number conceived to AI/number inseminated.
[4]Overall pregnancy rate = number conceived during the total breeding season/number in the group.

Trial 3: Table 21.3 indicates that a higher percentage of Control cows were cycling compared to MGA-PGF cows, even though their average days postcalving was only 4 days greater. Weights and condition scores prior to breeding season were similar for both groups. More importantly, Table 21.3 shows that cows did not respond to the MGA-PGF treatment. Only 8% of the cows were observed bred during the first 7 days of the breeding season. Lack of a response to treatment is not explainable.

Even though less than half of the cows in either group were cycling prior to the breeding season, most of the cows eventually cycled and became pregnant, as indicated by the low number of open cows. Based on fetal aging, the average date of conception for both groups was June 15, 26 days after the start of the breeding season. In this trial the MGA-PGF treatment was ineffective in increasing the number of cows conceiving early in the breeding season.

Trial 4: Results shown in Table 21.4 indicate that 59% of the MGA-PG7 treated cows showed estrus within 7 days as compared to only 17% of the control cows. This compared to 68% and 32% considering all 4 state locations. First service conception rates were reduced by 10% (45% vs. 55%) in the Kansas trial and by 16% (50% vs. 66%) in the four-state summary.

Table 21.3. Summary of Natural Mated Control and MGA-PGF Treated Cows

Treatment	No. Cows	Prior to Breeding Season: Avg. Days Postcalving	Prior to Breeding Season: % Cows Cycling	Prior to Breeding Season: Avg. Wt. (lb)	Prior to Breeding Season: Avg. C.S.	1st 7 Days of Breeding Season: % Cows Observed Bred	1st 7 Days of Breeding Season: % Cows Marked but not Observed Bred	After Breeding Season: Avg. Days Pregnant	After Breeding Season: % Open
MGA-PGF	59	57	32%	910	4.7	8%	5%	122	3%
Control	119	61	45%	913	4.7	8%	13%	122	4%

Table 21.4. Effect of MGA and PGF on Reproductive Parameters of Cows

Treatment	No. Cows	Estrus Response 7-day	Estrus Response 21-day	1st Service Conception Rate
MGA				
Upjohn	52	40/52=77%	45/52=87%	19/40=48%
Ohio	50	34/50=68%	39/50=78%	17/34=50%
Kansas	71	42/71=59%	55/71=77%	19/42=45%
Virginia	50	36/50=72%	49/50=98%	21/36=58%
Overall	223	152/223=68%	188/223=84%	76/152=50%
Control				
Upjohn	52	17/52=33%	45/52=87%	30/45=67%
Ohio	49	14/49=29%	37/49=76%	25/37=68%
Kansas	29	5/29=17%	20/29=69%	11/20=55%
Virginia	44	22/44=45%	43/44=98%	29/43=67%
pverall	174	56/174=32%	145/174=83%	95/145=66%

Evaluating Serving Capacity of Yearling Beef Bulls - A Field Trial[1]

Garth Boyd and Larry Corah

Summary

Results from two trials showed that serving capacity (SC) can be successfully evaluated in yearling beef bulls under field conditions and is influenced by sire line (P<.01). Also, providing sexual experience to low SC yearling bulls can improve SC and should be a standard part of the test. Scrotal circumference and breeding soundness examination scores, both traditional measures of bull fertility, were unrelated to SC.

Introduction

Most cows are still bred by natural mating, so success depends on the reproductive capacity and fertility of the bulls used. As a measurement of fertility, many beef bulls undergo a breeding soundness examination prior to either sale or breeding. This examination involves visual and manual examination of the genital system and assessment of semen. However, sex drive, which is essential for successful mating, is not measured.

In research trials, pregnancy rates of cow herds have varied from 0 to 100%, when using bulls of similar and acceptable scrotal size and seminal traits. The differences in pregnancy rates were due to differences in the bulls' serving capacity (SC) or sexual efficiency during mating.

Several methods for testing the sex drive or SC of beef bulls have been reported but the most accurate and useful test was developed by an Australian scientist, Dr. Mike Blockey. High heritability estimates for SC have been reported but the influence of sire line on SC, and whether providing sexual experience to virgin bulls affects their subsequent SC has not been evaluated. More important, it has not been demonstrated in the U.S. that SC can be measured practically under field conditions.

We conducted two experiments to determine 1) if SC can be evaluated in yearling beef bulls under field conditions, 2) what influence sire line has on SC, and 3) what effect providing sexual experience to low SC bulls would have on their subsequent SC.

[1]Sincere appreciation is expressed to the Gardiner family of Gardiner Angus, Ranch, Ashland, Kansas, for providing cattle, facilities, and management for this trial.

Experimental Procedures

Trial 1

A field trial involving 70 yearling (13 to 15 month old) Angus bulls, was conducted during Nov., 1985 and Jan., 1986. The bulls weighed approximately 985 lb and represented four artificial insemination (AI) sire lines. They included 42, 11, 9, and 8 sons of sires A, B, C, and D, respectively, and were reared together since birth.

The SC test involves the bulls being given a 20 min corral test. Bulls that achieve 0 or 1 services during the test are classified as Low SC (LSC). Medium SC (MSC) bulls achieve 2 or 3 services, and High SC (HSC) bulls achieve 4 or more services. The dirt pen used for the SC tests had four service crates[2] spaced 24 ft apart attached to the corral fences. Yearling, nonestrus Angus heifers weighing 650-800 lb were placed in the service crates and their vulvas were smeared with lubricating jelly. For sexual stimulation purposes, prior to each test, bulls were held in a alleyway adjacent to the test pen, which allowed a clear view of any mounting activity.

To acclimate the bulls to the test environment and determine if there was any relationship between reaction time to first service and subsequent SC scores, bulls went through a pretest session consisting of 10 minutes prestimulation followed by exposure to the restrained heifers. Each bull was immediately replaced by another bull after successfully completing one service or after having spent 30 minutes in the pen, whichever came first. Time to first service was recorded.

One week after the pretest session, bulls underwent the first SC test (SC1). Bulls were randomly allotted into subgroups of five and exposed to heifers for 20 minutes. The first group tested was prestimulated by watching teaser bulls, which were allowed to mount the restrained heifers over a 10 minute period. Thereafter, each test group served to sexually stimulate the next group, which could watch from the adjacent alleyway.

The second SC test (SC2) was conducted over 2 months later (Jan. 22) in the same manner as SC1, except that the subgroups of five bulls contained no more than three bulls of like SC category. One day after SC2, all bulls underwent a breeding soundness examination by a veterinarian. Scrotal measurements were adjusted to 1 year of age according to the following formula developed by Lunstra and others (U.S. Dept. Agric., Agric. Res. Ser. ARS-42, MARC Beef Research Prog. Rep. No. 2, pp 41-43, 1985.): Adjusted scrotal circumference (cm) = [(.032 cm/day) (365 - Actual bull age in days) + (Actual measurement)] + Age of dam adjustment factor. Adjustment factor for dams aged 2, 3, 4, and 5 or older is +1.3, +0.8, + 0.4, and + 0.0 cm, respectively.

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[2]Designed by Dr. Blockey and manufactured by Spring-O-Matic, Rt. 1, Box 128, Marion, KS 66861.

In Apr., 1986, the producer sold all but 32 of the 70 yearling bulls in a production sale. Without taking any other traits into consideration, HSC bulls sold for an average of $257.53 more than MSC bulls. None of the LSC bulls were offered for sale. Of the 32 remaining bulls, 24 were maintained together on pasture away from female contact, and eight were exposed to females during spring breeding season. On Nov. 11, 1986, all 32 bulls were retested for SC (SC3) as 2 year-olds. The test was conducted in the same manner, except that cows were used.

Trial 2

In November of 1986, Trial 1 was repeated in exactly the same manner as SC1 with 78 different yearling (13 to 15 months) Angus bulls weighing approximately 1025 lb and representing six AI sires, of which only one (sire A) was common to Trial 1. Sires A, E, F, G, H, and I were represented by 24, 17, 14, 9, 8, and 6 sons, respectively. After SC1, all LSC bulls (n=23) were separated and offered sexual experience by being run with nonrestrained, estrus females for 4 days. To stimulate maximum estrus activity, 43 Angus females (9 cows, 34 yearling heifers) were injected with 5 ml of prostaglandin on the first day of sexual experience "schooling". Five days after "schooling" ended, all bulls were retested for SC.

Results and Discussion

Trial 1.

Across all 70 bulls, the average SC1 and SC2 scores were 3.4 and 3.8 services, respectively. However, Figure 1 shows distinct differences in mean scores of the four sire lines (P<.01). Actual SC scores ranged from 0-11 services per bull. Mean SC1 scores ranged from 0.6 services for sons of sire D up to 4.2 services for sons of sire A. Mean SC2 scores show the same trend and illustrate the repeatability of the test. Average change in SC by sire line shows an increase between SC1 and SC2 for all lines, except sire line C (Figure 22.1), indicating that with added experience most yearling bulls become more proficient.

Age, weight, scrotal circumference, breeding soundness examination score, and reaction times of the 4 sire groups are presented in Table 22.1. These traits were unrelated to SC1 or SC2 scores.

The mean SC3 score for the 24 bulls retested as 2-year-olds was 4.2 services, which was an increase of .9 services compared to their last SC test as yearlings. Most of this increase was due to an improvement in SC for sons of sire D, indicating that with added maturity some LSC bulls will improve. Of the eight bulls used for breeding, seven were sons of sire A. Five and three of these bulls were HSC and LSC, respectively, at SC2 and all retested the same at SC3. This similarity in scores shows good repeatability and indicates that for MSC and HSC bulls, the yearling test was accurate, because experience and added maturity did not greatly improve their SC. Observations made during the breeding season on the three LSC bulls found one of the bulls displayed adequate mating activity, yet this bull retested as LSC perhaps because he was not properly stimulated.

Table 22.1. Effect of Sire Line on Parameters Measured for Bulls, Trial 1[a].

Parameter	Sire A	B	C	D
No. of sons	42	11	9	8
Age (days)	427	442	427	394
Adj. yearling wt. (lbs)	1001	968	952	963
Adj. yearling scrotal cir (cm)	33.7	32.9	32.0	33.9
Breeding soundness exam. scores[b]	63	72	60	68
Reaction time to 1st service (min)	8.8	13.0	11.8	10.0

[a]Mean values.
[b]Scores based on scrotal circumference and seminal traits.

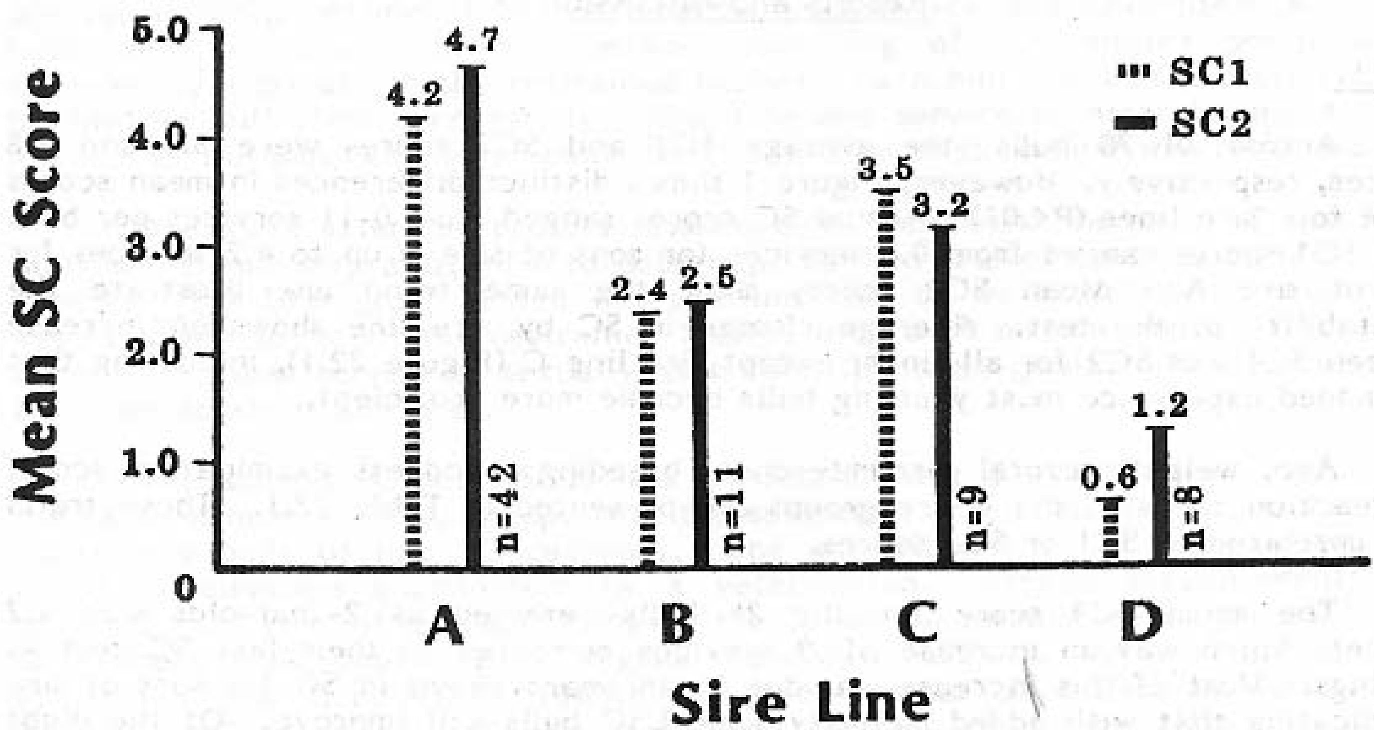

Figure 22.1. Trial 1. Number of bulls and their mean serving capacity score at the first test (SC1) and the second test (SC2) by sire line. Scores based on services achieved during a 20-minute test.

Trial 2.

Mean SC1 and SC2 scores for those bulls not schooled (n=58) are depicted in Figure 22.2 and again show differences between sire lines (P<.01). Of the 58 bulls, 78% stayed in the same category or improved one category. However, 22% decreased one category, from SC1 to SC2, perhaps because they were not properly stimulated. This resulted in an overall average change in SC of -.3 services.

The percentage of bulls "schooled" for each sire line is presented in Table 22.2. Mean SC1 and SC2 scores for "schooled" bulls are depicted in Figure 22.3 and show a dramatic impact of sexual experience on subsequent SC (P<.01). Of the 23 bulls, 14 moved into the MSC category and three (all sons of sire A) became HSC bulls at SC2. Only three bulls remained LSC. The remaining three bulls were temporarily lame and were not retested. Overall average change in SC was +2.2 services, which represented an increase for sons of all sire lines. Observations indicated that the "schooling" could be shortened to 48 hours and should be conducted in a larger pen to reduce fighting between bulls.

Of special interest in this study are sire A sons, which were tested in both trials. In Trial 1, 42 sons of sire A had a mean SC1 score of 4.2 services. Mean SC1 score for 24 different sons of the same sire in Trial 2 was 4.1 services. This similarity in SC scores for different groups of half brothers tested a year apart supports the high heritability of SC.

Table 22.2 presents data by sire line on parameters measured similar to Trial 1. Again, none of these traits were related to SC. Reaction time to service in the pretest session was a poor predictor of bulls' SC in both trials.

Serving capacity apparently is a highly heritable trait that is not related to traditional measures of bull fertility. Serving capacity can be measured successfully under field conditions, but before accurate culling decisions can be made, all LSC bulls should be "schooled" and then retested.

Table 22.2. Effect of Sire Line on Parameters Measured for Bulls, Trial 2.[a]

Parameter	Sire					
	A	E	F	G	H	I
No. of sons	24	17	14	9	8	6
Age (days)	420	415	429	426	411	423
Adj. yearling Wt. (lbs)	1041	1014	1034	999	1027	1012
Adj. yearling scrotal cir (cm)	35.8	35.2	35.6	34.3	34.9	37.1
Reaction time to 1st service (min)	6.2	6.6	5.7	3.8	6.8	4.6
% of sons requiring "schooling"	25	12	21	44	50	17

[a]Mean values.

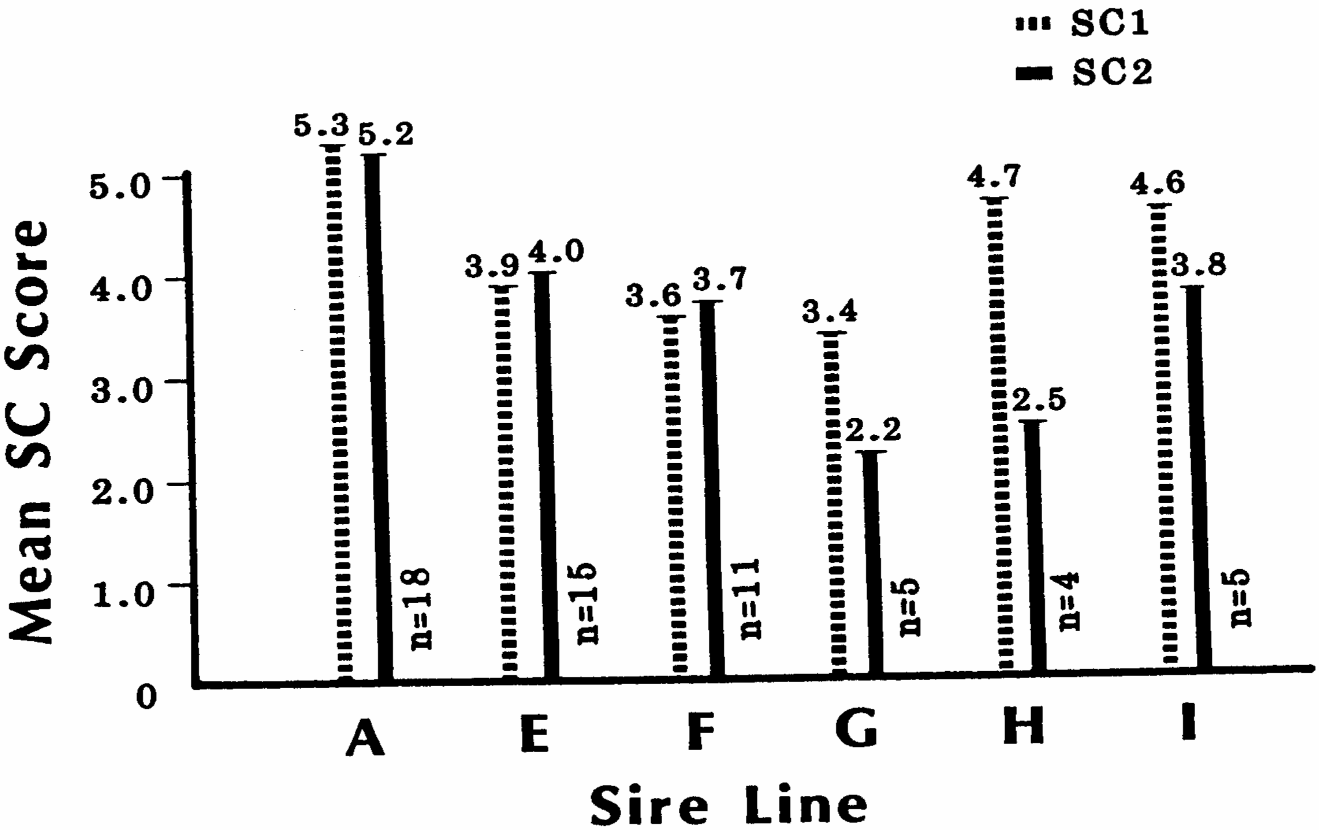

Figure 22.2. Trial 2. Number of non-schooled bulls and their mean serving capacity score at the first test (SC1) and second test (SC2) by sire line. Scores based on services achieved during a 20-minute test.

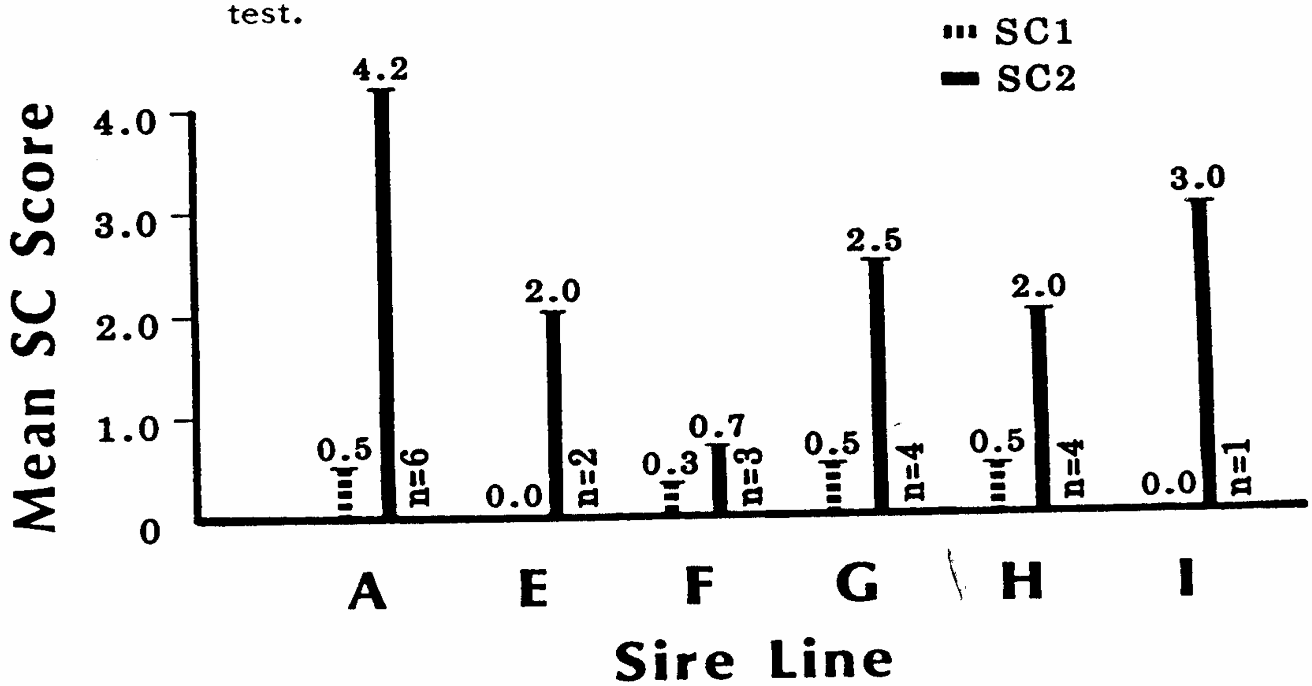

Figure 22.3. Trial 2. Number of schooled bulls and their mean serving capacity score at the first test (SC1) and second test (SC2) by sire line. Bulls underwent schooling after SC1 and were then retested. Scores based on services achieved during a 20-minute test.

Grazing and Feedlot Performance of Heifers Spayed by Two Methods[1]

Scott B. Laudert[2], Gerry L. Kuhl, and Alvin J. Edwards[3]

Summary

Two field trials were conducted to compare the pasture and finishing performance of heifers spayed by the Kimberling-Rupp (K-R) technique or by flank spaying plus autografting a piece of ovarian tissue into the rumen wall (FS+A). In trial 1, neither spaying method resulted in gains of grazing heifers different from that of intact controls; however, FS+A heifers gained 5.1% faster than K-R spayed heifers. In trial 2, grazing gains of heifers spayed by the two techniques were similar. During the finishing phase, no performance difference was found among intact, K-R, or FS+A heifers in trial 1 or between K-R and FS+A heifers in trial 2.

Introduction

The incidence of pregnancy in heifers entering commercial feedyards in the United States has been estimated to exceed 15% annually. Loss of performance and increased costs associated with pregnant feedlot heifers has stimulated interest and research in the area of ovariectomizing grazing heifers. This interest lead to the development of a spaying technique known as the Kimberling-Rupp (K-R) method by Dr. Cleon Kimberling and Dr. Gary Rupp of Colorado State University. This method involves the use of a stainless steel cylindrical instrument inserted through the vaginal wall into the peritoneal cavity to allow removal of the heifer's ovaries. Research comparing the K-R method with the conventional flank spaying method suggests that heifers undergo less stress and that performance is slightly improved. Moreover, the K-R technique is relatively fast, with less likelihood of infection, and hide damage from flank incision is eliminated.

More recently, other spaying techniques have been developed. The flank spay plus rumen-ovarian autograft (FS+A) technique developed in North Dakota received extensive media coverage when it was reported that heifers spayed with this technique performed better than steers. The FS+A technique involves flank spaying the heifer in the conventional manner and then implanting or grafting a small piece of ovarian tissue into the lining of the rumen wall. The theory behind this technique is that the ovarian tissue will be nourished by the extensive blood supply

[1]Appreciation is expressed to Grant County Feeders, Ulysses, KS for supplying cattle and facilities, and to National Beef Packers, Liberal, KS and Iowa Beef Processors, Holcomb, KS for slaughter assistance.

