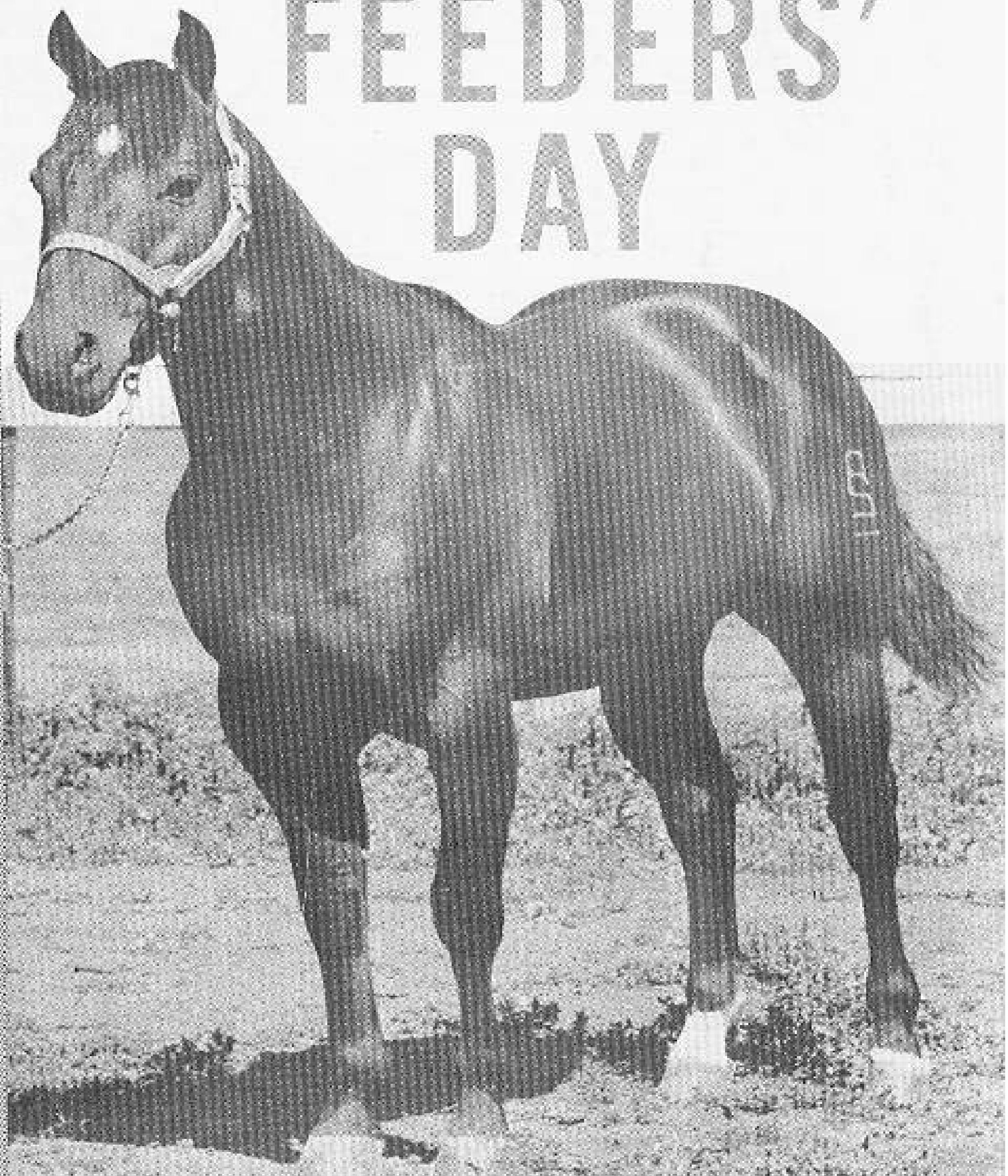
1961-1962 PROGRESS REPORTS

BULLETIN 447
MAY 5, 1962

49th LIVESTOCK FEEDERS' DAY



AGRICULTURAL EXPERIMENT STATION • MANHATTAN
KANSAS STATE UNIVERSITY OF AGRICULTURE
AND APPLIED SCIENCE
DIRECTOR GLENN H. BECK

CONTENTS

49th Annual Livestock Feeders' Day

KANSAS STATE UNIVERSITY

MANHATTAN, KANSAS

Saturday, May 5, 1962

8:00 to
10:00 a.m.—Experimental livestock on exhibit, Animal Husbandry Arena.

10:00 a.m.—ARENA, Presiding, John Berns, Peabody, Kansas, President, Kansas Livestock Association.

Review of Experiments, Animal Husbandry Staff

- Field conditioning of alfalfa hay for beef cattle.
- Levels of protein with sorghum grain in fattening rations for beef cattle.
- Sorghum silage, normal vs. early cut vs. silage with ground heads vs. silage without heads for wintering steers and heifers.
- Kansas beef cattle breeding-improvement tests.
- Beef cattle performance testing.
- Tests of stocking rates, grazing plans, and different burning methods for bluestem pastures.
- Phosphorus, calcium and protein supplements for steers and heifers on pasture.
- Cobalt for fattening heifers.
- Antibiotic and hormone combinations for wintering, grazing and fattening steers.
- Dehydrated alfalfa vs. vitamin A for cattle.
- Enzyme preparations in cattle wintering and fattening rations.
- Soybean meal vs. urea and their effects on amino acids in rumen fluids of steers.
- Pelleted rations for fattening lambs.
- Milk-fat lamb production practices for Kansas (Colby Station).
- Breeding for improved lamb production.
- Grain sorghums and barley for fattening lambs; preparation of rations for fattening lambs; wheat pasture fattening of lambs (Garden City Station).
- Corn vs. sorghum grain for growing-fattening pigs.
- Antibiotics for sows at breeding time.
- Pelleted rations vs. finely ground for growing-finishing pigs.
- Slatted floors for swine.
- Lamb carcass grading-factors related to quality.
- Dietary iron and meat quality.