[2]Extension Livestock Specialist, Southwest Kansas.

[3]Feedlot Specialist, College of Veterinary Medicine.

in the ruminal wall, allowing it to grow and produce naturally occurring female hormones similar to those in intact heifers. These trials were conducted to compare the pasture and subsequent feedlot performance of heifers spayed with the FS+A and K-R techniques.

Experimental Procedures

Trial 1. Four hundred and eight-one mixed breed heifers averaging 431 lbs were individually weighed and randomly allotted by breed type and origin to three spaying treatments: intact controls, K-R, or FS+A. All heifers were implanted with Ralgro® at processing. The heifers grazed a common native pasture in Clark County for 169 days. At the end of the grazing season, the heifers were hauled approximately 110 miles to a commercial feedyard and individually weighed. All heifers in the control and K-R groups, and one half of the heifers in the FS+A group were implanted with Synovex-H, while the other half of the FS+A heifers were implanted with Synovex-S. All heifers were further processed according to standard feedyard operating procedures. Each treatment group was fed in a separate pen for 125 days, then pen weighed prior to slaughter. Heifers in all pens were fed and managed similarly according to standard feedyard procedures. The grazing phase results were statistically evaluated by Analysis of Covariance to remove effects of initial body weight variation.

Trial 2. One hundred and fifty-six mixed breed heifers averaging 378 lbs were individually weighed and randomly allotted by breed type in an incomplete block design to two spaying treatments (K-R and FS+A) and three implant treatments (Ralgro®, Synovex-H®, and Synovex-S®) at the beginning of the grazing phase. The incomplete design did not include K-R spayed heifers implanted with Ralgro. All heifers then grazed for 156 days in the same pasture as the heifers in trial 1. At the end of the grazing season, heifers were hauled approximately 110 miles to a commercial feedyard and individually weighed. All heifers were fed in the same pen and managed similarly. Following a 143-day feeding period, the heifers were slaughtered. Carcass weight divided by the average dressing percentage (64.0%) of the heifers was used to estimate individual live slaughter weight. All data were evaluated by Analysis of Covariance to remove effects of initial weight variation.

Results and Discussion

Trial 1. Heifer grazing performance is presented in Table 23.1. Neither spaying method resulted in heifer gains different from that of the intact controls. However, the FS+A heifers gained 5.1% faster ($P<.05$) than the K-R spayed heifers. Feedlot performance of the heifers is shown in Table 23.2. These data are based on final group (pen) weights and, therefore, could not be statistically evaluated. However, there do not appear to be any material performance differences among the treatment groups.

Trial 2. Heifer grazing and feedlot performance are presented in Tables 23.3 and 23.4, respectively. There was no significant interaction ($P>.5$) between the spaying and implant treatments in either the grazing or feedlot phases, so the data were pooled. No differences in heifer gains were found between the two spaying techniques in either the grazing or feedlot phases. Results of the implant comparisons can be found in a companion paper on page 80 of this publication.

Table 23.1. Grazing Performance of Spayed Heifers, Trial 1

Item	Intact	Kimberling-Rupp	Flank Spay + Autograft
No. Heifers	65	133	283
Initial Wt., lb	446	436	426
Final Wt., lb	683	667	671
Daily Gain, lb	1.41[ab]	1.36[b]	1.43[a]

[ab]Means not sharing a common superscript are different (P<.05).

Table 23.2. Feedlot Performance of Spayed Heifers Implanted with Synovex-H or Synovex-S, Trial 1

Item	Synovex-H			Synovex-S
	Intact	K-R	FS+A	FS+A
No. Heifers	63	132	138	132
Initial Wt., lb	676	661	669	667
Final Wt., lb	1045	1036	1041	1045
Daily Gain, lb	2.95	3.00	2.98	3.02
Daily Feed (as fed), lb	27.90	27.23	27.61	27.29
Feed/Gain	9.46	9.08	9.27	9.04

Table 23.3. Grazing Performance of Spayed Heifers, Trial 2

Item	Kimberling-Rupp	Flank Spay + Autograft
No. Heifers	64	73
Initial Wt., lb	391	367
Final Wt., lb	602	581
Daily Gain, lb	1.35	1.37

Table 23.4. Feedlot Performance of Spayed Heifers, Trial 2

Item	Kimberling-Rupp	Flank Spay + Autograft
No. Heifers	61	95
Initial Wt., lb	603	584
Final Wt., lb	991	968
Daily Gain, lb	2.71	2.69

Implant Comparisons in Grazing and Finishing Spayed Heifers[1]

Scott B. Laudert[2] Gerry L. Kuhl, and Alvin J. Edwards[3]

Summary

Heifers that were flank-spayed plus rumen-ovarian autografted (FS+A) responded similarly to Ralgro®, Synovex-H®, and Synovex-S® implants on pasture. Grazing heifers spayed by the Kimberling-Rupp technique also responded similarly to Synovex-H and Synovex-S implants.

During the finishing phase, heifers implanted with Synovex-S gained 5.7% faster than heifers implanted with Ralgro, and those implanted with Synovex-H were intermediate in performance. There was no statistical interaction between spaying method and implant treatment during either the grazing or finishing phases.

Introduction

Previous research has shown that spayed heifers must be implanted in order to maintain acceptable grazing and finishing performance. Little research has been reported on the use of Synovex-S® implants in spayed heifers. This trial was conducted to compare the pasture and feedlot performance of spayed heifers implanted with Synovex-S®, Synovex-H®, and Ralgro®.

Experimental Procedures

One hundred and fifty-six mixed breed heifers averaging 378 lbs were randomly allotted by breed type in an incomplete block design to two spaying treatments, Kimberling-Rupp (K-R) or flank spay plus rumen-ovarian autograft (FS+A), and to three pasture implant treatments: Ralgro, Synovex-H, or Synovex-S. The incomplete design did not include K-R spayed heifers implanted with Ralgro. All heifers were individually identified and weighed before grazing native pasture in Clark County for 156 days.

At the end of the grazing season, all heifers were hauled approximately 110 miles to a commercial feedyard and individually weighed. At this time, the heifers were reallotted by breed type to three finishing implant treatments (Ralgro, Synovex-H, and Synovex-S) within each spaying method and previous grazing

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[1]Appreciation is expressed to Grant County Feeders, Ulysses, KS for supplying cattle and facilities, and to Iowa Beef Processors, Holcomb, KS for slaughter assistance.

[2]Extension Livestock Specialist, Southwest Kansas.

[3] Feedlot Specialist, College of Veterinary Medicine.

implant treatment, such that one-third of the heifers in each grazing implant group received Ralgro, Synovex-H, or Synovex-S. Cattle were implanted only once at the beginning of the finishing period.

All heifers were fed in the same pen and handled similarly. Following a 143-day feeding period, all heifers were slaughtered. Individual carcass weight divided by the group dressing percentage (64.0%) was used to estimate individual live slaughter weight.

All data were evaluated by Analysis of Covariance to remove effects of initial weight variation.

Results and Discussion

Comparative performance of heifers spayed by the two methods can be found in a companion paper on page 77 of this publication.

Pasture gains of the FS+A spayed heifers implanted with Ralgro, Synovex-H and Synovex-S are shown in Table 24.1. There were no differences in heifer gains among the implant treatments.

There was no statistical interaction between spaying method (K-R and FS+A) and implant (Synovex-H and Synovex-S) during the grazing phase. Therefore, the data were combined across spaying treatments and are shown in Table 24.2. No gain difference was found between the Synovex-H and Synovex-S implanted heifers spayed by the K-R and FS+A techniques.

Similarly, the interaction between spaying method and implant treatment was not significant during the finishing phase, so the data were combined and are reported in Table 24.3. Synovex-S implanted, spayed heifers gained 5.7% faster (P=.13) than those implanted with Ralgro. Synovex-H implanted, spayed heifers were intermediate in gain between those implanted with Ralgro and Synovex-S.

Table 24.1. Grazing Performance of Flank-Spayed + Autografted Heifers Implanted with Ralgro, Synovex-H or Synovex-S

Item	Ralgro	Synovex-H	Synovex-S
No. Heifers	34	35	38
Initial Wt., lb	370	359	374
Final Wt., lb	588	567	594
Daily Gain, lb	1.39	1.33	1.40

Table 24.2. Grazing Performance of Spayed Heifers Implanted With Synovex-H or Synovex-S

Item	Synovex-H	Synovex-S
No. Heifers	67	70
Initial Wt., lb	376	380
Final Wt., lb	585	596
Daily Gain, lb	1.34	1.38

Table 24.3. Feedlot Performance of Spayed Heifers Implanted With Ralgro, Synovex-H or Synovex-S

Item	Ralgro	Synovex-H	Synovex-S
No. Heifers	58	52	46
Initial Wt., lb	590	596	588
Final Wt., lb	965	983	986
Daily Gain, lb	2.63[a]	2.70[ab]	2.78[b]

[ab]Means not sharing a common superscript are different (P=.13).

Effect of Several Spaying Methods on Grazing Heifer Gains[1]

Gerry Kuhl, Terry Goehring, Bob Ritter[2], Scott Laudert[2], and William McCully[3]

Summary

Several spaying and ovarian autografting methods were tested in three field trials with 658 grazing heifers. None of the techniques examined were found to have a beneficial effect on heifer gains compared to intact controls. Heifers' initial weight, frame size, and body condition score were associated with cattle performance; however, their relative impact on gains varied across the three trials.

Introduction

Interest in spaying heifers as a means of improving performance and preventing pregnancy has been renewed. Moreover, it has been suggested that transplanting a section of the ovary to other areas of the body (termed autografting) will stimulate heifer growth through estrogen production from the transplant, but suppress estrous activity.

Several different techniques for spaying and autografting have been developed in recent years. The Kimberling-Rupp (K-R) intravaginal spay technique is an alternative to the traditional flank spay (FS) method. The flank spay plus autograph (FS+A) technique involves placing a small piece of ovarian tissue into the ruminal wall. More recently, a rather crude form of ovarian autografting using the K-R method has been suggested. This technique involves simply dropping the excised ovaries inside the peritoneal cavity (K-R + Ovary Drop) instead of removing them from the body. Field trials were conducted to determine the effect of these spaying alternatives on gains of grazing heifers.

Experimental Procedures

Three field trials involving a total of 658 yearling, mixed breed heifers were conducted in south central Kansas. In trial 1, treatments included: 1) intact controls; 2) Kimberling-Rupp vaginal spay, with ovaries removed (K-R); 3) Kimberling-Rupp vaginal spay, with the ovaries dropped intraperitoneally (K-R + Ovary Drop); and 4) flank spay, with rumen-ovarian autograft (FS+A). In trials 2 and 3, treatments included: 1) intact controls; 2) flank spay, with ovaries removed

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[1]Sincere appreciation is expressed to Innis Croft, Croft Farms, Anthony, KS for supplying cattle and facilities; to Drs. Dean Bertholf and Gary Schulteis, Anthony Veterinary Clinic, Anthony, KS and Dr. Scott Crain, Country Vet Clinic, Meade, KS for conducting the spaying procedures; and to Pratt Feeders, Pratt, KS and Garth Boyd, Extension Assistant for assistance in data collection.

[2]Extension Livestock Specialist, South Central and Southwest Kansas, respectively.

[3]Harper County Extension Agricultural Agent.

(FS); and 3) FS+A. The cattle were processed, including routine vaccinations and parasite control, then backgrounded on silage for 2 to 4 weeks before the trials were initiated. Feed was removed from the cattle 48 hours prior to the start of each trial to facilitate surgical procedures. On day 1, the heifers were individually weighed, implanted with Ralgro®, and randomly allotted to treatments.

Heifers in trial 1 were pastured on winter wheat; those in trials 2 and 3 grazed-out wheat, then grazed native range half season (early-intensive) or season-long, respectively. The statistical analysis of heifer performance accounted for differences because of treatment and subjective breed type, with initial weight, frame size, and body condition score used as covariables.

Results

The results of the three field trials are presented in Table 25.1. Heifer performance in trials 1 and 3 was not significantly ($P>.10$) influenced by spaying treatment. However, FS+A heifers gained slower ($P<.05$) than FS heifers in trial 2. Over the three trials, none of the spaying methods examined had a beneficial effect on pasture gains when compared to intact heifers. These results are consistent with other recent research reports.

The effect of initial weight (approximate range 400 lbs), frame size (subjectively evaluated as small, medium, or large) and body condition score (1=extremely thin, 9=extremely fleshy) on heifer performance was evaluated by covariate analysis. In trials 1 and 3, for each 100 lb increase in initial heifer weight, pasture gain decreased by an average of .13 lb per day. In trials 2 and 3, heifer gain was increased by an average of .11 lb per day for each unit increase in frame size. Condition score was important only in trial 2, with heifer performance decreasing .10 lb per day for each unit increase in condition score.

Table 25.1. Effect of Several Spaying Methods on Grazing Heifer Gains

Item	Intact Controls	Kimberling-Rupp Spay	Kimberling-Rupp+ Ovary Drop	Flank Spay	Flank Spay + Autograph
Trial 1-137 Days:					
No. Heifers	45	46	41	--	46
Initial Wt., lb[1]	483	498	497	--	498
Daily Gain, lb[2]	1.34	1.39	1.35	--	1.36
Trial 2-129 Days:					
No. Heifers	46	--	--	98	85
Initial Wt., lb[1]	430	--	--	420	413
Daily Gain, lb[2]	1.63[ab]	--	--	1.69[a]	1.57[b]
Trial 3-233 Days:					
No. Heifers	48	--	--	99	104
Initial Wt., lb[1]	435	--	--	447	436
Daily Gain, lb[2]	1.31	--	--	1.24	1.27

[ab]Means within the same row not sharing a common superscript differ ($P<.05$).
[1]Actual means.
[2]Least-squares means.

Effect of Stocker Receiving Diet on Subsequent Pasture Gains[1]

Frank Brazle[2], Gerry Kuhl,
and David Harmon

Summary

Seven diets were fed for 27 days to newly arrived heifers to evaluate their impact on stocker gains during the receiving and pasture periods. The diets were as follows: soybean hulls plus soybean meal; suncured alfalfa plus wheat middlings; dehydrated alfalfa plus grain sorghum; distillers dried grain plus cottonseed hulls; brome hay plus 2 lb protein supplement/day; prairie hay plus 2 lb protein supplement/day; and a commercial receiving ration. During the receiving period, diets of soybean hulls plus soybean meal, distillers dried grain plus cottonseed hulls, and the commercial receiving ration produced the highest cattle gains. The soybean hull plus soybean meal diet and the commercial receiving ration resulted in the best combined drylot and pasture gains as well.

Introduction

Receiving rations for feedlot cattle are designed to adapt the rumen's microflora to a grain diet. Adapting the rumen's microflora to a lush pasture diet may be just as important. We evaluated seven receiving diets to determine their affect on pasture gains of intensive-early grazed stocker cattle.

Experimental Procedures

In March, 301 yearling heifers averaging 500 lbs were purchased in Oklahoma City and shipped to Moline, Kansas. The stockers were fed prairie hay and water on arrival and were processed the following morning. The cattle were vaccinated for Infectious Bovine Rhinotracheitis (IBR); Bovine Virus Diarrhea (BVD); Parainfluenza$_3$ (PI$_3$); Leptospirosis pomona; Clostridium chauvei, septicum, novyi, sordellii, and perfringens C and D (7-way); dewormed with Tramisol® injectable; and implanted with Ralgro®.

The heifers were randomly allotted to 7 receiving rations with 3 pens of cattle on each diet. The major ingredients in the receiving rations were as follows:

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[1]Appreciation is expressed to Delmer Miller, Scott City, KS and John ReQua Wichita, KS for providing cattle and to Ranch Aid, Inc., Eureka, KS; Bung Inc., Emporia, KS; Longton Dehydrating and Milling Co., Longton, KS; and American Diversified Co., Ethanol Plant, Hastings, NE for funding support. A sincere thank you to Jim Williams and Ed Durbin, Moline, KS for use of their facilities and to Dr. Williams, Moline, KS for assistance in processing and treating the cattle.

Appreciation is also extended to Agricultural Extension Agents' KelLee Parr, Elk Co.; Jeff Davidson, Greenwood Co.; Dale Lanham, Woodson Co.; and David Pace, Chautauqua Co.; and to Terry Goehring, Extension Assistant for data collection.

[2]Extension Livestock Specialist, Southeast Kansas.

1) soybean hulls (83%) plus soybean meal (10%); 2) suncured alfalfa (47%) plus wheat middlings (47%); 3) dehydrated alfalfa (55%) plus grain sorghum (39%); 4) distillers dried grain (41%) plus cottonseed hulls (51%); 5) a commercial receiving ration; 6) poor quality brome hay plus 2 lb soybean meal-based supplement per head daily; and 7) prairie hay plus 2 lb soybean meal-based supplement daily (Table 26.1). Cattle on the first 5 diets also received 2 lb of prairie hay per head daily.

All concentrate mixtures were pelleted and fortified with Deccox® (125 mg/head daily), salt, and vitamin A. All diets except the two hay- based rations were designed to contain minimum nutritional levels (dry basis) of 14% crude protein, 15% crude fiber, 60% TDN, .4% calcium, .3% phosphorus, and 1% potassium. Heifers were individually weighed at the start and finish of the 27-day receiving period, and at the end of 82-day grazing trial. Rumen fluid was collected from 30% of the heifers at the start and end of the receiving period. All heifers were intensive-early grazed in one native tallgrass pasture stocked at 2 acres/head.

Results and Discussion

Heifers fed the diets containing soybean hulls plus soybean meal, the commercial receiving ration, and distillers dried grain plus cottonseed hulls gained the fastest during the 27-day receiving period. Cattle fed the prairie and brome hay plus protein supplement diets were intermediate in gains during the receiving period, and those consuming wheat middlings plus suncured alfalfa or grain sorghum plus dehydrated alfalfa had the lowest gains (Table 26.2).

Highest cattle intake during the first 27 days was achieved on the commercial receiving ration, followed by the brome and prairie hay diets. The wheat middlings plus dehydrated alfalfa diet resulted in lowest heifer intake (Table 26.2). The best cattle feed conversions were obtained on the soybean hulls plus soybean meal, commercial receiving ration, and distillers dried grain plus cottonseed hull diets. Heifers fed the soybean hulls plus soybean meal and wheat middlings plus suncured alfalfa diets had the lowest ruminal pH and highest rumen propionic acid levels on day 27. Results suggest that these two rations had higher digestable energy levels than the other rations and may explain the lower heifer intakes, even though the soybean hulls plus soybean meal ration was one of the highest in crude fiber. About 25% of the heifers were treated for shipping fever, with no differences among treatments.

The heifers started on distillers dried grain plus cottonseed hulls had the lowest pasture gains. This may be explained by the fact that, although this ration was the highest in crude protein, its high ruminal bypass potential resulted in the lowest ($P<.05$) rumen ammonia level at the end of the receiving period, which likely inhibited ruminal microbial growth.

This trial confirms that the receiving ration fed to stockers before going to grass can affect short-term grass gains. Feeding a higher energy ration that results in faster gains for 3 to 4 weeks before grass will not necessarily reduce subsequent grass gains, as illustrated by the heifers fed diets containing soybean hulls plus soybean meal, and the commercial receiving ration. Feeding prairie hay plus 2 lb of protein supplement did not optimize stocker gains on grass, as has been suggested. However, stockers fed high energy starting rations for a longer period would be fleshier going to grass, which could result in lower grass gains.

Table 26.1. Ingredient Composition and Analysis of Receiving Rations

Items	Prairie Hay + 2 lb Prot. Suppl.[1]	Brome Hay + 2 lb Prot. Suppl.[1]	Distillers Dried Grain + Cottonseed Hulls	Soybean Hulls + Soybean Meal	Wheat Midds + Suncured Alfalfa	Grain Sorghum + Dehydrated Alfalfa	Commercial Receiving Ration[2]
				Ration Ingredients, lb/ton			
Soybean Meal	1835	1835	-----	200	-----	-----	-----
Soybean Hulls	-----	-----	-----	1667	-----	-----	-----
Cottonseed Hulls	-----	-----	1025	-----	-----	-----	-----
Dist. Dried Grain	-----	-----	832	-----	-----	-----	-----
Suncured Alfalfa	-----	-----	-----	-----	940	-----	-----
Wheat Midds	-----	-----	-----	-----	948	-----	
Dehydrated Alfalfa	-----	-----	-----	-----	-----	1100	-----
Grain Sorghum	-----	-----	-----	-----	-----	778	-----
Liquid Molasses	-----	-----	100	100	100	100	-----
White Salt	50	50	10	10	10	10	-----
Dicalcium Phosphate	100	100	-----	20	-----	10	-----
Limestone	-----	-----	20	-----	-----	-----	-----
Potassium Chloride	-----	-----	10	-----	-----	-----	-----
Vitamin A&D Premix	10	10	2	2	1	1	-----
Deccox Premix	5	5	1	1	1	1	-----
				Chemical Analysis, Dry Matter Basis			
Crude Protein, %	5.0[2]	6.0[2]	17.9	15.2	14.5	15.2	16.2
Crude Fiber, %	36.0[2]	35.0[2]	24.0	33.0	22.0	19.0	26.0
Potassium, %	.83[2]	1.29[2]	1.51	1.41	1.63	2.77	1.17

[1]Protein supplement ingredients only.
[2]Purina Receiving Chow® with Deccox®.
[3]Hay analysis only.

Table 26.2. Effect of Starting Ration on Stocker Performance Durinng Receiving and Grazing Periods

Item	Prairie Hay + 2 lb Prot. Suppl.	Brome Hay + 2 lb Prot. Suppl.	Distillers Dried Grain + Cottonseed Hulls	Soybean Hulls + Soybean Meal	Wheat Midds + Suncured Alfalfa	Grain Sorghum + Dehydrated Alfalfa	Commercial Receiving Ration
No. Heifers	43	43	43	43	43	43	43
Starting Wt., lb	493	475	485	483	483	491	490
Daily Gain, lb:							
Receiving-27 Days	2.16^{ab}	2.09^{ab}	2.30^{a}	2.30^{a}	1.88^{b}	1.92^{b}	2.45^{a}
Grazing-82 Days	1.24^{a}	1.36^{a}	1.08^{b}	1.34^{a}	1.24^{a}	1.36^{a}	1.31^{a}
Overall-109 Days	1.48^{ab}	1.54^{ab}	1.38^{b}	1.58^{a}	1.40^{b}	1.49^{ab}	1.59^{a}
Daily Feed Intake, lb:							
Receiving-27 Days	14.2^{ab}	14.5^{a}	14.0^{b}	13.8^{b}	13.4^{b}	13.8^{b}	14.6^{a}
% of Body Wt.	2.88	3.05	2.88	2.86	2.78	2.83	2.98
Feed/Gain, lb	6.6^{b}	7.0^{ab}	5.0^{c}	6.0^{c}	7.2^{a}	7.2^{a}	6.0^{c}
Rumen Parameters, Day 27:							
pH	6.78^{b}	6.72^{b}	6.82^{b}	6.45^{a}	6.51^{a}	6.83^{b}	6.72^{b}
Ammonia, mmoles/l	3.39^{b}	5.30^{ab}	$.48^{c}$	5.25^{ab}	3.65^{b}	5.69^{ab}	3.14^{b}
Total VFA's, mmoles/l	72.7^{b}	73.3^{b}	55.6^{c}	87.7^{ab}	76.6^{b}	60.6^{c}	64.6^{c}
Propionic Acid, mmoles/l	10.9^{b}	12.1^{b}	10.9^{b}	17.2^{a}	16.9^{a}	12.2^{b}	10.2^{b}

[abc]Means with different superscripts differ ($P<.05$).

Influence of Sorghum Grain Supplementation on Forage Utilization by Beef Steers Consuming Immature Bluestem[1]

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

Summary

Supplementing beef steers consuming immature bluestem with 0, 1, 2, or 4 lbs of sorghum grain daily did not affect forage intake. Thus, total intake increased as level of grain increased. Total dry matter, cell wall, and starch digestibilities were mildly depressed with increasing grain. Rumen fill and rates of passage were similar for all treatments, and differences in rumen fermentation characteristics were minimal.

Introduction

Intensive range utilization systems such as intensive-early stocking (IES), are being used increasingly by Flint Hills livestock producers. Limited research at the Fort Hays Branch Station has shown that supplementing steers with grain under IES increases gain per head and beef per acre. However, other research indicates that grain supplementation may reduce forage utilization. Information is limited on the influence of grain supplementation on immature bluestem utilization. We designed this study to evaluate how various levels of sorghum grain (milo) affect utilization of immature bluestem by beef steers.

Experimental Procedures

Sixteen ruminally cannulated Hereford x Angus steers (avg. wt., 600 lbs.) were assigned to one of four treatments: 1) control (no supplement), 2) 1 lb, 3) 2 lb, or 4) 4 lb of supplemental milo per head per day. Animals were kept under shelter in individual pens. Fresh bluestem range grass, cut and chopped daily, was fed at 15% over each animal's previous 7-day average intake from June 10 to July 9, 1986. Forage and grain offered and forage refusals were weighed and subsampled daily, analyzed for dry matter, and stored for future analyses. A 14-day adaptation period beginning June 10 was followed by 7 days of intake measurement and 7 days of total fecal collection. Cobalt EDTA, used to monitor liquid flow rates and rumen volume, was given intraruminally on the last day of fecal collection. Rumen fluid samples were taken at 0, 3, 5, 7, 9, 12, and 24 hours postdosing. Ruminal fill of solid digesta was determined by complete ruminal evacuation immediately after the last fecal collection. Solid ruminal contents were subsampled and analyzed for indigestible acid detergent fiber.

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

[2]Dept. of Surgery and Medicine.

Results and Discussion

Since there were no differences (P>.10) in forage intake across treatments, total diet intake increased (P<.05) with additional grain (Table 27.1). In contrast, total dry matter, cell wall, and starch digestibilities decreased (P<.05) with increasing grain level. Digestibility decreases were not due to changes in liquid or solid passage rates, since neither varied (P>.10) with grain addition (Table 27.2). Ruminal liquid volume and indigestible fiber were also similar (P>.10) across treatments.

Increasing milo supplementation had minimal effect on most rumen fermentation characteristics. Ruminal propionate level and acetate:propionate ratio, as well as ruminal NH_3-N and total volatile fatty acids (VFA) concentrations, were similar (P>.10) among treatments (Table 27.2). However, ruminal acetate and pH decreased (P<.01), whereas butyrate increased (P<.10) with grain addition. Some changes were noted for minor VFA's. However, patterns were not consistent.

According to this study, cattle consuming immature bluestem may be supplemented with up to 4 lb milo per day with only a minimal decrease in forage utilization. Therefore, additional research is needed to monitor performance response to early season grain supplementation and to determine levels of supplementation that optimize economic returns.

Table 27.1. Influence of Sorghum Grain Supplementation on Dry Matter (DM) Intake and Digestibility in Beef Steers Consuming Immature Bluestem Range Grasses

Item	Grain Sorghum Per Day				SE[a]
	No Supplement	1 lb	2 lb	4 lb	
Forage DM intake (lb/d)	12.4	13.1	13.4	13.5	0.59
Grain DM intake (lb/d)	0	0.9	1.9	3.7	--
Total DM intake (lb/d)[b]	12.4	14.0	15.3	17.2	0.59
Forage DM intake (% body wt.)	2.12	2.21	2.16	2.23	0.10
Total DM intake (% body wt.)[b]	2.12	2.36	2.47	2.85	0.10
Total tract DM digestibility (%)[b]	55.3	55.8	53.2	53.5	0.61
Cell wall digestibility (%)[b]	55.5	54.7	51.7	52.0	1.02
Starch digestibility (%)[b]	88.2	87.9	84.1	80.0	1.26

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

[b]Linear response to increasing grain level (P<.05).

Table 27.2. Effect of Sorghum Grain Supplementation on Digesta Flow and Rumen Fermentation Characteristics in Beef Steers Consuming Immature Bluestem Range Grasses

Item	Grain Sorghum Per Day				SE[a]
	No Supplement	1 lb	2 lb	4 lb	
Liquid volume (liters)	50.67	43.16	47.97	47.94	4.25
Liquid passage (%/h)	6.88	7.36	7.75	8.15	0.61
Indigestible fiber fill (lb)	3.68	3.26	3.98	4.11	0.38
Indigestible fiber fill (% BW)	0.62	0.54	0.64	0.69	0.06
Indigestible fiber passage (%/h)	2.44	2.56	2.41	2.40	0.25
pH[b]	6.63	6.56	6.47	6.46	.07
NH_3-N (mM)	3.44	2.34	1.54	3.37	1.17
Total VFA (mM)	79.98	85.59	80.86	87.98	2.70
VFA molar percentages:					
Acetate[b]	77.98	76.82	75.88	75.53	0.38
Propionate	12.73	12.74	12.83	12.66	0.28
Butyrate[b]	7.79	8.94	9.83	10.14	0.27
Isobutyrate	0.58	0.57	0.55	0.57	0.03
Valerate[b]	0.37	0.42	0.42	0.52	0.04
Isovalerate[c]	0.55	0.51	0.48	0.59	0.02
Acetate:Propionate	6.17	6.04	5.93	6.00	0.16

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

[b]Linear response to increasing grain level ($P<.10$).

[c]Quadratic response to increasing grain level ($P<.01$).

Effect of Supplemental Protein:Energy Ratio on the Intake, Digestibility, Fill, and Turnover of Dormant Bluestem Range-Grasses

T. DelCurto, R.C. Cochran, K.A. Jacques,
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Summary

Feeding a low crude protein (12%) supplement depressed dormant bluestem range-grass fiber digestibility, whereas moderate (27%) and high (41%) protein supplementation maintained forage digestibility and encouraged intake. Increased intake for moderate and high protein groups appeared to be associated with increased rumen dry matter and indigestible fiber fill.

Introduction

Narrow profit margins for cow-calf producers necessitate optimizing both animal performance and native forage utilization. Protein supplements have been reported to increase dry matter intake (DMI) and digestibility (DMD) of poor quality forage. In contrast, energy supplements frequently have been reported to depress DMI and DMD. However, information on such responses for winter bluestem is limited. Therefore, we evaluated the influence of protein:energy ratio in supplemental feeds on intake and digestibility of dormant, bluestem range forage.

Experimental Procedures

Sixteen ruminally-fistulated yearling steers were allotted at random to four treatments: (a) control (no supplement); (b) low (12%) crude protein supplement; (c) moderate (27%) CP supplement, and (d) high (41%) CP supplement. The supplements were mixtures of rolled milo and soybean meal fed at approximately 2.2 lbs/hd/day (.5% of body weight).

Dormant native range forage was cut in January (1986), stored, and fed at approximately 15% above the average intake. Predominant species were big bluestem, little bluestem, indiangrass, and sedge. Kentucky bluegrass, sideoats grama grass, and switchgrass were minor constituents.

Steers were allowed 2 weeks (Jan. 15 to 31, 1986) to adjust to supplements and forage, then intake was measured for 7 days (Feb. 1 to 7). Steers were fitted with fecal bags, and fecal output was measured and sampled for the next 8 days (Feb. 7 to 14) to determine digestibility. Ruminal fill of indigestible fiber was determined by emptying the rumen, weighing and subsampling contents, and analyzing samples for indigestible acid detergent fiber. On Feb. 15, the steers were dosed with CoEDTA, and rumen samples were collected 0, 3, 6, 9, 12, and 24 hours after feeding to measure rumen fluid volume and liquid dilution rate.

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[1]Dept. of Agronomy.
[2]Dept. of Surgery and Medicine.

Results and Discussion

Moderate (27%) and high (41%) protein supplements increased ($P<.05$) the intake of dormant range forage (Table 28.1). Forage intakes of steers receiving the low protein supplement were similar ($P>.10$) to those receiving no supplement. Dry matter digestibility of the total diet was enhanced by all three protein supplements. However, the low protein supplement depressed ($P<.05$) plant cell wall (NDF) digestibility. Calculated estimates of forage digestibility followed the same trend as measured cell wall digestibility. Rumen dry matter and indigestible fiber fills were larger ($P<.01$) for steers fed moderate and high protein supplements (Table 28.2). Intake response appears to be positively related to fiber fill. In contrast, liquid and indigestible fiber passage rates were not well related to intake. According to this study, improving the diet's nitrogen status stimulates consumption and improves utilization of low quality, bluestem range forage.

Table 28.1. Influence of Protein:Energy Ratio in Supplemental Feed on the Intake and Digestibility of Dormant, Bluestem Range Grasses

Item	No Supplement	Low Protein	Moderate Protein	High Protein	SE[a]
Forage intake (% body weight)[b]	.88	.85	1.36	1.22	.15
Supplement intake (% body weight)	--	.50	.50	.50	--
Total dry matter intake (% body wt)[b]	.88	1.35	1.86	1.71	.15
Dry matter digestibility (%)[c]	35.3	44.8	48.4	48.8	1.97
Plant cell wall (NDF) digestibility (%)[d]	37.9	29.9	39.9	38.6	2.17
Calculated forage digestibility (%)[d]	35.5	24.1	36.7	33.6	2.12

[a]SE = standard error, (n=4).
[b]Linear response to increasing protein level ($P<.10$).
[c]Quadratic response to increasing protein level ($P<.10$).
[d]Cubic response to increasing protein level ($P<.10$).

Table 28.2. Influence of Protein:Energy Ratio in Supplemental Feed on the Fill and Passage Rate of Dormant, Bluestem Range Grasses

Item	No Supplement	Low Protein	Moderate Protein	High Protein	SE[a]
Rumen dry matter contents (lbs)[b]	5.17	7.03	11.30	9.64	1.00
Indigestible fiber fill (lbs)[b]	2.11	2.50	4.74	3.81	.28
Indigestible fiber fill (% body weight)[b]	.92	1.04	1.90	1.62	.08
Indigestible fiber passage (%/hr)[b]	2.14	3.11	2.02	2.42	.27
Liquid dilution rate (%/hr)[b]	2.69	5.71	5.22	5.60	.42

[a]SE = standard error, (n=4).
[b]Cubic response to increasing protein level ($P<.10$).

Evaluation of Stocking Rate, Compudose® Implants, and Rumensin® Ruminal Delivery Devices within Intensive-Early Stocking

R.C. Cochran, J.G. Riley, C.E. Owensby[3], G. Towne[3], E.S. Vanzant, and R. Pope

Summary

Stocking rate in an intensive-early stocking system (1.25, 1.50, or 1.76 acres per steer) did not influence steer gains. Available forage on loamy upland sites was lower after steer removal on July 15 for the highest stocking rate. However, after late season rest, available forage was similar for all stocking rates.

Steer gains were consistently greater for groups implanted with Compudose® (estradiol 17ß) or Compudose plus a Rumensin® (monensin) ruminal delivery device. The Rumensin device alone was successful in increasing average daily gain only at the highest stocking rate.

Introduction

Suggested season-long grazing schemes in the Flint Hills run from May 1 to October 1, with a stocking rate of about 3.5 acres per steer. Grazing cattle for half the season (May 1 to July 15) at twice the normal rate (1.75 acres/steer) increases gain per acre, while maintaining animal performance. This intensive-early stocking (or double stocking) system also may improve range forage composition. Although intensive-early stocking works well at doubled stocking rates, information is limited on animal and plant response to higher stocking rates.

Increased weight gain of pasture cattle receiving Rumensin® has been well documented. However, systems for administering the drug on pasture are inconvenient and do not ensure that each animal receives the correct amount. Recently, the Rumensin ruminal delivery device (RRDD) became available for experimentation.

We evaluated the efficacy of RRDD's alone and combined with Compudose® implants. This was part of a long-term study to determine the influence of increased stocking rates, within intensive-early stocking, on animal and plant response.

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

[2]Appreciation is expressed to Elanco Products Co., Division of Eli Lilly Co., for financial assistance and the research products evaluated in this trial.

[3]Dept. of Agronomy.

Experimental Procedures

Two hundred and forty-four crossbred beef steers averaging 545 lbs were distributed to six 60-acre tall grass prairie pastures. Stocking rates (2 pastures per stocking rate) were: 1) 1.76 acres/steer; 2) 1.50 acres/steer; and 3) 1.25 acres/steer.

Steers within each pasture were assigned to four treatments: 1) control; 2) RRDD (expected Rumensin release rate, approximately 100 mg/day); 3) Compudose implant; and 4) RRDD plus a Compudose implant. All steers were weighed following an overnight stand without feed or water at trial initiation (April 30, 1986) and termination (July 15, 1986).

Available forage was determined by clipping forage in each pasture within 10 frames (frame size, 1/10,000 acres) per range site. The two range sites were loamy upland and breaks. Forage was clipped immediately after steers were removed (July 15) and again at the end of the growing season (mid-October).

Results and Discussion

Response to Rumensin or Compudose depended on the stocking rate ($P<.05$). At the highest (1.25 acres/steer) stocking rate, RRDD's improved gain ($P<.05$). However, for the lower (1.76 acres/steer) and intermediate (1.5 acres/steer) stocking rates, gains of steers carrying RRDD's were similar to controls ($P>.10$) (Table 29.1). Steers implanted with Compudose, or implanted steers with RRDD's gained more ($P<.01$) than control steers for all stocking rates. We confirmed Rumensin delivery by occassional surgical removal of some RRDD's.

On loamy upland sites, total forage available after steer removal was lower ($P<.06$) for the highest stocking rate than for the lowest rate, but was similar on the intermediate and low stocking rate (Table 29.2). Forage available on the breaks was similar at all three stocking rates. At the end of the growing season, available forage was similar regardless of the previous stocking rate.

Implanting with Compudose resulted in more consistent gain improvements than using RRDD's. However, the Rumensin release rate (100 mg/day) was below the recommended Rumensin feeding level of 200 mg/day, which may partially explain the inconsistent response. Increasing the stocking rate did not reduce average daily gain, and forage production for even the highest stocking rate recovered following late-season rest.

Table 29.1. Influence of Stocking Rate, Compudose Implant, and Rumensin Ruminal Delivery Device (RRDD) on Average Daily Gain of Crossbred Beef Steers Managed within Intensive-early Stocking

Stocking Rate (acres/steer)	Treatment Gains (lbs/head/day)			
	Control	RRDD	Compudose	RRDD + Compudose
1.76	2.2	2.3	2.6[a]	2.6[a]
1.50	2.2	2.2	2.8[a]	2.7[a]
1.25	2.3	2.5[a]	2.7[a]	2.8[a]

[a]Treatment mean differs from control (P<.01).

Table 29.2. Influence of Stocking Rate on Total Forage Available for Loamy Upland and Breaks Range Sites at Mid-summer and Mid-fall

Item	Stocking Rate (acres/steer)		
	1.76	1.50	1.25
Loamy upland - total dry forage production (lbs/acre)			
Mid-summer	1939	1430[b]	976[a]
Mid-fall	2639	2193	2171
Breaks - total forage production (lbs/acre)			
Mid-summer	1588	1290	938
Mid-fall	1956	1576	1566

[a]Treatment mean is different from control (P<.01).

[b]Treatment mean is similar to control (P>.10).

Effect of Terramycin® and Bovatec® in Free-Choice Mineral Mixtures on Gains of Heifers Grazing Native Grass[1,2]

F. Brazle[3], G. Kuhl, D. Harmon, and S. Laudert[4]

Summary

Supplementing heifers in an intensive-early grazing program with Terramycin® or Bovatec® in free-choice, mineral-soybean meal mixtures resulted in comparable cattle performance. Both feed additive mixtures increased heifer gains about .3 lb per day compared to controls supplemented with a simple mineral mixture.

Introduction

Significant performance responses have been found from supplementing stocker cattle with antibiotics and ionophores on native grass pasture. However, these two types of feed additives have not been directly compared in mineral mixtures for grazing cattle. The purpose of this study was to evaluate the gains of stockers offered Bovatec® and Terramycin® in free choice, mineral-soybean meal mixtures.

Experimental Procedures

On April 22, 144 mixed breed heifers averaging 515 lbs were individually weighed and randomly allotted to three grazing supplement treatments: 1) a salt-dicalcium phosphate mineral mixture (control), 2) Terramycin in a mineral-soybean meal mixture, and 3) Bovatec in a mineral-soybean meal-grain mixture (Table 30.1). The heifers grazed in six native tallgrass pastures stocked at 1.8 acres per animal (intensive-early grazing), with two pastures assigned to each treatment. The supplement mixtures were fed in wind-vane feeders, with intakes monitored weekly. The heifers were weighed off trial on July 15 and shipped the same day 300 miles to a commercial feedlot in western Kansas. The heifers were reweighed on arrival at the feedlot and after 27 days on feed. Rumen fluid was collected by stomach tube for rumen pH and volatile fatty acid (VFA) analysis from 10 heifers on each treatment at the start and finish of the grazing period.

[1]Appreciation is expressed to Pfizer, Inc., Lee's Summit, MO and to Hoffmann-LaRoche, Inc., Nutley, NJ for partial funding support.
[2]Appreciation is expressed to Marta Laylander, Neosho County Extension Agricultural Agent; Terry Goehring, Extension Assistant; and Montezuma Feeders, Inc. for assistance in data collection.

[3]Extension Livestock Specialist, Southeast Kansas.
[4]Extension Livestock Specialist, Southwest Kansas.

Results and Discussion

There was no difference in pasture gains between the Terramycin and Bovatec supplemented heifers (Table 30.2). Cattle receiving these supplements gained about .3 lb more ($P<.01$) per head daily than controls. Intake of the Bovatec mixture was lower than desired, resulting in only 122 mg of Bovatec consumed per head daily. The desired level was 150 to 200 mg per day. Heifer consumption of the Terramycin mixture was more than adequate, with cattle receiving 422 mg of the feed additive per head daily.

Heifers fed Bovatec had the lowest shrinkage in transit to the feedlot of any treatment group. This may have been a function of slightly less gut fill in grazing animals consuming an ionophore. Heifer gains during the first 27 days in the feedlot favored the controls, but the difference was not statistically significant. Stockers fed either Terramycin or Bovatec gained faster over the total 110-day period than controls.

There were no differences ($P>.15$) among any of the treatments in rumen pH or molar percentages of propionic and acetic acid at the end of the grazing period (Table 30.3). Moreover, no changes were detected from the start to the end of the grazing period in these rumen parameters.

Table 30.1. Composition and Heifer Intake of Experimental Mineral Mixtures

Ingredients, lb/ton:	Terramycin	Bovatec	Control
Soybean Meal	200	200	----
Grain Sorghum	----	600	----
Salt	1340	1078.8	1500
Dicalcium Phosphate	300	100	500
Terramycin®, 50 gm/lb	160	----	----
Bovatec®, 68 gm/lb	----	21.2	----
Daily Heifer Intake:			
Mineral Mixture, lb	.105	.169	.069
Bovatec®, mg	----	122	----
Terramycin®, mg	422	----	----

Table 30.2. Effect of Terramycin and Bovatec on Gains of Heifers Grazing Native Grass

Item	Terramycin	Bovatec	Control
No. Heifers	56	46	44
Starting Wt., lb	523	511	516
Average Daily Gain, lb:			
Pasture, 83 Days	1.75[a]	1.74[a]	1.45[b]
Feedlot, 27 Days	5.06	5.06	5.49
Overall, 110 Days	2.21[c]	2.23[c]	2.09[d]
Trucking Shrink, lb[1]	39.7[a]	35.9[b]	38.1[ab]

[1]Average heifer shrink from pasture to feedlot, shipped 300 miles.

[a,b]Means in same row not sharing the same superscript are different (P<.01).

[c,d]Means in same row not sharing the same superscript are different (P<.10).

Table 30.3. Effect of Terramycin and Bovatec on Rumen pH and VFA Levels of Grazing Heifers

Rumen Parameter	Terramycin	Bovatec	Control
pH	7.21	7.09	7.13
Propionic Acid, molar %	12.7	13.6	13.8
Acetic Acid, molar %	72.8	73.4	78.3

Effect of Limited-Creep Feeding Calves of Spring-Calving Cows Grazing Native Grass[1]

Frank Brazle[2], Gerry Kuhl, Larry Corah
and Keith Zoellner

Summary

Two limited-creep feeding trials were conducted with spring-born, suckling calves on native grass. The high-energy creep rations containing an ionophore were fed during the last 63 or 85 days before weaning in the two trials. Creep intake was limited with salt to about 1.5 lb per calf daily. Calves consuming the limited-creep feeds gained .26 to .31 lb more per head daily and required 4.4 to 5.5 lb of creep per lb of extra weaning weight.

Introduction

Native grass declines in energy and crude protein during the summer and fall. Milk production of spring-calving cows also declines during this period, resulting in reduced calf nutrition and performance. Traditional creep feeding programs usually have not been economical because of excessive creep consumption and consequent poor creep-to-gain conversion. However, when creep intake is limited, these disadvantages should be overcome. Moreover, the addition of an ionophore to pasture supplements should improve calf performance. Two trials were conducted to evaluate the effectiveness of supplementing suckling calves with limited-fed, grain-based creeps containing an ionophore.

Experimental Procedures

Trial 1 was conducted in 1983 with 58 3-year-old cows and their calves grazing two native grass pastures. On August 8, the calves were weighed and randomly allotted to either control (no creep) or limited-creep plus Rumensin® treatments. The creep feed was 69% ground milo, 15% soybean meal, 8.5% of a 40% protein supplement containing 1200 g Rumensin per ton, 5% salt, and 2.5% dicalcium phosphate. The mixture contained 16% crude protein and 50 mg Rumensin per lb. The creep was fed in one pasture in a self-feeder. The calves were reweighed at weaning after 85 days on trial.

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[1]Appreciation is expressed to Dr. Dale Larson, Farmland Industries, Inc., Kansas City, MO and Dr. Robert Stuart, Hoffmann-LaRoche, Nutley, NJ and for funding support; to Thayne Boone, Neal, KS for providing cattle in trial 1; and to Jeff Davidson, Greenwood County Extension Agricultural Agent for assistance in data collection.

[2]Extension Livestock Specialist, Southeast Kansas.

Trial 2 was initiated on August 14, 1986 with 174 cow-calf pairs allotted to either control, limited-creep, or limited-creep plus Bovatec® pasture treatments. The creep feeds were self-fed in wind-vane feeders fenced off for calf access only. Creep intake was monitored every 3 days and the salt level was adjusted to maintain intake at about 1.5 lb per day. The cow-calf pairs were rotated among the three native grass pastures to minimize pasture effects. The calves were reweighed and condition scored at weaning, after 63 days on trial. Composition of the commercially prepared limited-creeps is shown in Table 31.1.

Results and Discussion

In trial 1, calves consuming the limited-creep plus Rumensin gained .31 lb more ($P<.01$) per head daily than controls (Table 31.2). In trial 2, both groups of limited-creep fed calves gained .26 lb more ($P<.001$) per head daily than controls (Table 31.3). However, there was no significant difference in calf body condition at weaning among the three treatments. The amount of creep required per lb of additional calf gain ranged from 4.4 lb in trial 1 to 5.5 lb in trial 2. In trial 2, inclusion of Bovatec® in the creep did not increase calf gains, but feed efficiency tended to improve.

The lack of a greater response to Bovatec in the second creep trial may be explained by the fact the cattle were rotated among large pastures every 20 days and the creep-fed calves often did not consume creep for at least 3 days after each rotation. Thus, the relative shortness of the trial (63 days) and the intermittent intake of creep, requiring the calves' rumen fermentation to repeatedly adjust to Bovatec®, may have impacted negatively on the normally beneficial response observed when ionophores are fed to cattle on grass.

Table 31.1. Average Composition of Commercial Limited-Creeps Fed in Trial 2

Item	Limited-Creep + Bovatec	Limited-Creep
Crude Protein, %	16	16
Crude Fiber, %	9.8	9.8
Estimated TDN, %	70	70
Calcium, %	.60	.60
Phosphorus, %	.46	.46
Salt, %	2.0	3.0
Bovatec®, mg/lb	68	----

Table 31.2. Effect of Limited-Creep Feeding on Calf Performance -- Trial 1

Item	Limited Creep + Rumensin	Control
No. Calves	31	27
Initial Wt., lb	308	290
Daily Gain, lb	1.84[a]	1.53[b]
Daily Creep Intake, lb	1.46	----
Feed/Gain, lb	4.4	----

[ab]Means in the same row not sharing a common superscript are different (P<.01).

Table 31.3. Effects of Limited-Creep Feeding With or Without Bovatec® on Calf Gains and Body Condition -- Trial 2

Item	Limited-Creep	Limited-Creep + Bovatec	Control
No. Calves	60	57	57
Initial Wt., lb	373	373	374
Daily Gain, lb	1.42[a]	1.42[a]	1.16[b]
Body Condition Score[1]	6.18	5.99	6.12
Daily Creep Intake, lb	1.44	1.36	----
Feed/Gain, lb	5.5	5.2	----

[1]Calf body condition scored on 1 to 10 system: 1=extremely thin, 10=very fleshy.

[ab]Means in the same row not sharing a common superscript are different (P<.001).

Influence of Rumen Bypass Fat Fed in a Range Supplement on the Performance of Cows and Calves Grazing Bluestem Range[1]

Larry Corah, Bob Cochran, Dave Harmon, and Terry Goehring

Summary

Adding rumen bypass fat to a range supplement did not improve reproductive characteristics, cow weight and condition changes, or calf performance during a 43-day postpartum feeding period.

Introduction

Feeding fat to lactating dairy cows has improved their performance because of increased energy intake. Since energy is one of the nutrients limiting reproductive performance, the potential of dietary fat in beef cow rations merits study. The objectives of this study were to evaluate the influence of feeding rumen bypass fat in a range supplement on: a) postpartum changes in body weight, condition, blood urea nitrogen, and progesterone levels; b) milk production and calf gains; and c) reproductive performance.

Experimental Procedures

Sixty-six cow - calf pairs were randomly assigned within age and calving date to two treatment groups: 1) control -- 4.5 lb/hd/day of a corn/soybean meal supplement and 2) Megalac® — 4.5 lb/hd/day of the supplement used in group 1, with .75 lb/hd/day Megalac added. Three pastures were randomly assigned per treatment. Pastures varied in size and were stocked to provide a similar area per cow-calf pair. All cows had continual access to a salt/dicalcium phosphate mixture.

Cows and calves were weighed after an overnight stand without forage and water at the beginning and end of the 43-day trial. On weigh days, cows were also evaluated for body condition by palpation over the ribs and thoracic vertebrae, and by ultrasound. Palpation condition score was the average of two independent observers' rankings (1 = extremely emaciated, 9 = extremely obese).

Milk production was measured on cow-calf pairs by the weigh-suckle- weigh technique on day 36 to 39. Two observations of 12-hour milk production were summed to estimate daily milk production. Blood samples for progesterone analysis were collected on days 1, 12, 23, 33, and 43 of the trial. Samples for blood urea nitrogen were collected on days 12, 23, 33, and 43.

[1]Appreciation is expressed to Church and Dwight Co., Inc. for providing the Megalac used in this study. Megalac® is a rumen bypass fat with a guaranteed fat analysis of at least 82.5%.

At the end (day 43) of supplement feeding, all cows received a prostaglandin injection as an initial step in a synchronization program. Then, cows were heat-checked daily and artifically inseminated. On day 53, all cows not bred received a second prostaglandin injection. Daily heat checking and artificial insemination continued until day 61, when three cleanup bulls were turned in. Bulls were removed on day 99. All cows were run together during the breeding period (days 43 to 99). Blood progesterone levels were used to verify that cows were cycling.

Results and Discussion

Both control and Megalac supplements increased cow weight and condition (Table 32.1). In spite of the additional energy provided by the rumen bypass fat, control cows tended to have higher (P=.09) daily gains. Calf gains, and cow milk production, blood urea nitrogen levels, and percentage displaying heat during the artificial insemination period were similar (P>.10). In this study, feeding Megalac in a range supplement immediately before the breeding season did not yield positive responses; however, information on how the level and timing of bypass fat supplementation affects grazed forage intake and utilization would be helpful in deciding whether the responses we observed are typical, or if an alternate approach could alter cow and/or calf response.

Table 32.1. Effect of Rumen Bypass Fat on Weight Response in Cows and Calves, Milk Production, Percentage of Cows Cycling, Body Condition Change, and Blood Urea Nitrogen

Item	Control[a]	Control + Megalac[b]
Number cows	34	32
Cow initial weight (lbs)	806	810
Cow final weight (lbs)	862	845
Cow ADG (lbs)	1.3	.8
Calf initial weight (lbs)	118	115
Calf final weight (lbs)	195	192
Calf ADG (lbs)	1.8	1.8
Cow milk production (lbs/day)	16.7	15.8
% cows cycling at start of breeding season	41.2	43.8
Initial condition score[c]	4.38	4.45
Final condition score	4.64	4.68
Initial ultrasound (cm)	.26	.28
Final ultrasound (cm)	.29	.29
Blood urea nitrogen (mg/dl)	5.57	5.38

[a]Control supplement contained (%): Ground corn - 89.6; soybean meal - 7.8; and wet molasses - 2.6.
[b]Megalac supplement contained (%): Ground corn - 76.8; soybean meal - 6.7; Megalac - 14.3; and wet molasses - 2.2.

[c]Condition score represents the average of two independent observers' rankings (1 = extremely emaciated, 9 = extremely obese).

Effect of Bovatec® Level in Supplemental Feed on Performance and Forage Utilization Characteristics of Wintering Beef Cattle[1,2]

R.C. Cochran, L.R. Corah, K.A. Jacques, T.B. Avery[3], K.O. Zoellner, and J.F. Higginbotham[4]

Summary

Various levels of lasalocid (Bovatec®) added to a protein supplement did not improve weight or condition change of beef cows grazing poor quality winter pasture. Similarly, calf birth weight and most forage utilization characteristics (e.g., intake, passage rate, and fermentation characteristics) were not altered by Bovatec level. Although forage digestibility was influenced by Bovatec level, changes were not sufficient to influence performance characteristics.

Introduction

Improved rate of gain for pasture cattle receiving Bovatec® has been well documented. However, there is little information on Bovatec use with poor quality forages especially with grazing, pregnant, beef cows. Therefore, we evaluated performance and forage utilization when Bovatec was added at different levels to a protein supplement fed to wintering beef cattle.

Experimental Procedures

Three trials were conducted during the winter of 1985/86 at Kansas State University's Cow-Calf Unit. In trial 1, 120 pregnant beef cows received either 0, 100, 200 or 300 mg Bovatec/hd/d in 4 lb of 20% crude protein range cubes (principal components: cottonseed meal, wheat middlings, and corn). Ten cows from each treatment were assigned to each of three dormant, tallgrass-prairie pastures. Cattle were gathered each morning, separated into treatment groups and bunk-fed the appropriate supplement, beginning in mid-December and continuing until calving. Cow weight and body condition were recorded at trial initiation and after calving. Body condition scores were the average of two independent observers' scores and were estimated by palpation over the ribs and thoracic vertebrae. The scoring system ranged from 1 (extremely emaciated) to 9 (extremely obese).

[1]The expert assistance of Mr. Gary Ritter and Mr. Wayne Adolph is acknowledged and appreciated.
[2]Appreciation is expressed to Hoffmann-LaRoche (Nutley, NJ) and Ralston Purina (St. Louis, MO) for financial assistance and research product, respectively.
[3]Dept. of Surgery and Medicine.
[4]Dept. of Nuclear Engineering.

In trial 2, 40 pregnant beef cows (one full replication of trial 1) and 12 esophageally-fistulated beef steers were used to evaluate the influence of Bovatec level on intake and digestibility of winter forage. Supplements were the same as in trial 1 except that all supplements were labeled with ytterbium chloride. Supplements were fed individually for 14 days, and during the final 7 days, fecal samples were collected daily from all animals.

Esophageally-fistulated steers were used to collect samples of grazed forage on four separate occasions during the 7-day fecal collection period. Ytterbium concentrations in fecal samples were used to determine fecal output, whereas the ratio of indigestible acid detergent fiber in esophageal and fecal samples was used to determine digestibility.

In trial 3, 16 ruminally-fistulated steers were used to evaluate the influence of Bovatec level on the rumen fermentation of tallgrass-prairie forage. Cobalt EDTA was used to follow liquid digesta passage.

Results and Discussion

Bovatec level had no effect (P>.10) on total weight change and calf birth weight (Table 33.1). Cows lost an average of 121 lbs from mid-December through 48 hours postcalving. Calf birth weights averaged 79.5 lbs. Similarly, Bovatec did not influence (P>.10) changes in body condition scores (average change, -.85). Since cows entered the trial with an average body condition score of 5.5, they were below the minimum score of 5 at calving, which has been described as necessary for a prompt return to estrus.

Forage organic matter intake averaged 1.5% of body weight and was not affected (P>.10) by added Bovatec (Table 33.1). Forage organic matter digestibility was slightly depressed (P<.01) at the 100 mg level of Bovatec but increased thereafter, so that digestibility on the 300 mg level was similar to that for controls. Individual volatile fatty acids (VFA) and total VFA production, as well as ammonia (NH_3) and pH values, were unaffected (P>.10) by Bovatec level (Table 33.2). However, liquid flow through the digestive tract tended (P=.10) to follow the same pattern as that for organic matter digestibility.

Adding Bovatec to a 20% crude protein supplement did not improve the performance of pregnant beef cows grazing winter bluestem range. Similarly, intake of forage organic matter was not influenced. Although forage organic matter digestibility varied with Bovatec level, the difference was too small to influence weight or condition change. Ruminal fermentation and fluid flow characteristics were not altered by Bovatec level.

Table 33.1. Effect of Bovatec Level on Weight Change, Condition Change, Forage Organic Matter (OM) Intake, and Digestibility of Pregnant Beef Cows and Birth Weight of Calves

Item	Bovatec Level (mg/head/day) 0	100	200	300	SE[a]
Initial weight (lbs)	1038	1030	1034	1047	22
Final weight (lbs)	913	920	911	922	--
Weight loss (lbs)	-125	-110	-123	-125	11
Initial condition score	5.7	5.5	5.4	5.6	.1
Final conditon score	4.8	4.5	4.7	4.8	.1
Change in condition score	-.9	-1.0	-.7	-.8	.2
Forage OM intake (% body wt)[b]	1.55	1.61	1.54	1.49	.1
Forage OM digestibility (%)[b]	36.2	32.2	33.3	38.9	1.2
Calf birth weight (lbs)	79	81	80	78	2

[a]Standard error.
[b]Quadratic response with increasing level of Bovatec (P<.01).

Table 33.2. Influence of Bovatec Level on Ruminal Fluid Flow and Fermentation Characteristics in Ruminal-fistulated Beef Steers

Item	Bovatec Level (mg/head/day) 0	100	200	300	SE[a]
Dilution rate (%/h)	8.09	7.91	8.20	7.66	.58
Ruminal volume (l)	47.63	74.74	54.81	49.64	9.63
Digesta flow rate (l/h)[b]	3.87	5.91	4.49	3.80	.66
pH	6.57	6.49	6.49	6.59	.05
NH_3-N (mM)	2.06	2.18	2.31	3.46	.80
Total VFA (mM)	79.04	75.79	81.60	81.75	4.75
	VFA Molar Percentage				
Acetate	71.03	71.34	70.56	70.39	1.01
Propionate	18.40	19.56	19.68	19.73	.91
Butyrate	8.75	7.43	8.07	7.99	.48
Isobutyrate	.55	.51	.50	.62	.07
Valerate	.76	.68	.69	.63	.05
Isovalerate	.51	.48	.50	.64	.11
Acetate:Propionate	3.88	3.70	3.61	3.60	.21

[a]Standard error.
[b]Quadratic response with increasing Bovatec (P=.10).

Effect of Commercial Inoculants on the Fermentation of Alfalfa, Corn, Forage Sorghum, and Triticale Silages[1]

Keith Bolsen, Daniel Fung,
Harvey Ilg, Ahmed Laytimi, Renee Hart,
Vicki Chain, and Lisa Nuzback

Summary

Fourteen commercial inoculants were evaluated in seven trials using alfalfa, corn, forage sorghum, and triticale silages. Microbial profiles of the inoculants and of the crops differed widely. Viable lactic acid bacteria (LAB) supplied per gram of fresh crop by the inoculants ranged from less than 10^3 to over 10^5. Only the alfalfas had 10^3 or fewer LAB per gram of crop when the forages were treated and as a result, fermentation responses were excellent for those inoculants that supplied 10^4 or more LAB per gram of treated crop. Corn and triticale underwent a very rapid fermentation rate with very little response to the inoculants. The forage sorghums did not ensile as rapidly as the corn because of their cooler initial temperatures, and most inoculants had little or no effect on the fermentation characteristics. The results of these experiments indicate that if a crop has a high number of LAB, adding more in the form of an inoculant is unlikely to improve the silage fermentation. If a crop has a low number of LAB, it probably will respond to an inoculant, provided the inoculant supplies a large number of viable bacteria.

Introduction

Silage additives are receiving fairly wide acceptance in the U.S. Recently, Bolsen and Heidker (1985)[2] published a guide to over 150 silage additive products marketed in the U.S. Those additives contained over 120 different active ingredients. Microbial inoculants were the most numerous. Over 40 claims are made by the 91 manufacturers or distributors cited in the guide. We believe the buyer should look for good evidence that inoculants improve the fermentation and conservation processes. Results from laboratory-scale experiments are helpful, especially if the crops used are similar to the buyer's. Under laboratory conditions, effective silage inoculants should speed the drop in pH through a faster and greater production of lactic acid.

The objective of these seven trials was to determine the effect of commercial silage inoculants on the rate and efficiency of fermentation in alfalfa, corn, forage sorghum, and triticale. We included 14 products to provide evaluation over a wider range of inoculants than in our previous trials (Report of Progress 494).

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[1]Financial assistance was provided by Sanofi Sante Animale, 37 Avenue George V, 75008 Paris, France.

[2]Bolsen, K.K. and J.I. Heidker. 1985. Silage Additives USA. Chalcombe Publications, Box 1222, Manhattan, Kansas 66502.

Experimental Procedures

The laboratory silos were 4 x 14 inch PVC pipes closed with Jim-Caps on each end. One Jim-Cap was fitted with a Bunsen valve to allow gases to escape. All silages were made in 1985 from crops grown near Manhattan. For filling, 100 to 125 lbs of fresh crop was placed on a plastic sheet, and the additive applied and mixed thoroughly. The control crop was also hand-mixed. After all silage treatments were prepared, the silos were filled on an alternating schedule, which distributed the time from harvest through silo filling equally across all treatments. The silos were packed with a hydraulic press, which excluded air and filled all silages to similar densities. Silos were stored at approximately 85 F.

The 14 inoculants evaluated and active ingredients as listed by the manufacturer or distributor are shown in Table 34.1.

Compositions of the pre-ensiled crops used in all the following experiments are shown in Table 34.2. All inoculants and their microbial counts are shown in Table 34.3.

Table 34.1. List of the Inoculants Evaluated, their Manufacturer or Distributor, and their Active Ingredient(s)

Inoculant	Manufacturer or Distributor	Active Ingredient(s)
AGMASTER® ALFALFA SILAGE INOCULANT	Marschall Products Division of Miles Laboratories, Madison, Wisconson	Lactobacillus plantarum and Pediococcus acidilactici
AGMASTER® CORN SILAGE INOCULANT		Lactobacillus xylosus and Pediococcus acidilactici
BIOMATE LAB CONCENTRATE	Chr. Hansen's Laboratory, Inc., Milwaukee, Wisconsin	Lactobacillus plantarum and Pediococcus cerevisiae
BIOPOWER™	BioTechniques Laboratories, Inc., Redmond, Washington	Streptococcus faecium and Lactobacillus plantarum
BIOSILLAC	Kemi-Intressen AB, Sundbyberg, Sweden	Lactobacillus plantarum and other species

Table 34.1. (continued) List of the Inoculants Evaluated, their Manufacturer or Distributor, and their Active Ingredient(s)

FORAGER	Shell Chemicals (UK) Ltd	Lactobacillus plantarum, Lactobacillus bulgaricus, Lactobacillus coryneformis, Lactobacillus acidophilus, Pediococcus acidilactici, Streptococcus thermophilus, cellulase and hemicellulase, Pectinase
KEM LAC	Kemin Industries, Inc., Des Moines, Iowa	Lactobacillus plantarum, Lactobacillus bulgaricus, and Lactobacillus acidophilus
KOFASIL LAC	Plate Kofasil GmBh, Bonn, West Germany	Lactobacillus plantarum, Streptococcus faecium , and Pediococcus
PIONEER BRAND 1174 CONCENTRATED SILAGE INOCULANT	Pioneer Hi-Bred International, Inc., Des Moines, Iowa	Lactobacillus plantarum (multiple strains) and Streptococcus faecium
PIONEER BRAND 1177 SILAGE INOCULANT	Pioneer Hi-Bred International, Inc., Des Moines, Iowa	Lactobacillus plantarum (multiple strains) and Streptococcus faecium
SI CONCENTRATE 40 A/F	Great Lakes Biochemical Co., Inc., Milwaukee, Wisconsin	Lactobacillus plantarum, Lactobacillus brevis, Pediococcus acidolactici, Streptococcus cremoris, and Streptococcus diacetylactis
SILO-BEST SOLUBLE	Cadco, Inc., Des Moines, Iowa	Streptococcus faecium M-74, Lactobacillus acidophilus, Pediococcus sp., and Lactobacillus plantarum
SURE-SILE	Microbial Developments, Ltd; Malvern Link, Worcs. UK	Lactobacillus plantarum, Pediococcus acidilactici, enzymes, and nutrients
USO_3M (experimental)	Sanofi Santi Animale, Paris, France	Lactobacillus plantarum, Lactobacillus casei, and enzymes.

Table 34.2. Composition of the Pre- Ensiled Crops Used in the Seven Trials

Item	Trial 1: Triticale	Trial 2: Alfalfa	Trial 3: Corn	Trial 4: Sorghum	Trial 5: Alfalfa	Trial 6: Sorghum	Trial 7: Sorghum
Dry Matter, %	33.4	38.3	31.3	32.6	43.5	29.85	25.0
pH	6.35	5.97	5.83	5.88	5.98	5.92	5.93
Buffer Capacity[1]	36.3	49.2	16.3	23.4	48.6	17.4	19.1
	% of the Crop DM						
WSC[2]	9.40	6.75	12.20	13.36	7.95	14.40	16.95
Total Nitrogen	2.01	2.77	1.34	1.15	2.83	1.37	1.15
Insol. Nitrogen	1.00	1.82	.91	.82	1.92	.98	.86
NDF[2]	65.1	48.7	39.6	66.7	*	59.8	*
ADF[2]	41.8	32.3	21.4	41.5	30.4	36.9	*
	Colony-Forming Units per gram of Crop						
Mesophilic	$7.5x10^8$	$3.3x10^7$	$2.3x10^8$	$1.5x10^8$	$6.0x10^7$	$7.5x10^7$	$1.0x10^8$
Lactic Acid Bacteria**	$4.9x10^5$	$2.7x10^3$	$2.6x10^6$	$2.5x10^4$	$<10^3$	$2.9x10^5$	$2.0x10^5$
Yeasts and Molds	$4.6x10^6$	$1.5x10^4$	$4.9x10^6$	$2.2x10^5$	$2.1x10^4$	$1.2x10^6$	$1.0x10^6$

[1]Milliequivalents of NaOH/100 g of crop dry matter.
[2]WSC = water soluble carbohydrates, NDF = neutral detergent fiber, and ADF = acid detergent fiber.
*Not available
** $1x10^3$=1,000; $1x10^6$=1,000,000.

Table 34.3. Numbers of Colony-Forming Units (CFU) of Lactic Acid Bacteria (LAB) in the Silage Inoculants and Numbers of LAB Applied per Gram of Fresh Crop

Silage Inoculant	Trial 1: Triticale		Trial 2: Alfalfa		Trial 3: Corn		Trial 4: Forage Sorghum	
	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop
A	$1.3x10^8$	$3.4x10^5$	$7.9x10^7$	$2.1x10^5$	---	---	---	---
B	---	---	---	---	$8.3x10^7$	$2.2x10^5$	$5.0x10^5$	$1.2x10^3$
C	$5.0x10^7$	$1.1x10^5$	$1.7x10^8$	$3.2x10^5$	$1.3x10^8$	$2.5x10^5$	$7.7x10^7$	$1.5x10^5$
D	$4.0x10^7$	$3.7x10^4$	$2.2x10^7$	$2.0x10^4$	$1.1x10^7$	$1.0x10^4$	$2.6x10^6$	$2.7x10^3$
E	$6.5x10^5$	$<10^3$	$1.2x10^6$	$1.2x10^3$	$1.5x10^5$	$<10^3$	$3.0x10^3$	$<10^3$
F	$<10^3$	$<10^3$	$<10^3$	$<10^3$	---	---	---	---
G	$1.0x10^5$	$<10^3$	$<10^3$	$<10^3$	$<10^3$	$<10^3$	---	---
H	$3.2x10^6$	$6.4x10^3$	$3.8x10^7$	$7.6x10^4$	$4.4x10^6$	$8.8x10^3$	$7.5x10^4$	$<10^3$
I	---	---	---	---	$7.9x10^5$	$1.0x10^3$	$3.5x10^5$	$<10^3$
J	$2.1x10^7$	$1.1x10^4$	$3.7x10^6$	$1.8x10^3$	$6.5x10^6$	$3.2x10^3$	$1.8x10^6$	$<10^3$
K	$5.0x10^7$	$6.6x10^4$	$5.6x10^7$	$7.4x10^4$	$3.2x10^7$	$4.2x10^4$	$1.8x10^7$	$2.9x10^4$
L	$8.8x10^6$	$8.8x10^3$	$3.7x10^7$	$3.7x10^4$	$1.6x10^6$	$1.6x10^3$	$<10^3$	$<10^3$
M	---	---	---	---	$3.4x10^5$	$<10^3$	$1.6x10^5$	$<10^3$
N	$1.4x10^8$	$7.0x10^4$	$5.5x10^7$	$2.8x10^4$	$3.0x10^7$	$1.5x10^4$	$<10^3$	$<10^3$

Table 34.3. (continued)

Silage Inoculant	Trial 5: Alfalfa		Trial 6: Forage Sorghum		Trial 7: Forage Sorghum	
	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop	CFU/ml or g of Inoculant	CFU Applied/g of Fresh Crop
B	---	---	---	---	$1.9x10^8$	$5.0x10^5$
C	---	---	---	---	$2.8x10^8$	$5.3x10^5$
E	---	---	$1.3x10^6$	$1.5x10^3$	---	---
G	---	---	---	---	$8.0x10^6$	$1.2x10^4$
K	$6.6x10^7$	$8.7x10^4$	$4.6x10^6$	$5.3x10^3$	---	---
N	---	---	$3.1x10^7$	$1.6x10^4$	---	---

Trial 1: Triticale. Silages were made from early-dough stage triticale (from ARCO Seed Co.) on June 19. The direct-cut crop contained 33 to 34% dry matter (DM) at harvest. The 11 inoculants evaluated are shown in Table 34.3. Three silos per treatment were opened at 24 and 48 hours and 4 and 90 days post-filling.

Trial 2: Alfalfa. Silages were made from 2nd-cutting alfalfa on July 2, and the crop was field-wilted to approximately 38% DM prior to harvest. The 11 inoculants evaluated are shown in Table 34.3. All other procedures were as described in Trial 1, except additional opening times for control and inoculants C, E, and N included 12 hours and 7 and 21 days post-filling.

Trial 3: Corn. Silages were made from dent-stage corn on August 14 and the crop contained approximately 38% DM at harvest. The 12 inoculants evaluated are shown in Table 34.3. Three silos per treatment were opened at 12, 24, and 48 hours and 90 days post-filling. Additional opening times for control and inoculants C, E, and N were 6 hours and 7 and 21 days post-filling.

Trial 4: Forage Sorghum. Silages were made from late-dough stage forage sorghum (DeKalb 25E hybrid) on October 29. The crop contained approximately 33% DM at harvest. The 11 inoculants evaluated are shown in Table 34.3. Three silos per treatment were opened at 12, 24, and 48 hours and 21 and 90 days post-filling.

Trial 5: Alfalfa. Silages were made from 3rd-cutting alfalfa on July 16, and the crop was field-wilted to 42 to 44% DM at harvest. The inoculant evaluated is shown in Table 34.3. Three silos per treatment were opened at 24 and 48 hours and 4, 14, and 90 days post-filling.

Trial 6: Forage Sorghum. Silages were made from late-dough stage Acco Paymaster 351 hybrid forage sorghum on October 3. The crop contained approximately 30% DM at harvest. The three inoculants evaluated are shown in Table 34.3. Three silos per treatment were opened at 12 and 24 hours and 4, 21, and 90 days post-filling.

Trial 7: Forage Sorghum. Silages were made from late-dough stage forage sorghum (DeKalb 25E) on October 17. The crop contained approximately 25% DM at harvest. The three inoculants evaluated are shown in Table 34.3. Three silos per treatment were opened at 12, 24, and 48 hours and 4, 21, and 90 days post-filling.

Chemical Analyses of the Pre-ensiled Crops and Silages. Pre-ensiled crops were analyzed for DM, pH, total nitrogen (N), insoluble nitrogen, water soluble carbohydrates, acid detergent fiber, neutral detergent fiber, and buffer capacity. Silages from 6 hours to 14 days were analyzed for pH and lactic acid; 21-day silages for pH, lactic acid, and volatile fatty acids (VFA); and 90-day silages for DM, pH, lactic acid, VFA, ethanol, total N, and ammonia-nitrogen.

Microbiological Evaluations. Pre-ensiled samples of forage and inoculants were weighed, mixed in a high-speed blender and then diluted in sterile buffer. The following microorganism counts were made after appropriate dilutions with sterile buffer:

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

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

Lactic acid bacteria count. This measured the natural populations of lactic acid bacteria (LAB) in the forage and the LAB provided by inoculants at the time they were applied to the forage. Rogosa agar (DIFCO) was used, and the incubation was at 37 C for 3 days.

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

Results and Discussion

Results in Table 34.2 indicate widely different microbial profiles for the seven crops. Only the alfalfa in Trials 2 and 5 had 10^3 (1,000) or fewer LAB per gram of crop when the forages were treated and the silos were filled. The triticale and corn each had over 10^6 (one million) LAB per gram of crop, which are very high populations for pre-ensiled forages. Two of the forage sorghums had over 10^5 LAB per gram of crop, which is also considered a relatively high count.

The LAB numbers for the 14 silage inoculants, and the LAB applied per gram of treated crop in the seven trials are shown in Table 34.3. The inoculants were obtained directly from the manufacturer or were supplied by a representative of Sanofi Sante Animale in June and July of 1985. The products were stored according to label instructions until their last use in October 1985. Four inoculants (E, F, G, and M) supplied less than 10^3 viable LAB per gram of treated crop during their first use; three inoculants (H, I, and L) provided less than 10^4 (10,000) viable LAB per gram. Seven products supplied at least 10^4 LAB per gram on July 2 in Trial 2, but only two of these (C and K) provided 10^4 on October 29 in Trial 4. Clearly, there were large differences among inoculants in their initial numbers of LAB and in viability during storage.

Trial 1. Results are presented in Table 34.4. the triticale underwent a very rapid pH drop during the first 24 hours post-filling, from about 6.20 initially to between 4.19 and 4.27. It is not surprising that none of the 11 inoculants speeded the ensiling process, even those that supplied 10^4 or 10^5 LAB per gram of treated crop. The crop already contained 1.5 times more LAB than the number provided by inoculant A (490,000 vs. 340,000 per gram) and 6 times more than the number provided by inoculant K (490,000 vs. 66,000 per gram).

Trial 2. Results are shown in Table 34.5 and Figures 34.1 and 34.2. The alfalfa was highly "responsive", especially during the first 4 days post-filling. Seven inoculants (A, C, D, H, K, L, and N) dramatically increased the rates of pH decline and lactic acid production. These products also provided at least 10^4 LAB per gram of treated crop. Chemical composition differences among control and inoculated silages were narrowed in the day 90 silages. However, treated silages generally had lower pH, acetic acid, ethanol, and NH_3-N values and higher lactic acid contents than control silage.

Trial 3. Results are shown in Table 34.6 and Figures 34.3 and 34.4. The corn was a low response crop, which underwent an extremely rapid fermentation rate even in the control silage. All 12 silages were at or below a pH of 4.5 by hour 12 post-filling and at or below a pH of 4.1 by hour 24. Several of the inoculant silages had numerically lower pH values and higher lactic acid contents at hour 12, but differences were not consistently maintained at subsequent opening times. Few, if any, trends occurred in the data to correlate the day 90 silage characteristics with those of the products.

Trial 4. Results are shown in Table 34.7. The forage sorghum was a low response crop and had a composition profile similar to that of the corn used in Trial 3. The sorghum did not ensile as rapidly as the corn, but its cooler initial temperature at harvest (55 vs. 90 F) was largely responsible for the slower fermentation. The surprisingly low LAB numbers in most products eliminated any possibility of significant effects on rate and efficiency of fermentation. Inoculant C had the highest LAB applied per gram of crop ($1.5x10^5$) and it also gave the lowest pH at hours 24 and 48. Again, as was observed in Trial 3, the day 90 silages were very well preserved and of similar chemical composition.

Trial 5. Results are shown in Table 34.8 and confirm the results obtained with inoculant K in the early alfalfa trial (Table 34.5). At 48 hours post-filling, the treated silage had a one-unit lower pH (4.84 vs. 5.82) and 4.5 times as much lactic acid (5.78 vs. 1.28%) as the control silage.

Trials 6 and 7. Results are shown in Table 34.9 and are similar to those obtained with the forage sorghum used in Trial 4 (Table 34.7). Both the hybrids (Acco 351 and DeKalb 25E) were low response crops, characterized by high numbers of LAB on the pre-ensiled forage and sufficient water soluble carbohydrates to produce a relatively rapid silage fermentation. Although four of the six inoculants supplied 10^4 or 10^5 LAB per gram of treated crop, none produced a consistently lower pH or higher lactic acid content compared with the control from hour 12 to day 4 post-filling.

For a crop to ensile properly, an energy source (such as glucose or starch) and lactic acid bacteria must be present under anaerobic conditons. If a crop has a high number of lactic acid bacteria, adding more in the form of an inoculant is unlikely to affect the rate and efficiency of the ensiling process. If a crop is low in lactic acid bacteria, it probably will respond to an inoculant, provided the inoculant contains a large number of bacteria. Thus, a quick test for counting viable lactic acid bacteria, both in crops and in silage inoculants, would be a great advantage to silage producers.

Our data indicate that the number of lactic acid bacteria necessary for a rapid, efficient fermentation is about 10^5 CFU per gram of crop. When a crop with a low count is supplemented with an inoculant, it is important that the inoculant provides a high number of viable bacteria.

Table 34.4. pH and Chemical Composition Over Time for the Triticale Silages in Trial I

Time Post-filling and Item[1]		Control	Silage Inoculant Treatment										
			A	C	D	E	F	G	H	J	K	L	N
Initial:	pH	6.22	6.20	6.25	6.26	6.26	6.24	6.22	6.22	6.19	6.22	6.27	6.26
	Lactic	.07	.07	.06	.05	.07	.05	.05	.04	.07	.05	.05	.04
Hour 24:	pH	4.26	4.24	4.19	4.21	4.24	4.25	4.25	4.24	4.24	4.24	4.26	4.27
	Lactic	2.28	2.60	2.12	2.48	2.33	2.53	2.50	2.43	2.46	2.43	2.30	2.42
Hour 48:	pH	4.04	4.03	3.99	4.03	4.04	4.04	4.04	4.03	4.04	4.03	4.03	4.03
	Lactic	4.20	3.74	4.24	3.86	3.87	4.16	4.66	4.79	4.66	4.10	4.35	4.08
Day 4:	pH	4.13	4.14	4.12	4.12	4.12	4.13	4.12	4.12	4.15	4.12	4.11	4.11
	Lactic	4.76	4.82	4.80	4.85	4.68	5.27	4.44	4.80	4.52	4.69	4.40	5.26
Day 90:	pH	4.09	4.10	4.09	4.09	4.08	4.12	4.10	4.12	4.09	4.07	4.08	4.11
	Lactic	7.74	6.46	6.10	6.70	6.26	6.40	7.53	6.51	7.34	7.61	8.50	7.12
	Acetic	2.36	2.81	3.68	2.09	2.27	2.22	2.08	1.97	2.26	2.61	2.18	2.30
	Total	10.38	9.49	10.10	9.00	9.28	8.97	9.91	8.69	9.94	10.48	10.93	9.78

[1] Acids are reported as a % of the silage dry matter.

Table 34.5. pH and Chemical Composition Over Time for the Alfalfa Silages in Trial 2

Time Post-filling and Item[1]		Control	Silage Inoculant Treatment										
			A	C	D	E	F	G	H	J	K	L	N
Initial:	pH	5.97	5.97	5.97	5.99	5.95	5.99	5.99	5.99	5.98	5.97	5.97	5.97
	Lactic	.14	.12	.15	.11	.16	.15	.13	.13	.14	.14	.15	.14
Hour 12:	pH	6.13		4.88		6.16							6.14
	Lactic	.32		2.59		.22							.19
Hour 24:	pH	6.05	4.72	4.65	5.18	5.87	6.07	5.99	5.22	5.85	5.01	5.22	5.40
	Lactic	.53	3.29	5.19	2.17	1.66	.42	.78	3.07	1.27	3.09	2.35	2.20
Hour 48:	pH	5.73	4.63	4.64	4.80	5.38	5.74	5.67	5.04	5.52	4.76	5.00	4.86
	Lactic	2.03	6.50	6.44	5.84	3.27	1.95	1.79	4.20	2.69	4.66	4.22	4.51
Day 4:	pH	5.08	4.57	4.61	4.70	4.98	5.05	5.32	4.84	5.15	4.66	4.92	4.68
	Lactic	3.90	6.71	6.92	7.33	5.86	4.71	4.16	6.84	4.33	6.82	6.25	6.48
Day 7:	pH	4.79		4.59		4.80							4.61
	Lactic	6.85		7.24		6.91							8.58
Day 21:	pH	4.68		4.57		4.72							4.59
	Lactic	6.87		7.08		6.82							6.96
Day 90:	pH	4.79	4.52	4.60	4.58	4.68	4.60	4.68	4.72	4.72	4.58	4.72	4.56
	Lactic	4.99	4.80	5.31	7.68	4.82	6.90	4.58	4.06	3.81	5.09	5.13	5.76
	Acetic	2.06	.96	1.52	1.33	1.91	1.70	1.34	1.14	1.54	1.23	1.27	1.89
	Total acids	7.06	5.86	6.84	9.05	6.73	8.63	6.04	5.25	5.43	6.37	6.46	7.66
	Ethanol	.23	.16	.24	.16	.25	.19	.14	.13	.19	.23	.18	.26
	NH_3-N	.24	.22	.21	.22	.26	.27	.24	.23	.24	.23	.24	.19

[1] Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

Table 34.6. pH and Chemical Composition Over Time for the Corn Silages in Trial 3

Time Post-filling and Item[1]		Silage Inoculant Treatment												
		Control	B	C	D	E	G	H	I	J	K	L	M	N
Initial:	pH	5.82	5.82	5.82	5.80	5.83	5.80	5.83	5.84	5.81	5.81	5.82	5.79	5.81
	Lactic	.25	.24	.24	.21	.23	.26	.26	.27	.27	.29	.21	.29	.27
Hour 6:	pH	5.51		5.42		5.47								5.49
	Lactic	.35		.46		.45								.50
Hour 12:	pH	4.53	4.43	4.41	4.49	4.43	4.40	4.35	4.36	4.50	4.30	4.30	4.45	4.39
	Lactic	1.12	1.34	1.08	1.11	.93	1.46	1.80	1.87	1.38	1.42	2.00	1.19	1.33
Hour 24:	pH	4.07	4.05	4.05	4.08	4.07	4.08	4.01	4.02	4.10	4.00	4.02	4.10	4.06
	Lactic	2.51	3.45	2.76	3.28	2.98	3.03	3.94	3.19	2.81	3.39	2.83	3.23	2.84
Hour 48:	pH	3.89	3.89	3.88	3.90	3.89	3.89	3.87	3.88	3.93	3.88	3.90	3.91	3.90
	Lactic	4.02	4.19	3.97	4.90	4.29	4.59	5.07	4.87	4.72	4.23	5.22	4.46	4.23
Day 7:	pH	3.76		3.76		3.76								3.76
	Lactic	5.84		6.22		5.65								5.30
Day 21:	pH	3.69		3.68		3.69								3.69
	Lactic	5.22		5.87		5.62								6.00
	Acetic	1.56		1.41		1.71								1.61
	Total	6.78		7.28		7.33								7.61
Day 90:	pH	3.86	3.87	3.86	3.87	3.87	3.87	3.88	3.87	3.90	3.89	3.90	3.87	3.86
	Lactic	5.99	6.50	6.10	6.05	6.70	6.71	5.49	7.23	6.84	5.36	5.84	6.39	6.69
	Acetic	1.50	1.88	3.40	2.37	2.75	1.88	2.07	2.13	1.80	3.07	3.63	2.43	1.42
	Total acids	7.49	8.38	9.50	8.42	9.45	8.59	7.56	9.36	8.64	8.47	9.47	8.82	8.11
	Ethanol	2.26	2.07	2.01	2.11	2.15	2.43	2.37	2.20	1.96	2.43	2.13	2.22	2.70
	NH_3-N	.11	.09	.10	.09	.10	.09	.09	.09	.09	.09	.10	.09	.11

[1]Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.

Table 34.7. pH and Chemical Composition Over Time for the Forage Sorghum Silages in Trial 4

Time Post-filling and Item[1]		Silage Inoculant Treatment											
		Control	B	C	D	E	H	I	J	K	L	M	N
Initial:	pH	5.84	5.90	5.85	5.89	5.89	5.88	5.85	5.90	5.91	5.72	5.82	5.90
	Lactic	.21	.26	.26	.24	.23	.26	.28	.24	.24	.27	.28	.20
Hour 12:	pH	5.51	5.50	5.54	5.52	5.58	5.47	5.46	5.54	5.58	5.53	5.44	5.57
	Lactic	.59	.38	.56	.40	.48	.47	.40	.39	.36	.47	.53	.48
Hour 24:	pH	4.52	4.46	4.36	4.51	4.52	4.50	4.51	4.50	4.49	4.50	4.51	4.53
	Lactic	1.43	1.57	1.66	1.27	2.40	1.31	1.35	1.21	1.41	1.71	1.50	2.61
Hour 48:	pH	4.26	4.21	4.17	4.26	4.26	4.25	4.28	4.26	4.24	4.25	4.26	4.26
	Lactic	3.60	3.86	4.70	3.87	3.92	3.88	4.50	3.65	3.85	3.68	3.14	3.94
Day 21:	pH	3.86	3.87	3.87	3.87	3.86	3.84	3.88	3.86	3.85	3.85	3.87	3.86
	Lactic	5.72	4.71	5.46	4.81	5.70	5.00	4.75	5.36	5.21	3.40	5.60	5.52
Day 90:	pH	3.88	3.89	3.89	3.87	3.87	3.86	3.89	3.82	3.86	3.87	3.87	3.88
	Lactic	5.48	4.88	5.20	5.64	5.90	5.41	5.92	5.22	5.37	5.20	5.10	5.22
	Acetic	1.22	1.47	.56	1.67	.44	1.15	1.33	.60	.70	.82	1.39	.40
	Total acids	6.70	6.35	5.76	7.31	6.34	6.56	7.25	5.82	6.07	6.02	6.49	5.62
	NH_3-N	.06	.06	.05	.06	.06	.06	.06	.06	.06	.06	.06	.06

[1]Acids and NH_3-N are reported as a % of the silage dry matter.

Table 34.8. pH and Chemical Composition Over Time for the Alfalfa Silages in Trial 5

Time Post-filling and Item[1]		Control	Inoculant K
Initial:	pH	5.97	5.97
	Lactic	.21	.18
Hour 24:	pH	6.11	5.70
	Lactic	.30	1.43
Hour 48:	pH	5.82	4.84
	Lactic	1.28	5.78
Day 4:	pH	5.42	4.80
	Lactic	3.31	7.03
Day 14:	pH	4.99	4.73
	Lactic	5.60	6.81
Day 90:	pH	4.81	4.76
	Lactic	5.91	6.18
	Acetic	2.53	1.88
	Total acids	8.46	8.14
	NH_3-N	.23	.21

[1]Acids and NH_3-N are reported as a % of the silage dry matter.

Table 34.9. pH and Chemical Composition Over Time for the Forage Sorghum Silages in Trials 6 and 7

Time Post-filling and Item[1]		Trial 6				Trial 7			
			Inoculant				Inoculant		
		Control	E	K	N	Control	B	C	G
Initial:	pH	5.92	5.93	5.92	5.91	5.74	5.74	5.73	5.73
	Lactic	.23	.21	.25	.24	.28	.16	.24	.22
Hour 12:	pH	4.84	4.85	4.79	4.79	4.79	4.78	4.78	4.74
	Lactic	.73	.71	.83	.82	1.16	1.01	.89	.83
Hour 24:	pH	4.52	4.55	4.53	4.55	4.27	4.26	4.25	4.27
	Lactic	1.18	1.49	1.32	1.68	2.25	2.22	2.07	2.06
Hour 48:	pH	--	--	--	--	4.00	3.99	3.98	4.02
	Lactic	--	--	--	--	3.70	3.48	3.74	3.34
Day 4:	pH	4.09	4.10	4.09	4.08	3.90	3.88	3.87	3.89
	Lactic	3.61	3.93	3.54	3.96	3.84	3.92	4.05	3.81
Day 21:	pH	4.00	4.01	4.01	3.94	3.85	3.83	3.82	3.85
	Lactic	4.25	4.31	4.21	4.49	*	*	*	*
Day 90:	pH	4.04	4.05	4.07	3.96	3.89	3.88	3.88	3.90
	Lactic	4.54	4.55	4.58	4.93	4.23	4.11	4.63	3.95
	Acetic	1.57	1.63	1.67	1.66	2.21	1.85	1.92	2.13
	Total acids	6.21	6.27	6.33	6.73	6.48	6.00	6.59	6.13
	Ethanol	*	*	*	*	1.06	1.21	1.29	1.18
	NH_3-N	.08	.08	.09	.08	.07	.06	.06	.07

[1]Acids, ethanol, and NH_3-N are reported as a % of the silage dry matter.
*Not available.

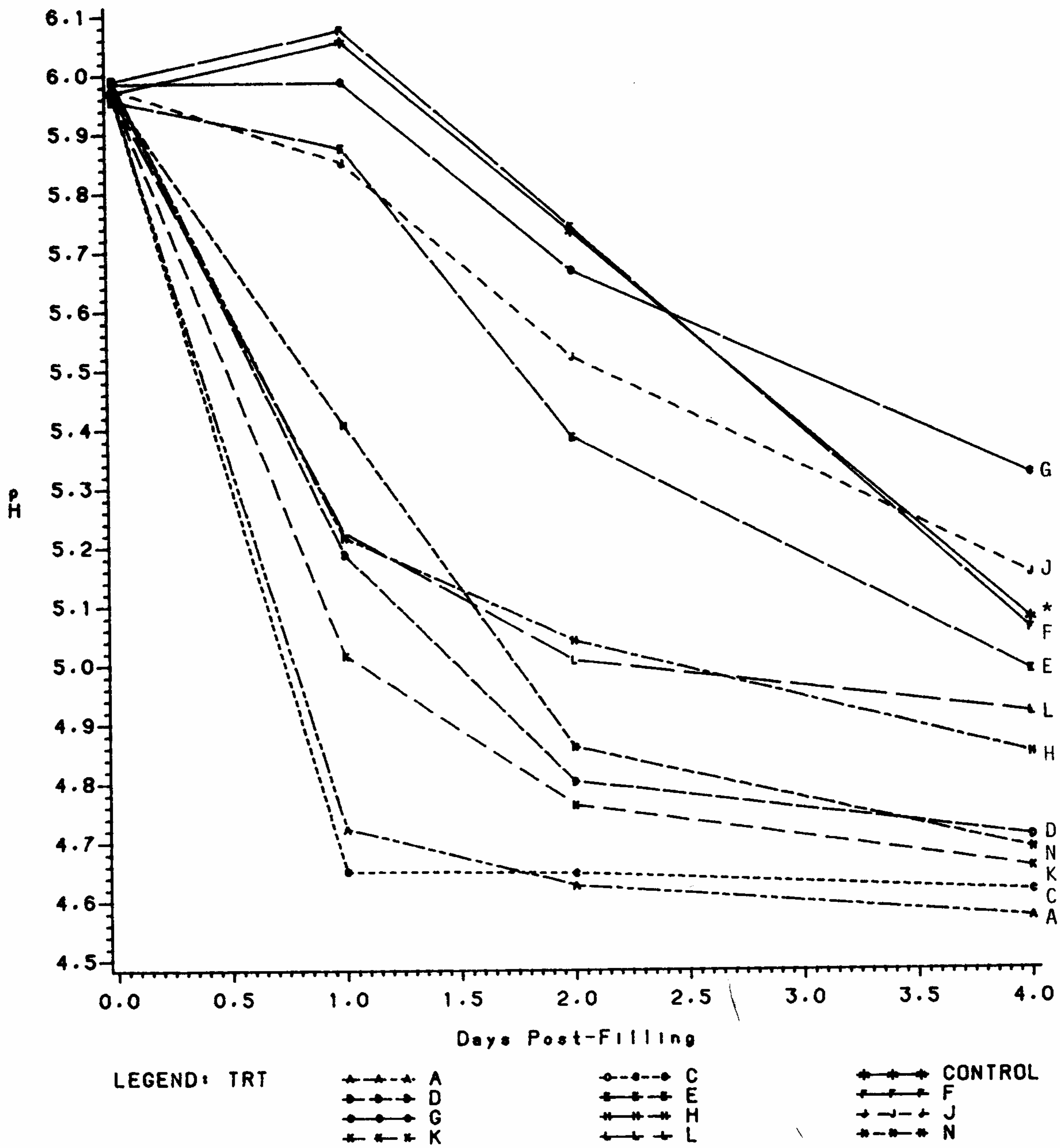

Figure 34.1. Effect of Inoculants on pH Over Time for Alfalfa Silages in Trial 2

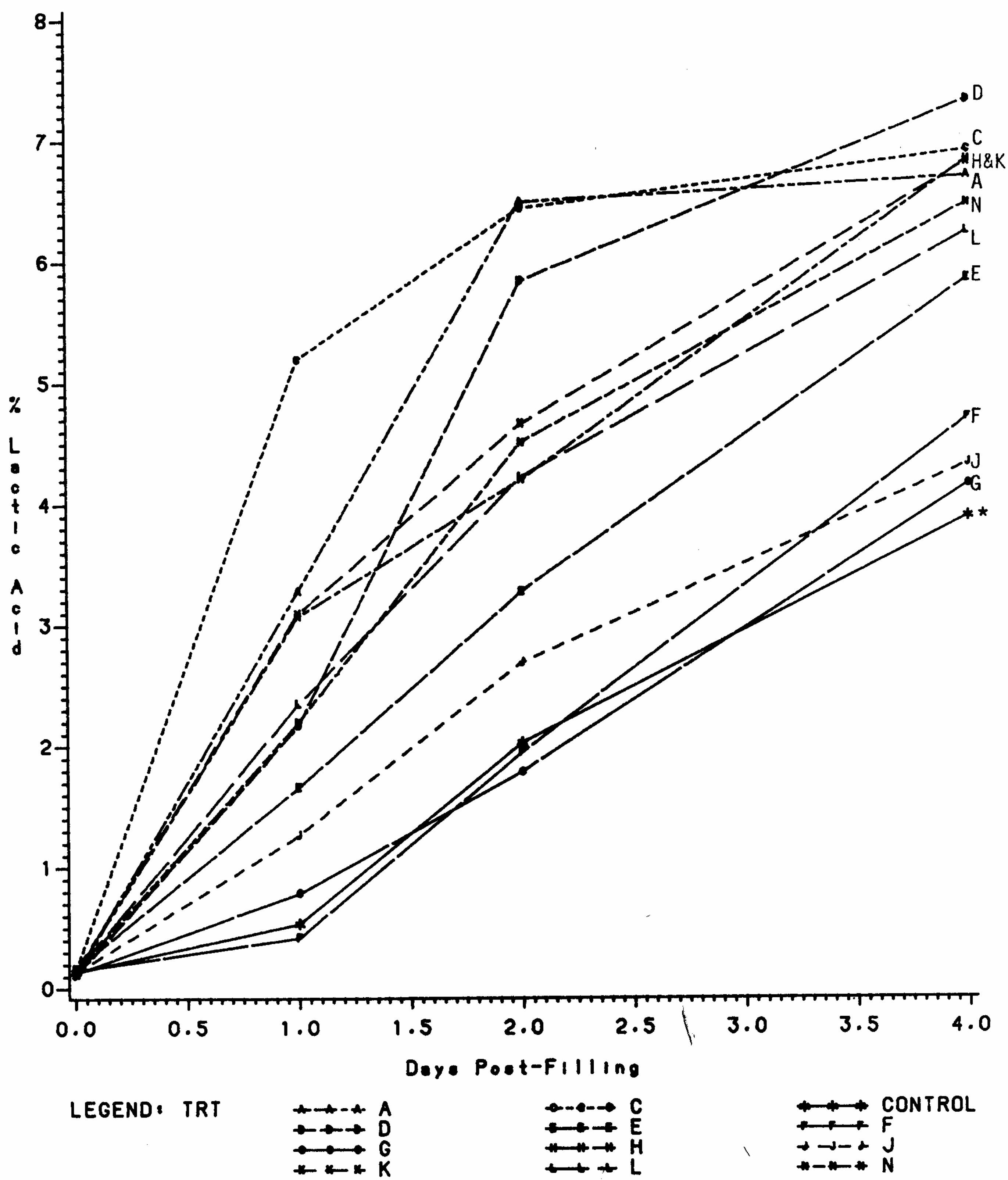

Figure 34.2. Effect of Inoculants on Lactic Acid Over Time for the Alfalfa Silages in Trial 2

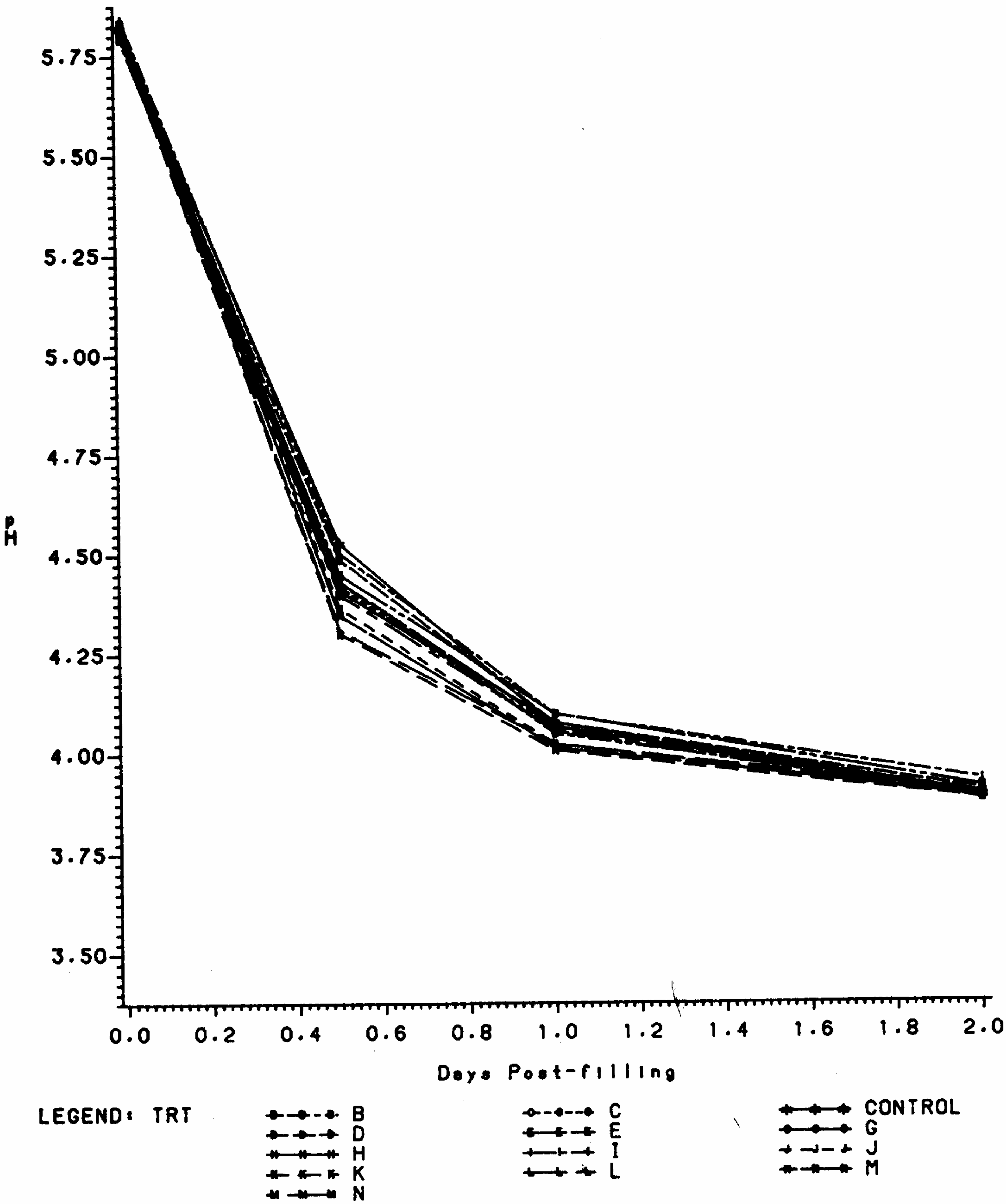

Figure 34.3. Effect of Inoculants on pH Over Time for the Corn Silages in Trial 3

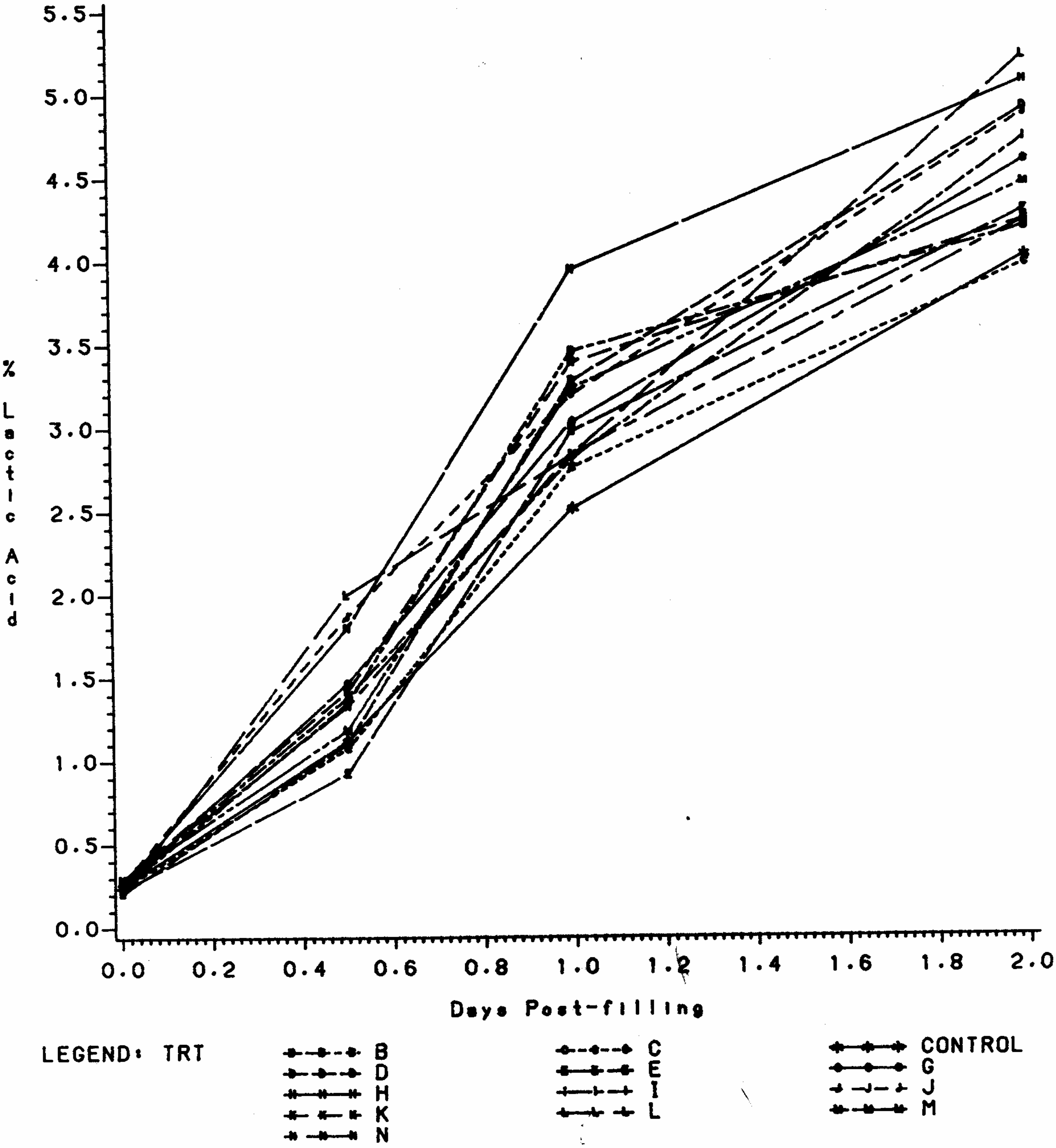

Figure 34.4. Effect of Inoculants on Lactic Acid Over Time for the Corn Silages in Trial 3

Additive-treated Corn Silages for Growing Cattle[1,2,3]

Lyle Lomas[4], Keith Bolsen, Harvey Ilg,
Brett Kirch, and Ahmed Laytimi

Summary

Whole-plant corn silages were treated with USO_3M or Silo-Best Soluble® in one trial and with Garst M-74® in a second trial. In Trial 1 all three silages were well preserved and moderately stable in the air. USO_3M silage lost less dry matter during fermentation than control or Silo-Best silages. Cattle fed the USO_3M silage made 7.6% faster gains and were 5.2% more efficient than those fed the control silage. Cattle performance with the Silo-Best Soluble and control silages was similar. In trial 2, heifer gains were nearly identical for both control and Garst M-74 silages.

Introduction

These trials evaluated three microbial inoculant additives, USO_3M, Silo-Best Soluble®, and Garst M-74®, for whole-plant corn silage using farm silo techniques. The effect of inoculants on the rate and efficiency of fermentation of corn and other silage crops using laboratory silos is reported in the article on page 107 of this Progress Report.

Experimental Procedures

Trial 1. Three whole-plant corn silages were compared: (1) control (no additive), (2) USO_3M, and (3) Silo-Best Soluble. Both additives were applied at the blower and at the manufacturers' recommended rates. The silages were made by the alternate load method in 10 x 50 ft concrete stave silos on September 4 and 5, 1985 from Pioneer 3183 corn harvested in the early-dent stage at 30 to 32% dry matter (DM). Each silo was partitioned vertically into halves as it was filled, with approximately 26 tons per half. The partitions were separated by plastic mesh fencing. Four thermocouple wires and five nylon bags, filled with 4.5 to 5.5 lb of fresh crop, were placed in the vertical center of each half, and ensiling

[1]Garst M-74® contains Streptococcus faecium M74, Lactobacillus plantarum, and Pediococcus sp. and is marketed by Garst Seed Company, Box 300, Coon Rapids, Iowa.

[2]Silo-Best Soluble® contains Streptococcus faecium, Lactobacillus acidophilus, Lactobacillus plantarum, and Pediococcus sp. fermentation products and is marketed by Cadco, Inc., Des Moines, Iowa, which provided partial financial assistance.

[3]USO_3M is an experimental inoculant containing Lactobacillus plantarum and Lactobacillus casei and was provided by Sanofi Sante Animale, 37 Avenue George V, 75008 Paris, France, which also provided partial financial assistance.

[4]Southeast Kansas Branch Experiment Station.

temperatures were monitored for the first 42 days. The silos were opened on February 16, 1986 and emptied at a uniform rate during the following 14 weeks. Samples were taken twice weekly for dry matter recovery and chemical analyses.

Each silage was fed to 15 yearling steers and heifers (three pens of cattle per silage) in an 84-day growing trial, which began on February 17, 1986. Rations were full-fed and all contained 87.6% silage and 12.4% supplement on a DM basis. Rations were formulated to provide 12.0% crude protein (DM basis), 200 mg of Rumensin® per animal daily, equal amounts of calcium and phosphorus, and vitamins A, D, and E. Supplements were top-dressed and partially mixed with the silages in the bunk. Feed offered was recorded daily for each of the pens and the quantity of silage fed was adjusted daily to assure that feed was always available. Feed not consumed was removed, weighed, and discarded every 7 days or as necessary.

For 3 days before the start of the feeding trial, all cattle were limit-fed a forage sorghum silage ration to provide a DM intake of 1.75% of body weight. Cattle were then weighed individually on 2 consecutive days after 16 hr without feed or water. For 2 days before the final weighing, the cattle were fed their respective silage rations at a restricted intake of 1.75% of body weight.

Trial 2. Whole-plant corn was treated with Garst M-74 inoculant at the time of ensiling and compared to untreated (control) silage. Both silages were made by the alternate load method in 16 x 50 ft concrete stave silos on August 6, 7, 8, 9 and 12, 1985 from a blend of 120-day Garst hybrids harvested in the mid to full-dent stage at 40 to 45% dry matter. Garst M-74 inoculant was applied at the blower at the manufacturer's recommended rate. The silos were opened on September 25, 1985 and emptied at a uniform rate during the next 36 weeks. Samples were taken twice weekly for DM recovery and chemcial analyses.

Each silage was fed to 18 yearling heifers (three pens of cattle per silage) in an 84-day growing trial which began on March 5, 1986. Rations contained 90.0% corn silage and 10.0% supplement on a DM basis and were fed *ad libitum*. Each ration was formulated to provide 13.0% crude protein (DM basis), 30 g of Bovatec® per ton of ration DM, equal amounts of calcium and phosphorus, and vitamins A, D, and E. Silage and supplement were mixed in a feed wagon and fed as a complete-mixed ration. Feed offered was recorded daily for each pen. Feed not consumed was removed, weighed, and discarded as necessary.

All heifers were fed supplemented control silage *ad libitum* for 8 days prior to the start of the feeding trial. At the beginning of the growing period, all heifers were implanted with Synovex-H® and dewormed with injectable levamasole hydrochloride. Initial and final weights were taken following a 16-hr shrink from both feed and water. One heifer receiving the Garst M-74 silage was removed from the trial for reasons unrelated to experimental treatment.

Results and Discussion

Trial 1. Ensiling temperatures (Figure 35.1) were nearly identical for the three silages; the absolute temperatures were quite high and reflected the very warm temperature of the fresh crop at harvest. The bottom half of each silo was filled in the afternoon and top half on the following morning. The maximum air temperature approached 100 F on both days.

Although chemical analyses are incomplete, preliminary results indicate that all silages had relatively low pH values, intermediate levels of total fermentation acids (predominately lactic acid), and low NH_3-N contents — all characteristics of well preserved corn silage. The three silages were moderately stable in air during the feedout period.

Silage recovery and loss data are shown in Table 35.1. In the concrete stave silos, DM lost during fermentation, storage, and feedout was 16.9% less for the USO_3M silage (5.9%) than for the control silage (7.1%). The data from the buried nylon bags showed a similar trend; USO_3M-treated bags lost 34.4% less DM than control bags (6.1 vs. 3.9%). Silo-Best Soluble did not consistently improve DM recoveries as compared to the control silage.

Table 35.1. Dry Matter Recoveries and Losses from the Concrete Stave Silos and Buried Bags for the Three Corn Silages

Item		DM Recovery: Feedable	DM Recovery: Non-feedable (Top spoilage)	DM Lost during Fermentation, Storage, and Feedout
		% of the DM Ensiled		
Concrete Stave Silos:				
Control	Top	90.3	1.7	8.0
	Bottom	93.5	—	6.5
	Avg.	91.9	—	7.1
USO_3M	Top	91.0	2.1	6.9
	Bottom	95.0	—	5.0
	Avg.	93.0	—	5.9
Silo-Best Soluble	Top	90.3	1.3	8.4
	Bottom	94.1	—	5.9
	Avg.	92.2	—	7.2
Buried Bags:				
Control	Top	93.6	—	6.4
	Bottom	94.2	—	5.8
	Avg.	93.9	—	6.1
USO_3M	Top	95.4	—	4.6
	Bottom	96.7	—	3.3
	Avg.	96.1	—	3.9
Silo-Best Soluble	Top	93.8	—	6.2
	Bottom	95.5	—	4.5
	Avg.	94.7	—	5.3

Performance by cattle during the 84-day feeding period is presented in Table 35.2. Cattle fed the USO_3M corn silage made 7.6% faster gains and were 5.2% more efficient than those fed the control silage. Having only three pens per treatment prevented these differences from being statistically significant. Cattle performance with the Silo-Best Soluble and control silages was similar.

Also shown in Table 35.2 are cattle gains per ton of corn ensiled. These data combine farm-scale silage recovery (Table 35.1) and cattle performance. The USO_3M-treated corn silage produced 7.3 lb more gain per ton of crop ensiled than the control silage; Silo-Best Soluble produced 1.0 lb more gain per ton.

Trial 2. Performance by heifers during the 84-day feeding period is presented in Table 35.2. Gains were nearly identical, although cattle fed Garst M-74 silage consumed 4.6% more feed. When cattle performance was combined with silage recoveries, the better feed conversion from the control silage offset the better recovery for the treated silage.

Table 35.2. Performance by Cattle Fed the Five Corn Silages and Cattle Gain per Ton of Crop Ensiled in the Two Trials

	Trial 1			Trial 2	
Item	Control	USO_3M	Silo-Best Soluble	Control	Garst M-74
No. of Cattle	15	15	15	18	17
Initial Wt., lb	642	640	645	543	544
Final Wt., lb	873	890	872	711	711
Total Gain, lb	231	250	227	168	167
Avg. Daily Gain, lb	2.76	2.97	2.70	2.00	1.99
Daily Feed Intake, lb[1]	18.94[ab]	19.39[a]	18.40[b]	15.76	16.49
Silage	16.59	16.97	16.11	14.18	14.84
Supplement	2.35	2.42	2.29	1.58	1.65
Feed/lb of Gain, lb[1]	6.89	6.53	6.81	7.88	8.29
Silage Fed, lb/Ton Ensiled[2]	1838	1860	1844	1732*	1762*
Silage/lb of Gain, lb[2]	17.2	16.3	17.1	20.3	21.3
Cattle Gain/Ton of Crop Ensiled, lb[2]	106.8	114.1	107.8	85.3	82.7

[ab]Values in Trial 1 in the same row with different superscripts differ (P<.10).
[1]100% dry matter basis.
[2]Values are adjusted to the same silage DM content; 35 percent.
*Dry matter recoveries were 86.6% for control and 88.1% for Garst M-74 silages.

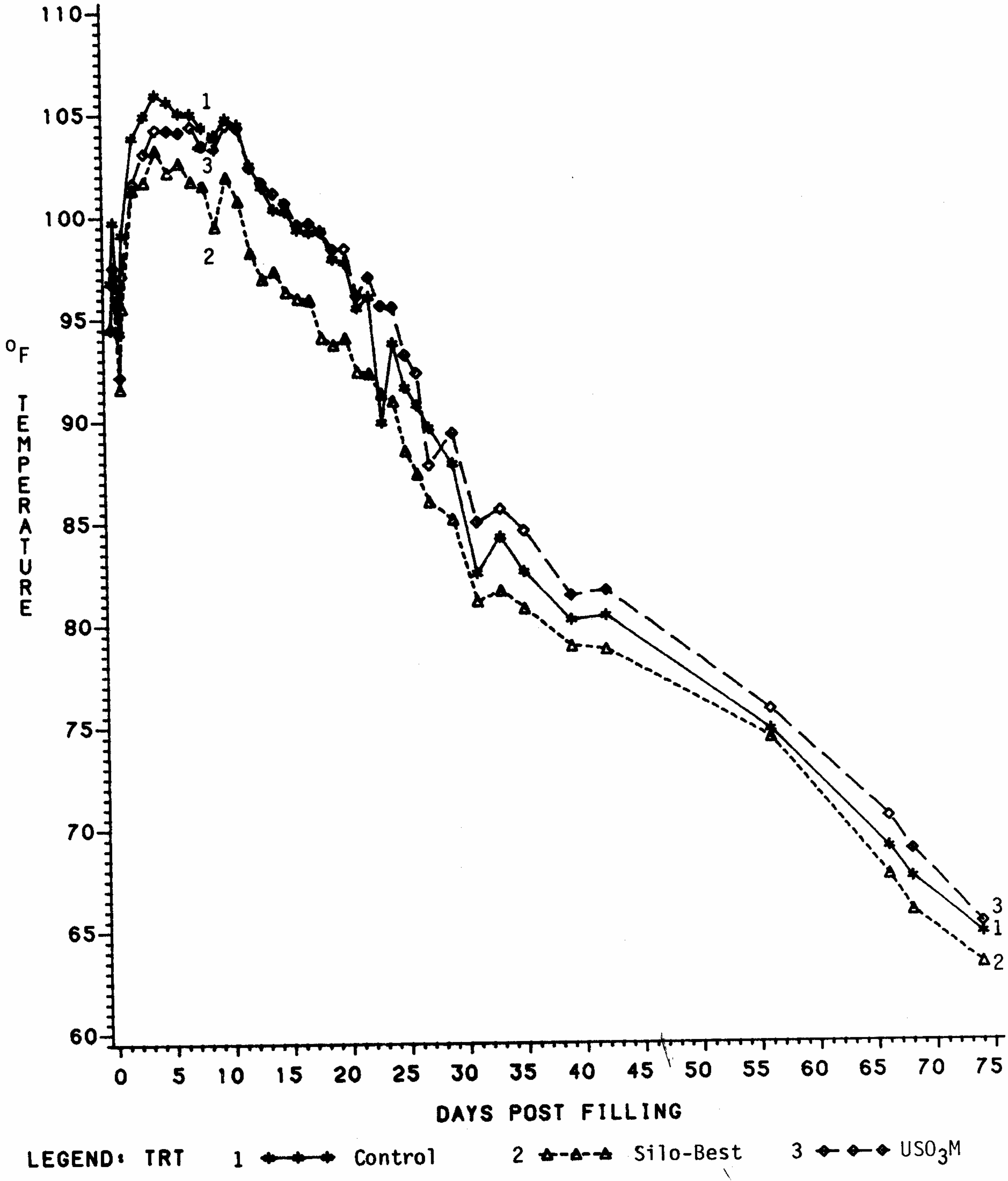

Figure 35.1. Ensiling Temperatures for the Three Corn Silages (Mean of the Top and Bottom Halves of Each Silo)

Effect of Environmental Temperature and an Inoculant on the Fermentation of Forage Sorghum Silage[1]

Keith Bolsen

Summary

The inoculant, BioPower®, increased the rate and efficiency of ensiling in Acco Paymaster 351 forage sorghum regardless of storage temperature. The untreated, 60 F silage fermentated slower and had higher pH, lower lactic acid, and higher acetic acid values than its 90 F counterpart.

Introduction

Silage-making in Kansas begins in May with crops like alfalfa and winter cereals and ends in November with late-season forage sorghums. During these 7 months, minimum and maximum daytime temperatures will range from less than 32 F to over 100 F. How do the air temperature and the temperature of harvested forage as it enters the silo affect the ensiling process? Results from last year (Report of Progress 494) indicated that initial fermentation was delayed by a cool temperature and that a warm initial temperature produced silages with lower pH values and higher acid contents. In addition, a silage inoculant increased the fermentation rate of cool alfalfa but not forage sorghum.

The objective of this trial was to further document the effect of storage temperatures and inoculants on the rate and efficiency of fermentation in forage sorghum.

Experimental Procedures

The laboratory silo used in this trial, the treatment methods, and the silo-filling techniques were similar to those described in the article on page 107 of this report. The inoculant, BioPower®, was applied in liquid form, contained *Streptococcus faecium* and *Lactobacillus plantarum*, and supplied 2.1×10^5 colony-forming units of bacteria per gram of crop. Chemical composition and microbiology of the pre-ensiled crop are presented in Table 36.1.

The silages were made from late-dough stage hybrid forage sorghum (Acco Paymaster 351) during the second week of October. The direct-cut material contained 35.5% dry matter and was approximately 70 F when ensiled.

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[1]Partial financial assistance was provided by BioTechniques Laboratories, Inc., 15555 N.E. 33 Bio Tech Road, Redmond, WA 98052.

Four treatments were compared: (1) control (no inoculant), with the laboratory silos stored at 60 F (control-60); (2) control, with silos stored at 90 F (control-90); (3) BioPower-treated, with silos stored at 60 F (BioPower-60); and (4) BioPower-treated, with silos stored at 90 F (BioPower-90). Twenty-one laboratory silos were filled for each treatment, with three silos per treatment opened at 12, 24, and 48 hours and 4, 7, 14, and 42 days post-filling.

Results and Discussion

Presented in Table 36.2 are the fermentation dynamics of the four silages. At hours 12 and 24 post-filling, both 90 F silages had sharply lower pH values and higher lactic acid contents than the 60 F silages. Beginning at hour 48 at 90 F and day 4 at 60 F, the BioPower-treated silages had lower ($P<.05$) pH values and higher lactic acid contents than their counterpart control silages. These differences were maintained through day 42 post-filling. The BioPower-60 and control-90 silages had similar pH and acid profiles after 42 days. On day 42, the lower pH values and higher lactic to acetic acid ratios in the inoculated and higher temperature silages are evidence of the slower and less efficient fermentation in the cooler environment.

Table 36.1. Composition of the Pre-ensiled Forage Sorghum

Item	Acco 351
Dry Matter, %	35.5
pH	5.8
Water Soluble Carbohydrates[1]	12.2
Crude Protein[1]	5.63
Buffer Capacity[2]	19.9
Mesophilic[3]	9×10^6
Lactic Acid Bacteria[3]	1.2×10^4
Yeasts and Molds[3]	6×10^4

[1]Expressed as a percent of the dry matter.

[2]Milliequivalents NaOH per 100 grams of dry matter required to raise the pH of the fresh crop material to 6.0.

[3]Colony-forming units per gram of crop.

Table 36.2. Chemical Composition and pH Over Time for the Control and Inoculated Forage Sorghum Silages at Two Temperatures

Time Post-filling and Item		60 F Control	60 F BioPower	90 F Control	90 F BioPower	SE
Initial:	pH	5.74	5.82	5.74	5.82	--
	Lactic Acid[1]	.19	.21	.19	.21	--
Hour 12:	pH	5.70[b]	5.71[b]	4.63[a]	4.64[a]	.034
	Lactic Acid	.21[c]	.20[c]	.52[a]	.42[b]	.016
Hour 24:	pH	4.91[b]	4.90[b]	4.20[a]	4.21[a]	.013
	Lactic Acid	.26[b]	.35[b]	1.54[a]	1.47[a]	.038
Hour 48:	pH	4.25[b]	4.14[ab]	4.15[ab]	4.03[a]	.018
	Lactic Acid	1.63[b]	1.83[b]	2.47[a]	2.89[a]	.095
Day 4:	pH	4.20[c]	4.12[b]	4.09[b]	3.93[a]	.008
	Lactic Acid	1.89[c]	2.07[b]	2.16[b]	3.42[a]	.141
Day 7:	pH	4.21[c]	4.06[b]	4.04[b]	3.83[a]	.008
	Lactic Acid	2.52[c]	4.19[ab]	3.33[ab]	5.10[a]	.463
Day 14:	pH	4.22[d]	3.96[b]	4.00[c]	3.80[a]	.011
	Lactic Acid	2.27[c]	3.62[b]	3.36[b]	5.07[a]	.220
Day 42:	pH	3.96[c]	3.77[a]	3.86[b]	3.77[a]	.029
	Lactic Acid	3.64[b]	4.47[ab]	4.29[b]	5.23[a]	.309
	Acetic Acid[1]	2.64[a]	2.32[b]	2.23[b]	2.02[c]	.112

[1]Lactic and acetic acids expressed as a percent of the silage dry matter.

[abcd]Values on the same line not having the same superscript differ ($P<.05$).

Whole-plant Forage and Grain Sorghum Silages for Growing Cattle

Brett Kirch, Susan Hamma, Keith Bolsen,
Harvey Ilg, and Jim Hoover

Summary

Four trials were conducted to determine the feeding value of whole-plant forage and grain sorghum silages. In general, growing cattle fed grain sorghum hybrids (NK2778, Funk's 550, DeKalb 42Y, DeKalb E67) out performed those fed forage sorghum silages. Only moderate to high grain-content, forage sorghums (Buffalo Canex, Pioneer 947, Acco 351) gave performances that approached the grain sorghums. Low grain-content and nonheading forage sorghums (DeKalb 25E, Funk's G-1990) resulted in the poorest cattle performance. These studies indicate that grain content of a sorghum silage is the major determinant of cattle performance and that whole-plant grain sorghums should produce the fastest and most efficient gains in growing programs.

Introduction

Whole-plant, grain sorghum silage offers an alternative to traditional forage sorghum silages for feeding growing cattle. Grain sorghum silages generally have the following advantages over their forage sorghum counterparts: 1) higher grain content, which leads to higher daily gains, thus largely offsetting the yield advantages of forage sorghums; 2) more protein, which will lower supplementation costs; and 3) earlier maturity and improved dry-down characteristics, leading to better silage preservation and increased silage intake.

Summarized here are data from 4 years of feeding comparisons between whole-plant, grain sorghum and forage sorghum silages used for growing cattle.

Experimental Procedures

Summarized in Table 37.1 are the harvest dates, dry matters, and crude protein contents at harvest for the forage and grain sorghum hybrids used in the 1985 trial (Trial 4), as well as hybrids used in the three previous years (Trials 1, 2, and 3).

Further details of procedures for Trials 1, 2, and 3 are in the Reports of Progress 448, 470, and 494, respectively.

All hybrids were direct-cut using a Field Queen forage harvester. Grains were in the late-dough stage, except for the nonheading Funk's G-1990, which was ensiled on the same day as Pioneer 947 in Trial 1 and DeKalb 25E in Trial 2. All silages were made in either 10 x 50 ft or 14 x 60 ft concrete stave silos, except Pioneer 947 and DeKalb 25E in Trial 4, which were ensiled in 8 x 75 ft AgBags®.

Trial 1. The three whole-plant silages were each fed to 16 steer calves (four pens of four calves per ration with an initial avg. wt. of 453 lb). Each silage was full-fed with 2.0 lb of supplement per calf daily (as-fed basis). Rations were formulated to provide 12.5% crude protein (CP) on a dry matter (DM) basis, 150 mg of Rumensin® per head daily, equal amounts of calcium and phosphorus, and vitamin A. All calves received hormonal implants at the start of the trial. The growing trial lasted 56 days; November 20, 1982 to January 14, 1983.

Trial 2. The three whole-plant silages were each fed to 20 crossbred steers (four pens of five steers per ration with an initial avg. wt. of 572 lb). Rations were formulated and fed as described in Trial 1, except they contained 12.0% CP (DM basis) and provided 200 mg of Rumensin. The growing trial lasted 84 days; December 15, 1983 to March 9, 1984.

Trial 3. The three whole-plant silages were each fed to 16 crossbred steers and heifers (two pens of four steers and two pens of four heifers per ration) with an initial avg. wt. of 623 and 553 lb, respectively. Rations were formulated and fed as described in Trial 2, except the steer rations contained 11.0% CP (DM basis). The growing trial lasted 84 days; February 15 to May 10, 1985.

Trial 4. In 1985, whole-plant silages were made from four forage sorghum and three grain sorghum hybrids. Each silage was fed to eight crossbred steer and heifer calves (two pens of three steers and one heifer per ration with an initial avg. wt. of 538 lb). The fixed-percentage rations contained 87.6% silage and 12.4% supplement (DM basis). Each ration provided 12.0% CP (DM basis), 200 mg of Rumensin per calf daily, equal amounts of calcium and phosphorus, and vitamin A. The growing trial lasted 70 days; December 6, 1985 to February 14, 1986.

Calves were weighed on 2 consecutive days at the beginning and end of the trial, after 16 hr without feed or water. To minimize fill effects, all calves were fed a forage sorghum silage ration at 1.75% of body weight (DM basis) for 1 week before the trial began.

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

Results and Discussion

Chemical analyses of the silages fed in Trials 1, 2 and 3 are shown in Table 37.2. Dry matter and CP values were largest, and fiber components smallest, for silages with high grain-content. The nonheading Funk's G-1990 had the lowest CP values and the highest fiber values. In general, the high moisture, late maturing hybrids produced silages with high total fermentation acids and the highest in-silo DM losses.

Trial 1. Performance by calves fed three whole-plant silage rations is shown in Table 37.3. The grain sorghum hybrid (DeKalb E67) gave superior daily gain and intake. The moderate grain content forage sorghum hybrid (Pioneer 947) supported intermediate daily gain and intake, but was equal to the grain hybrid in efficiency.

The nonheading G-1990 produced very low daily gain and intake and gave the worst feed efficiency of the three silages.

Trial 2. The grain sorghum hybrid (DeKalb 42Y) gave better cattle performance when compared with the two forage sorghums (Table 37.3). Daily gain and intake were highest for DeKalb 42Y silage. The low grain-yielding forage hybrid (DeKalb 25E) and Funk's G-1990 supported comparable daily gains and intakes, but feed efficiency for the nonheading forage sorghum was the poorest of the three silages.

Trial 3. In this trial, cattle fed the grain sorghum silage (DeKalb 42Y) outperformed those fed the moderate grain-yielding forage sorghum (Buffalo Canex) and the low grain-yielding forage sorghum (DeKalb 25E) for both daily gain and intake (Table 37.3). Buffalo Canex silage supported better gain and intake than DeKalb 25E. Efficiency of gain was equal among all three hybrids. Note that no nonheading silage was included in this trial.

Trial 4. The three grain sorghum hybrids (Funk's 550, NK2778, DeKalb 42Y) produced the highest daily gains (Table 37.4). The moderate grain-yielding forage sorghum hybrids (Buffalo Canex, Acco 351, Pioneer 947) produced respectable gains: over 2 lb per day. The low grain-yielding forage sorghum hybrid (DeKalb 25E) produced the poorest gain of the seven hybrids.

Calves consumed more of the grain sorghum silage rations than the forage sorghum silages, and the intake of the low grain-yielding hybrid was quite low (only 2.0% of body wt.). Efficiency of gain was virtually the same for all hybrids with the exception of DeKalb 25E, which produced the least efficient gain.

Based on 4 years of data, it is doubtful that nonheading sorghums have a place in growing programs. Also, the reduced daily gains with low grain-yielding forage sorghums may limit their use in growing rations. Relative feeding values (RFV) were assigned to each sorghum type based upon comparative rates and efficiencies of gain, with performance by cattle fed the DeKalb grain sorghum hybrids given a value of 100. Nonheading and low grain-content forage sorghum silages had RFV's of 66 and 78, respectively, while moderate to high grain-content forage sorghum silages had an average RFV of 95. Considering the excellent rate and efficiency of gains, grain sorghums may be more valuable in whole-plant silage rations than when the crop is harvested for grain.

Feeding comparisons with seven grain-producing forage sorghums and three grain sorghums, all harvested as whole-plant silage, will be presented next year.

Table 37.1. Hybrid Types, Harvest Dates, and Dry Matter (DM) and Crude Protein (CP) Contents at Harvest

Year, Trial, and Hybrid	Hybrid Type	Harvest Date	Whole-plant % DM	Whole-plant % CP
1982 (Trial 1):				
Funk's G-1990	Forage[1]	Oct. 4	24.0	6.5
Pioneer 947	Forage[3]	Sept. 23	31.0	8.6
DeKalb E67	Grain	Sept. 20	37.0	8.9
1983 (Trial 2):				
Funk's G-1990	Forage[1]	Sept. 29	27.1	5.9
DeKalb 25A	Forage[2]	Sept. 27	29.2	6.0
DeKalb 42Y	Grain	Aug. 28-30	42.1	10.7
1984 (Trial 3):				
Buffalo Canex	Forage[3]	Aug. 27-28	30.8	8.0
DeKalb 25E	Forage[2]	Oct. 2	25.8	7.2
DeKalb 42Y	Grain	Sept. 4 & 26	41.3	9.6
1985 (Trial 4):				
Buffalo Canex	Forage[3]	Sept. 16	28.0	8.5
Acco Paymaster 351	Forage[3]	Sept. 26-27	32.6	8.8
Pioneer 947	Forage[3]	Sept. 27	37.0	7.8
DeKalb 25E	Forage[2]	Oct. 31	30.4	7.0
Funk's 550	Grain	Sept. 16	38.0	11.5
Northrup King 2778	Grain	Sept. 19	39.0	10.3
DeKalb 42Y	Grain	Oct. 7	44.0	10.3

[1]Nonheading forage sorghum.
[2]Low grain-content forage sorghum.
[3]Moderate to high grain-content forage sorghum.

Table 37.2. Chemical Analyses of the Forage and Grain Sorghum Silages Fed in Trials 1, 2, and 3

Item	Trial 1 (1982) Funk's G-1990 (NH[1])	Trial 1 (1982) Pioneer 947 (F)	Trial 1 (1982) DeKalb E67 (G)	Trial 2 (1983) Funk's G-1990 (NH)	Trial 2 (1983) DeKalb 25E (F)	Trial 2 (1983) DeKalb 42Y (G)	Trial 3 (1984) DeKalb 25E (F)	Trial 3 (1984) Buffalo Canex (F)	Trial 3 (1984) DeKalb 42Y (G)
Silage DM, %	22.0	37.0	36.0	24.9	25.1	42.3	24.75	29.8	42.3
pH	4.10	3.90	4.19	3.75	3.82	4.19	3.58	3.67	4.13
	% of the Silage DM								
Lactic Acid	2.77	4.62	5.10	9.61	8.78	5.92	4.60	4.88	3.58
Acetic Acid	6.00	1.75	1.61	3.01	2.43	1.54	2.57	1.56	2.04
Butyric Acid	.09	.01	.01	<.01	<.01	<.01	<.01	<.01	.08
Total Fermentation Acids	10.3	6.5	6.8	12.7	11.3	7.5	7.3	6.5	5.8
Acid Detergent Fiber	41.1	31.2	27.5	40.3	38.8	23.3	34.5	27.1	26.5
Neutral Detergent Fiber	66.4	55.6	42.9	64.9	63.9	40.1	63.0	53.5	41.7
Crude Protein	6.5	8.6	9.0	6.1	6.2	10.9	7.4	8.1	9.8
	% of the Total Silage Nitrogen								
Ammonia-N	--	--	--	5.2	4.2	6.5	4.0	2.9	6.1
Hot Water Insoluble-N	36	62	47	55	47	47	47	66	62

[1]NH = nonheading, F = forage sorghum, G = grain sorghum.

Table 37.3. Performance by Cattle Fed the Forage and Grain Sorghum Silage Rations in Trials 1, 2, and 3

Item	Trial 1 (1982)			Trial 2 (1983)			Trial 3 (1984)		
	Funk's G-1990 (NH[1])	Pioneer 947 (F)	DeKalb E67 (G)	Funk's G-1990 (NH)	DeKalb 25A (F)	DeKalb 42Y (G)	DeKalb 25E (F)	Buffalo Canex (F)	DeKalb 42Y (G)
No. of Cattle	16	16	16	20	20	20	16	16	16
Initial Wt., lb	452	453	453	572	572	573	576	592	593
Avg. Daily Gain, lb	$.95^{c}$	1.77^{b}	2.12^{a}	1.25^{b}	1.37^{b}	2.25^{a}	1.75^{c}	2.16^{b}	2.37^{a}
Avg. Daily Feed, lb[2]	8.4^{c}	11.9^{b}	15.0^{a}	12.6^{b}	12.0^{b}	19.4^{a}	13.4^{c}	16.9^{b}	18.5^{a}
Feed/lb of Gain, lb[2]	9.0^{b}	6.8^{a}	7.1^{a}	10.1^{b}	8.9^{a}	8.7^{a}	7.8	8.0	8.0
Relative Feeding Value[3]	60	94	100	71	79	100	88	95	100

a,b,c Means within a trial with different superscripts differ (P<.05).

[1] NH = nonheading, F = forage sorghum, G = grain sorghum.

[2] 100% dry matter basis.

[3] Based upon comparative rates and efficiencies of gain, with performance by cattle fed DeKalb grain sorghum silages assigned a value of 100.

Table 37.4. Performance by Cattle Fed the Forage and Grain Sorghum Silage Rations in Trial 4 (1985)

Item	Forage Sorghum Hybrid				Grain Sorghum Hybrid		
	DeKalb 25E	Buffalo Canex	Acco 351	Pioneer 947	Funk's 550	NK 2278	DeKalb 42Y
No. of Calves	8	8	8	8	8	8	8
Initial Wt., lb	541	538	533	536	535	543	542
Avg. Daily Gain, lb	1.34^{d}	2.09^{c}	2.15^{bc}	2.03^{c}	2.53^{a}	2.46^{ab}	2.45^{ab}
Avg. Daily Feed, lb[1]	12.7^{c}	14.4^{b}	15.0^{b}	14.6^{b}	17.7^{a}	17.8^{a}	18.1^{a}
Feed/lb of Gain, lb[1]	9.6^{b}	6.9^{a}	7.0^{a}	7.2^{a}	7.0^{a}	7.2^{a}	7.5^{a}
Relative Feeding Value[2]	66	97	97	93	105	102	100

a,b,c Means within a trial with different superscripts differ (P<.05).

[1] 100% dry matter basis.

[2] Based upon comparative rates and efficiencies of gain, with performance by cattle fed DeKalb grain sorghum silages assigned a value of 100.

Effect of Maturity at Harvest on Yield, Composition, and Feeding Value of Forage and Grain Sorghum Silages

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Summary

In the last 2 years, three trials were conducted to determine the influence of hybrid and stage of maturity at harvest on silage yield, composition, and nutritive value for 15 forage and nine grain sorghum hybrids. Agronomic data, such as days to half bloom, plant height, and whole-plant dry matter (DM) and grain yields, were also obtained. In Trial 1, Pioneer 947, Acco Paymaster 351, and DeKalb 25E forage sorghum hybrids had different whole-plant DM and crude protein (CP) contents. Whole-plant DM increased, whereas CP generally decreased with advancing maturity. Hybrid affected both DM intake and CP digestibility. Results indicated that the late-dough stage of maturity optimized both yield and nutritive value.

In Trials 2 and 3, grain sorghums reached the late-dough stage in fewer days than forage sorghums. The whole-plant DM and CP contents and grain yields differed considerably among the forage sorghums, and all were lower than values for the grain sorghum hybrids. However, whole-plant DM yields were generally higher, but much more variable for the forage than for the grain sorghums. These results substantiate that large variations exist among forage sorghums and between grain and forage sorghum hybrids. Sorghums with higher DM and grain content should be favored and harvested at the late-dough stage for silage.

Introduction

In 1984, Kansas produced almost 2 million tons of forage sorghum silage. It is essential that cattlemen have information on the relative yields and feeding values of the many hybrids and varieties that are currently available for this important feed resource. Our objective was to supplement previous research results documenting how hybrid and stage of maturity at harvest influence yield, composition, and nutritive value of silage made from different forage sorghums. Grain sorghum hybrids were included in two trials for comparison.

Experimental Procedures

Trial 1. Three forage sorghums (Pioneer 947, Acco Paymaster 351, and DeKalb 25E) were grown as described in Report of Progress 494 (Cattlemen's Day, 1986). Agronomic data from that report are reproduced in Table 38.1. Hybrids were harvested at four stages: late-milk to early-dough (stage 1), late-dough (stage 2), post-frost, hard-grain (stage 3), and 2 to 4 weeks post-frost, hard-grain (stage 4).

Each of the 12 forages was ensiled in 55 gallon metal drums lined with plastic and fed to mature wethers in a three-period voluntary intake and digestion trial. All rations were 90% silage and 10% supplement on a dry matter (DM) basis and formulated to contain 11.5% crude protein. Each 20-day feeding period consisted of a 6-day ration acclimation phase followed by a 5-day voluntary intake measurement, a 2-day ration intake adjustment to 90% of voluntary intake, and a 7-day fecal collection phase. Wethers were randomly assigned to the rations for each period.

Trial 2. Dryland forage and grain sorghum field plots were established in the summer of 1985. Four forage sorghum hybrids (Warner's Sweet Bee, Warner's Sweet Bee Sterile, Golden Harvest T-E Silomaker, and Conlee's Cow Vittles) and four grain sorghum hybrids (WAC 652G, DeKalb DK 42Y, NC+ 174, and Asgrow Colt) were used. They were chosen to represent a range of sorghum pedigrees, which included variation in maturity (season length), plant height, and forage and grain yields. Each hybrid was harvested at three stages of kernel development: late-milk to early dough, late-dough, and hard-grain. Warner's Sweet Bee Sterile, which produces no grain, was harvested shortly after each harvest of the grain-producing Sweet Bee. Treatments were arranged in a split-plot design with stages of harvest as main plots and hybrids as subplots, with four replications.

About 100 lb per acre of anhydrous ammonia and a broadcast pre-emergence herbicide (Ramrod®-Atrazine®) were applied before planting. All plots were planted on June 13. Two to 3 weeks after emergence, the plots were thinned to 34,850 plants per acre (6 inches between plants). On July 24, Lorsban® insecticide spray was applied for greenbug control. Each plot had six rows, 30 inches apart and 30 ft long.

Agronomic data collected for each plot included days to half bloom, plant height, whole-plant DM, and grain yields. Days to half bloom were used to measure season length. This is defined as the number of days between planting and the date when half the main heads exhibited some florets. Plant height was measured to the tallest point of the head immediately prior to the first harvest. Whole-plant DM yields were determined by harvesting 20 ft from each of the two center rows. All rows were harvested using a modified, one-row forage harvester. Chopped forage from each plot was weighed, sampled, and collected for making silage. Grain yields were determined by hand-cutting the heads from 20 ft of one of the remaining rows. The heads were dried and threshed in a stationary thresher.

Trial 3. Seven forage sorghum hybrids and five grain sorghum hybrids were grown in 1986. The forage sorghums included two early maturing (Buffalo Canex and Pioneer 956), two intermediate (DeKalb FS-5 and Pioneer 947), and three late maturing (Truimph Supersile, Golden Harvest T-E Silomaker, and DeKalb 25E) hybrids. Grain sorghums were represented by two early maturing (Funk's G 522 and Pioneer 8493), two intermediate (Asgrow Topaz and NC+ 174), and one late maturing hybrid (DeKalb 41Y). Within maturity groupings, hybrids were selected to represent a range of plant heights and forage and grain yields. Atlas, an intermediate maturing forage sorghum variety, was included for comparison.

Field plots were seeded on May 31, 1986 under dryland conditions near Manhattan. Approximately 100 lbs per acre of anhydrous ammonia was applied one month prior to planting. Furadan 15G® insecticide was placed in the furrows at planting and the following day pre-emergence herbicide (Ramrod®) was broadcast. In July, the plots were sprayed with Cygon 400® for greenbug control.

The hybrids were assigned in a randomized complete block design to three replicate plots each. Single plots had 6 rows, 30 inches apart and 200 ft long. Whole-plant yield for each plot was determined at the late-dough maturity stage by harvesting three center rows with a Field Queen forage harvester. Late-dough was selected so results could be compared to those of previous years' studies (Reports of Progress 470 and 494). Seven 55-gallon, metal drum pilot silos lined with 4 ml plastic were filled, sealed, and stored at ambient temperature to be used in a future digestion trial. The two outside rows were left as borders and heads were clipped from the remaining row from a random 60 ft to determine grain yield. The heads were dried and threshed with a stationary thresher.

Results and Discussion

Trial 1. Harvest dates, maturities, plant heights, compositions, and yields for the three hybrids are shown in Table 38.1. Pioneer 947 required only 28 days to advance from stage 1 to stage 3; Acco 351 required 35 days, and DeKalb 25E required 44 days.

Whole-plant DM content increased ($P<.05$) at each successive harvest stage for Pioneer 947, ranging from 29.6% at stage 1 to 44.0% at stage four. For Acco 351, DM content increased with advancing maturity after stage 2 and reached 40.4% at stage four. Consistent with previous trials, the DM content of DeKalb 25E did not change after stage one. Crude protein generally decreased with advancing maturity, but only in Pioneer 947 and DeKalb 25E were the changes statistically significant.

Whole-plant DM yield of Acco 351 was influenced less by stage of maturity than that of the other two hybrids (Table 38.1). The highest yields ($P<.05$) were at harvest stages 1 or 2 for Pioneer 947 and DeKalb 25E, and their lowest yields ($P<.05$) were at stage four. Grain yield for Pioneer 947 was not affected by harvest stage, but the lowest yield ($P<.05$) for Acco 351 occurred at the first stage and the lowest yield ($P<.05$) for DeKalb 25E was at the first two stages.

Chemical composition of the 12 forage sorghum silages is presented in Table 38.2. All silages were well preserved, with low terminal pH values and adequate lactic acid contents. The wetter DeKalb 25E silages had the lowest pH and highest lactic acid values at all four harvest stages. Harvest stage affected acid detergent fiber (ADF) only for Pioneer 947, with ADF content increasing as maturity advanced. The lower grain-yielding DeKalb 25E had higher ADF values at harvest stages 1 and 2 than the other two hybrids.

Main effects of hybrid and maturity on voluntary intakes and digestibilities are given in Table 38.3. Hybrid greatly affected intake ($P<.05$), with Acco 351 having the highest intake both in grams per day and in grams per metabolic body weight. Harvest effect on intake was exhibited by the lower intakes for the wetter stage 1 silages and more mature stage 4 silages. The DM, ADF, and neutral detergent fiber digestibilities were similar for all hybrids and harvest stages. Crude protein digestibilities were affected by hybrid and harvest date.

Trial 2. The results for harvest dates, maturities, plant heights, compositions, and yields are presented in Table 38.4. An average of 29 days elapsed between first and third harvest dates for the grain sorghum hybrids and 33 days elapsed between the first and third harvests for the forage sorghums. Whole-plant DM content was significantly higher at each successive harvest stage for all grain sorghum hybrids, but significantly higher only at the third harvest for the forage sorghum hybrids. The DM content was also higher at all stages of harvest for the grain sorghums when compared to the forage sorghums.

Crude protein content was highest in the grain sorghum hybrids and decreased as maturity increased. The forage sorghum hybrids showed little reduction in CP with advancing maturity, but the lowest CP value for grain sorghums was still greater than the highest value for any of the forage sorghum hybrids. Whole-plant DM yields were generally larger for the forage sorghum hybrids and yields were not affected by stage of maturity with the exception of WAC 652G, for which the late-milk to early-dough stage had a lower yield than the hard-grain stage. After stage 1, grain yields were higher for the grain sorghum hybrids, as would be expected. In general, grain yields increased with maturity except for three hybrids (Sweet Bee, Conlee's Cow Vittles, Asgrow Colt), which decreased in yield at the third harvest because of weathering effects and bird damage in some plots.

Trial 3. Harvest dates, days to half bloom, plant heights, compositions, and yields for the forage and grain sorghums are shown in Table 38.5. Harvest dates for the forage sorghums occurred over a range of 47 days, with Canex and Pioneer 956 reaching the late-dough stage earliest and Silomaker and DeKalb 25E, the latest. In comparison, harvest dates for the grain sorghums ranged over only 8 days, with the earliest being Funk's G 522 and Pioneer 8493 and the latest, DeKalb 41Y.

It is useful to note the considerable differences in DM and CP contents, and whole-plant DM and grain yields, especially among the forage sorghums. The DM content of the forage sorghums ranged from a low of 25.3% (Canex) to a high of 34.4% (Pioneer 947) at the late-dough stage, which was a difference of 9.1 percentage units. In contrast, the grain sorghums ranged from 33.6 to 35.1% DM, which was only a 1.5 percentage unit difference. The CP content of the forage sorghums ranged from a low of 6.3% (Atlas) to a high of 7.5% (Pioneer 956). All of the grain sorghum hybrids had higher CP values than the forage sorghums.

Whole-plant DM yields were generally higher but much more variable for the forage sorghums than the grain sorghums. Among the forage sorghums, Canex had the lowest yield (5.5 tons per acre) and Silomaker, the highest (8.2 tons). Grain sorghum yields ranged from 5.2 tons per acre (Pioneer 8493) to 5.7 tons (DeKalb 41Y). The grain yields for the forage sorghums had a wide range, from 51 bushels per acre (Canex) to 105 bushels (Pioneer 947). Grain yields for the grain sorghums ranged from 99 bushels per acre (Pioneer 8493) to 113 bushels (Asgrow Topaz).

Table 38.1. Harvest Dates, Maturities, Plant Heights, Dry Matters (DM), Crude Proteins (CP), and Whole-plant Forage and Grain Yields for the Three Forage Sorghum Hybrids in Trial 1 (June 8 planting date)

Hybrid and Harvest Stage	Harvest Date	Whole-plant DM	Whole-plant CP[2]	Whole-plant DM Yield	Grain Yield[3]	Grain: Forage
	1985	%	%	Tons/Acre	Bu/Acre	
Pioneer 947						
1 (116)[1]	Sept. 16	29.6^{d}	9.1^{a}	6.3^{b}	64	.33
2	Sept. 25	32.3^{c}	9.2^{a}	7.0^{a}	77	.37
3	Oct. 14	37.6^{b}	8.6^{ab}	5.0^{c}	62	.44
4	Nov. 18	44.0^{a}	7.8^{b}	4.0^{d}	70	.75
Acco 351						
1 (74)	Sept. 19	24.4^{c}	9.6	6.3^{ab}	38^{b}	.18
2	Oct. 1	26.4^{c}	9.2	6.8^{a}	71^{a}	.34
3	Oct. 24	36.3^{b}	9.1	6.6^{ab}	64^{a}	.31
4	Nov. 19	40.4^{a}	9.0	6.1^{b}	74^{a}	.42
DeKalb 25E						
1 (128)	Sept. 24	22.8^{b}	8.8^{a}	7.1^{a}	32^{b}	.12
2	Oct. 7	25.7^{a}	8.2^{ab}	6.4^{ab}	33^{b}	.14
3	Nov. 7	27.8^{a}	8.3^{ab}	6.3^{b}	40^{ab}	.18
4	Nov. 19	27.2^{a}	7.5^{b}	4.7^{c}	50^{a}	.35

[1] Plant height at harvest stage 1, inches.
[2] 100% dry matter basis.
[3] Adusted to 12.5% moisture.
[abcd] Means within a hybrid with different superscripts differ ($P<.05$).

Table 38.2. Chemical Composition of the 12 Forage Sorghum Silages in Trial 1

Hybrid and Harvest Stage	DM	pH	Lactic Acid	ADF	NDF	Hemi-cellulose
			Chemical Component[1]			
	%		% of the Silage DM			
Pioneer 947						
1	29.5	3.96	5.5	32.8	57.4	24.6
2	32.1	4.27	4.3	33.1	57.2	24.1
3	37.4	4.18	3.3	36.8	60.1	23.3
4	42.8	4.14	4.7	39.3	61.2	21.9
Acco 351						
1	26.2	3.93	5.5	35.8	62.8	27.3
2	28.0	4.23	3.7	33.3	60.1	26.8
3	35.1	4.13	4.8	36.3	60.0	23.7
4	41.1	4.39	3.2	34.9	57.4	22.5
DeKalb 25E						
1	23.5	3.78	6.5	37.1	61.2	24.1
2	26.2	3.83	6.3	37.0	57.4	20.4
3	26.7	3.84	5.3	38.0	60.3	22.3
4	29.6	4.02	4.5	38.6	58.8	20.2

[1] ADF = acid detergent fiber; NDF = neutral detergent fiber.

Table 38.3. Effects of Forage Sorghum Hybrid and Stage of Maturity on Ration Voluntary Intakes and Apparent Digestibilities in Trial 1[1]

Hybrid and Harvest Stage	VI		Digestibility, %			
	g DM/Day	g DM/kg MBW[2]	DM	CP	ADF	NDF
Hybrid						
Pioneer 947	509^{b}	29.9^{b}	55.2	42.7^{b}	42.5	49.8
Acco 351	585^{a}	34.7^{a}	54.8	48.2^{a}	42.0	48.6
DeKalb 25E	456^{c}	26.7^{c}	54.1	44.7^{ab}	40.8	45.3
Harvest Stage						
1	480^{e}	28.2^{e}	55.0	46.3^{d}	39.9	47.5
2	553^{d}	32.1^{d}	54.8	42.0^{e}	40.2	47.3
3	533^{d}	31.2^{d}	54.7	47.1^{d}	44.1	48.9
4	511^{de}	30.1^{de}	54.2	45.5^{de}	42.8	47.8

[1]VI = voluntary intake, DM = dry matter, CP = crude protein, ADF = acid detergent fiber, NDF = neutral detergent fiber.

[2]Metabolic body weight = $kg^{.75}$

[abc]Means in the same hybrid column with different superscripts differ ($P<.05$).

[de]Means in the same harvest stage column with different superscripts differ ($P<.05$).

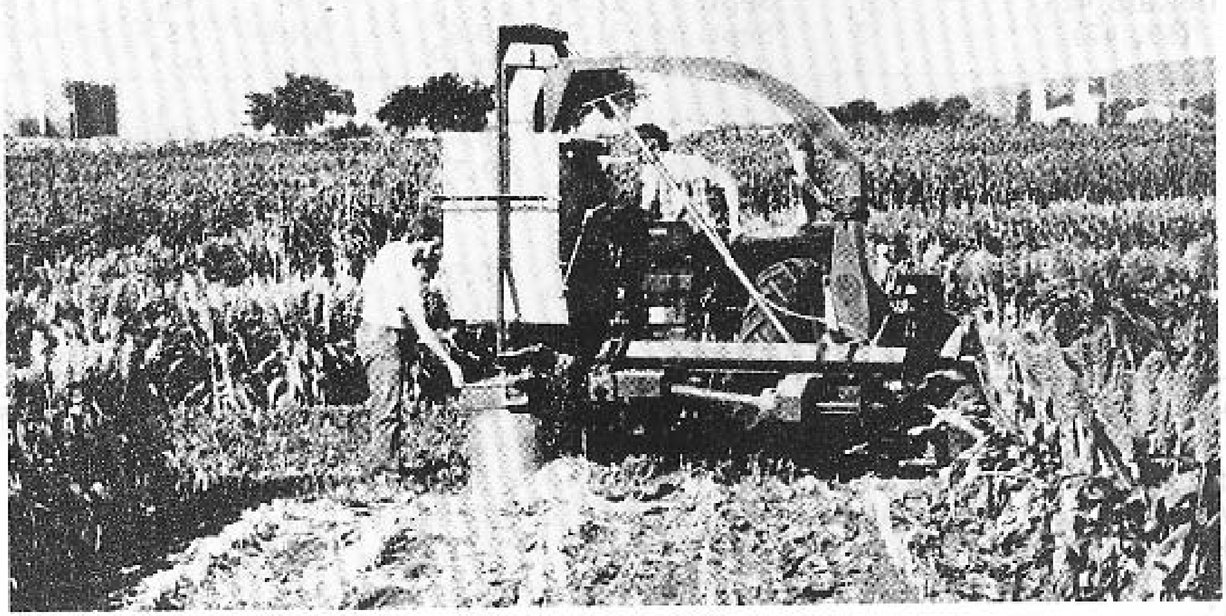


Table 38.4. Harvest Dates, Maturities, Days to Half Bloom, Plant Heights, Compositions, and Whole-plant Forage and Grain Yields for the Four Forage Sorghum and Four Grain Sorghum Hybrids in Trial 2 (June 13 planting date)

Hybrid	Harvest Stage[1]	Harvest Date	Whole-plant DM	Whole-plant CP[2]	Whole-plant DM Yield	Grain Yield[3]	Grain: Forage
		1985	%	%	Tons/A.	Bu/A.	
<u>Forage Sorghum</u>							
Warner's Sweet	1	Sept. 16	24.8^{a}	7.5	6.3	51^{ab}	$.25^{b}$
Bee	2	Sept. 27	28.0^{b}	7.9	6.2	61^{a}	$.33^{a}$
(74[4], 118[5])	3	Oct. 14	29.8^{b}	7.1	5.4	50^{b}	$.31^{ab}$
Warner's Sweet	1	Sept. 20	24.0^{a}	8.1^{a}	7.0	--	--
Bee Sterile	2	Oct. 1	25.3^{a}	8.0^{a}	7.1	--	--
(--, 107)	3	Oct. 15	28.2^{b}	6.8^{b}	7.1	--	--
Golden Harvest	1	Sept. 24	23.1^{a}	8.4	6.8	54^{b}	$.25^{b}$
T-E Silomaker	2	Oct. 4	25.6^{a}	8.0	7.0	59^{ab}	$.27^{ab}$
(84, 111)	3	Nov. 5	36.5^{b}	8.0	6.6	70^{a}	$.36^{a}$
Conlee's Cow	1	Oct. 2	24.5^{a}	7.5^{a}	7.4	36	.14
Vittles	2	Oct. 14	24.4^{a}	6.3^{b}	6.6	34	.15
(87, 141)	3	Nov. 7	31.4^{b}	7.1^{ab}	6.7	31	.13
<u>Grain Sorghum</u>							
WAC 652G	1	Sept. 7	29.0^{a}	11.6^{a}	4.4^{b}	65^{c}	$.59^{b}$
(63, 51)	2	Sept. 17	32.9^{b}	10.7^{b}	4.9^{ab}	88^{b}	$.82^{a}$
	3	Oct. 4	40.2^{c}	10.2^{b}	5.3^{a}	101^{a}	$.91^{a}$
DeKalb 42Y	1	Sept. 9	27.9^{a}	11.7^{a}	4.8	46^{c}	$.32^{b}$
(69, 47)	2	Sept. 19	31.0^{b}	10.6^{b}	5.1	78^{b}	$.63^{a}$
	3	Oct. 14	41.3^{c}	10.1^{b}	5.1	95^{a}	$.83^{a}$
NC+ 174	1	Sept. 16	28.2^{a}	10.4^{a}	5.1	84^{b}	$.70^{b}$
(71, 53)	2	Sept. 24	30.8^{b}	9.7^{b}	5.8	103^{a}	$.81^{b}$
	3	Oct. 15	41.2^{c}	9.2^{b}	5.2	112^{a}	1.20^{a}
Asgrow Colt	1	Sept. 24	26.9^{a}	10.0	5.4	85^{b}	.66
(78, 52)	2	Oct. 2	30.9^{b}	10.0	5.7	97^{a}	.75
	3	Oct. 24	42.2^{c}	9.4	5.1	87^{ab}	.74

[1]Harvest stage 1, late-milk to early-dough; stage 2, late-dough; and stage 3, hard-grain.
[2]100% dry matter basis.
[3]Adjusted to 12.5% moisture basis.
[4]Half bloom, days.
[5]Plant height at harvest stage 1, inches.
[abc]Means within a hybrid with different superscripts differ ($P<.05$).

Table 38.5. Harvest Dates, Days to Half Bloom, Plants Heights, Dry Matters (DM), Crude Proteins (CP), and Whole-plant Forage and Grain Yields for Eight Forage Sorghums and Five Grain Sorghums in Trial 3 (May 31 planting date)

Hybrid or Variety	Harvest Date	Half Bloom[1]	Plant Height[2]	Whole-plant DM	Whole-plant CP[3]	Whole-plant DM Yield	Grain Yield[4]	Grain: Forage
	1986			%	%	Tons/A.	Bu/A.	
Forage Sorghum								
Canex	Aug. 20	57	108	25.3	6.6	5.5	51	.30
Pioneer 956	Aug. 20	57	105	30.5	7.5	6.0	93	.63
DeKalb FS 5	Aug. 30	60	106	27.9	7.2	6.6	87	.50
Pioneer 947	Sept. 4	61	108	34.4	7.4	7.3	105	.57
Atlas	Sept. 4	64	103	27.5	6.3	6.9	52	.23
Supersile	Sept. 24	83	125	27.4	6.8	8.0	70	.28
Silomaker	Oct. 6	85	112	30.0	6.8	8.2	98	.43
DeKalb 25E	Oct. 6	87	131	27.9	7.4	7.0	68	.32
Grain Sorghum								
Funk's G 522	Aug. 21	51	59	33.7	8.8	5.6	106	.92
Pioneer 8493	Aug. 21	51	54	35.1	8.9	5.2	99	.91
NC+ 174	Aug. 23	52	62	34.0	8.1	5.6	106	.92
Asgrow Topaz	Aug. 26	53	55	33.6	8.4	5.5	113	1.08
DeKalb 41Y	Aug. 29	55	51	33.6	8.4	5.7	110	.96

[1]Half bloom, days.

[2]Plant height, inches.

[3]100% dry matter basis.

[4]Adjusted to 10.0% moisture.

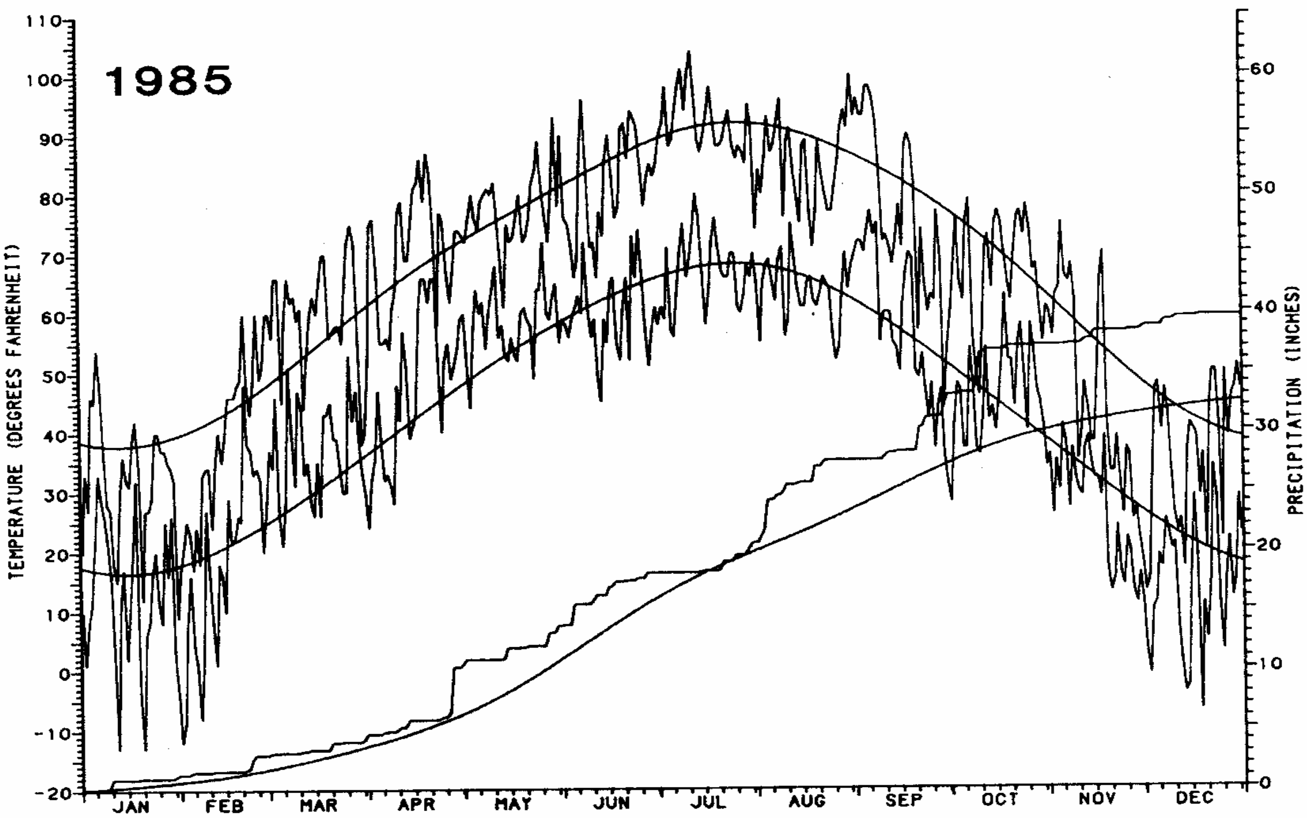
Weather Data, 1985 - 1986

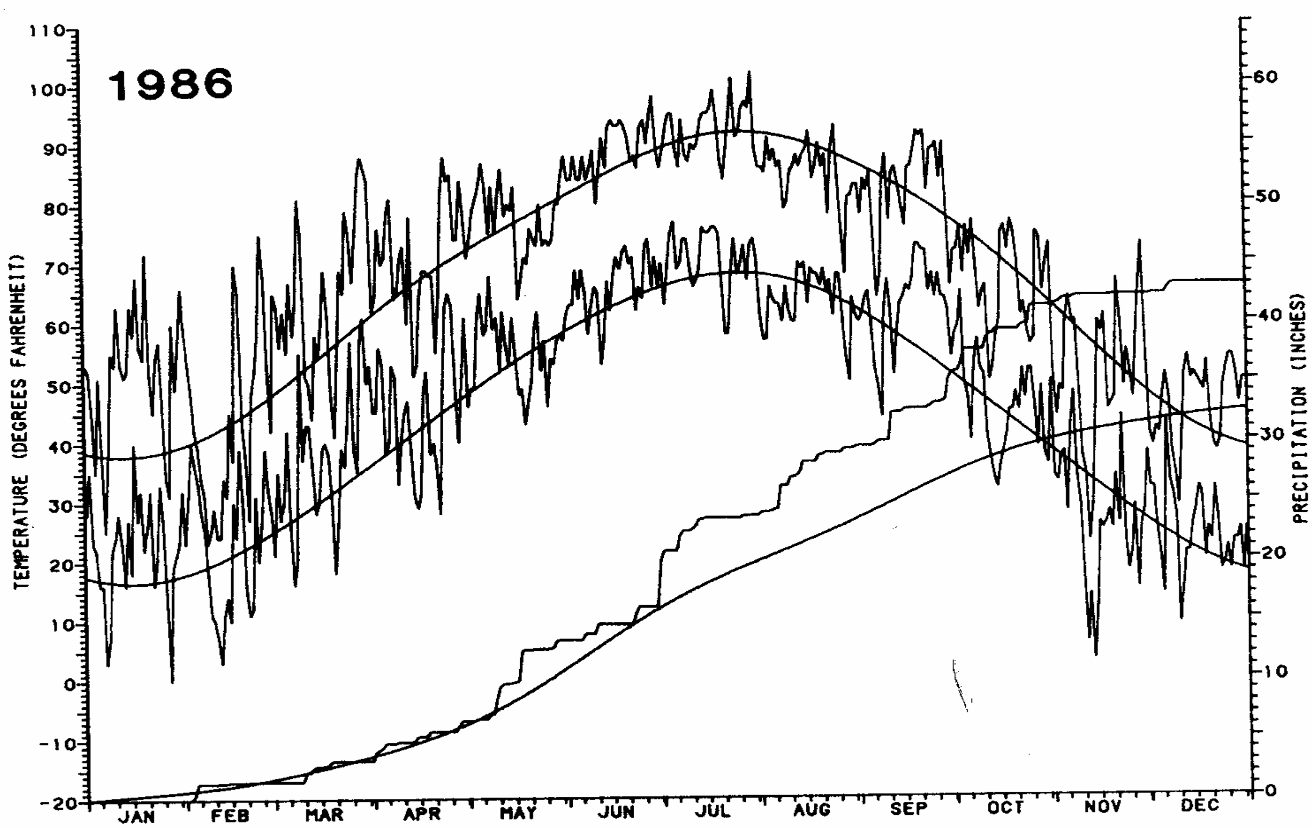
On the following page are graphs of 1985 and 1986 Manhattan weather, produced with the aid of the Kansas Agricultural Experiment Station Weather Data Library. The smooth line that starts in the lower left hand corner of each graph is the normal accumulated precipitation. The rough line represents actual precipitation. A long horizontal section of that line represents time during which no precipitation occurred. A verticle section represents precipitation.

The other two smooth lines represent average daily high and low temperatures, and the rough lines represent actual highs and lows.

These graphs are included because much of the data in this publication, especially data on cow maintenance requirements, and forage yields can be influenced by weather. Weather graphs have also been included in Cattlemen's Day publications for the past three years.

Mud, a weather variable that influences animal performance.





Graphical Weather Summary for Manhattan, Kansas

Biological Variability and Statistical Evaluation of Data

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

In some of the articles, you will see notations such as "P<.05". That means the probability of the differences resulting from chance is less than 5%. If two averages are said to be "significantly different," the probability is less than 5% that the difference is from chance. Thus the probability exceeds 95% that the difference results from the treatment.

Some papers report correlations; measures of the relationship between traits. The relationship may be positive (both traits tend to get bigger or 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 an unlimited number of animals) would fall within one standard error from the mean, in this case between 2.40 and 2.60.

Many animals per treatment, replicating treatments several times, and using uniform animals increases the probability of finding real differences when they exist. Statistical analysis allows more valid interpretation of the results regardless of the number of animals used in a trial. In nearly all the research reported here, statistical analyses are included to increase the confidence you can place in the results.

NOTICE

ACKNOWLEDGMENTS

Listed below are individuals, organizations, and firms that have contributed to this year's beef research program through financial support, product donations or services. We appreciate your help!

A.O. Smith Harvestore Products, Inc., Barrington, Illinois
American Cyanamid Co., Princeton, New Jersey
American Diversified Co., Ethanol Plant, Hastings, Nebraska
BioTechniques Laboritories, Inc., Redmond, Washington
Brookover Feedyards, Garden City, Kansas
Brookover Ranch Feedyard, Garden City, Kansas
Bunge, Inc., Emporia, Kansas
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Chalcombe Publications, Manhattan, Kansas
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Church & Dwight Company, Inc., Piscataway, New Jersey
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Farmland Industries, Inc., Kansas City, Missouri
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Iowa Beef Processors, Emporia and Holcomb, Kansas
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Kemin Industries, Inc., Des Moines, Iowa
Keystone Agri. Products, Garden City, Kansas
Livestock and Meat Industry Council, Inc. (LMIC), Manhattan, Kansas
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Merck & Company, Inc., Rahway, New Jersey
National Beef Packers, Liberal, Kansas
New Breeds Industries, Inc., Manhattan, Kansas
Norden Laboratories, Inc., Lincoln, Nebraska
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Pratt Feeders, Pratt, Kansas
Richard Porter, Reading, Kansas
Ralston Purina, Inc., St. Louis, Missouri
Ranch Aid, Inc., Eureka, Kansas
Roode Packing Co., Fairbury, Nebraska
Sanoti Sante Animale, Paris, France
Select Sires, Plain City, Ohio
Stauffer Chemical Co., Washington, Pennsylvania
Supreme Feeders, Liberal Kansas
Syntex Animal Health, Inc., Des Moines, Iowa
The Upjohn Company, Kalamazoo, Michigan
Joe Thielen and Family, Dorrance, Kansas
TransAgra International, Inc., Storm Lake, Iowa
Viskase Corp., Chicago, Illinois
Wendy's International, Dublin, Ohio

The Livestock & Meat Industry Council, Inc.

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Weber Hall is currently being renovated and expanded. The Livestock and Meat Industry Council Inc. pledged $500,000 in livestock industry support to purchase research and teaching equipment. When this is accomplished, Weber Hall will be one of the finest research and teaching facilities for animal agriculture in the world.

Much of the research reported in this manuscript has been partially supported with industry dollars through the LMIC. For this to continue, animal agriculture needs to join hands and make Weber Hall a center of excellence.

A combined effort by agri-businesses and individuals will be required to raise these funds. Dollars given to this project will return great dividends to the industry.

Pledges can be made for 1987, 1988 and 1989.

Send your check or pledge to:

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