12:00 noon—Lunch, Arena

12:45 p.m.—**Awards to Beef Production Contest Winners, Room 107.** W. H. Atzenweiler, Agricultural Commissioner, Kansas City Chamber of Commerce; and Extension Animal Husbandmen.

KANSAS STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
MANHATTAN
C. PEAIRS WILSON, Director

1:15 p.m.—Feeders' problems and how we are meeting them, Roy Schoeb, Schoeb Ranch Feed Yards, Cherokee, Okla.

Cowherd operators' problems, Bill House, Ranchman, Cedar Vale, Kansas.

Questions and Discussion.

3:00 p.m.—Adjournment.

6:30 p.m.—Kansas State Union—Banquet for visiting stockmen and ladies, Block and Bridle Club.

Honoring: O. W. Fishburn
Mr. and Mrs. Ray S. Zimmerman
H. T. Hineman (deceased)

FOR THE LADIES

Friday, May 4, 1962

6:30 p.m.—Dinner, Gillett Hotel, Kansas Cow Belles and all visiting ladies. (Make reservations with Mrs. C. G. Elling, 701 Elling Drive, Manhattan.)

Presiding—Mrs. Clarence Sprout, Mullinville, Kansas, President, Kansas Cow Belles.

Saturday, May 5, 1962

9:30 a.m.—Coffee, Justin Hall (Home Economics Building). Animal Husbandry ladies.

10:30 a.m.—Food Preparation Demonstrations, Foods and Nutrition Class in Principles of Food Demonstration. School of Home Economics, K.S.U.

12:00 noon—Lunch, Animal Husbandry Arena.

6:30 p.m.—Block and Bridle Banquet (see general program).

COVER PHOTO—King Flit, Quarter Horse stallion, owned by Kansas State University, was donated to the University in 1958 by Robert Q. Sutherland. He has sired four colt crops at Kansas State. King Flit was sired by King P-234 and is out of Flit, by Leo. He earned his N.C.H.A. Certificate of Ability as a cutting horse and is a Register of Merit reining horse on A.Q.H.A. records. Kansas State University maintains a breeding herd of Quarter Horses and produces animals for use in its instruction and research programs.

Feed Prices—1961-62

	1960-61	1961-62
Cracked corn, cwt.	$ 2.14	$ 2.20
Rolled sorghum grain, cwt.	1.75	1.90
Soybean oil meal, cwt.	3.45	3.60
Dehydrated alfalfa pellets, ton	50.00	
Alfalfa hay, ton	17.00	18.00
Sorghum silage, ton	5.75	6.00
Prairie hay, ton	14.00	16.00
Bluestem pasture, summer, per head:		
Yearlings		16.00
Two-year-olds		20.00
Bluestem pasture, winter, per head per month:		
Calf		.50
Yearling		.75
Salt, cwt.	.90	.90

Beef Cattle

Dehydrated Alfalfa vs. Vitamin A with and without Aureomycin in Cattle Rations Using Sorghum Grain (Project 567).

D. Richardson, E. F. Smith, F. W. Boren and B. A. Koch

The animals in this test were used in a previous wintering test (Cir. 383, pages 32-33, 1961) to study grain vs. forage type sorghum silage; dehydrated alfalfa as a source of vitamin A vs. vitamin A; and vitamin A with and without Aureomycin. At the end of the test, cracked sorghum grain was added to the ration and the fattening phase was started. Animals that had received dehydrated alfalfa in the wintering phase continued to receive it during the fattening phase and likewise those that received vitamin A continued to receive vitamin A. The dehydrated alfalfa contained approximately 50 mgs. of carotene per pound. Assuming 400 I.U. of vitamin A per milligram of carotene, one half pound of dehydrated alfalfa supplied the equivalent of 10,000 I.U. of vitamin A; hence, the comparison of one half pound dehydrated alfalfa pellets as a source of vitamin A with 10,000 I.U. of preformed vitamin A. Each source of vitamin A was fed with and without Aureomycin. The ration ingredients and average daily consumption are shown in Table 1. Salt and a mixture of salt and dicalcium phosphate were fed free choice.

Results and Discussion

Total gains of the animals were not so good because of their fleshy condition at the start of the test, hot weather conditions, and possibly other factors. However, treatment effects were highly significant. Both lots receiving dehydrated alfalfa gained significantly faster than the two lots receiving preformed vitamin A. Animals receiving Aureomycin with either dehydrated alfalfa or vitamin A gained significantly faster than those without Aureomycin. The difference was highly significant for the lot receiving dehydrated alfalfa and Aureomycin. Even with the great differences in gain, there were no significant differences in marbling or carcass grades. Results with carotene were as good or better than with an equivalent amount of preformed vitamin A. If a ration needs additional vitamin A, dehydrated alfalfa appears to be a good source, and the alfalfa also contains other beneficial nutrients.

Table 1

Vitamin A vs. dehydrated alfalfa with and without Aureomycin.

February 24 to August 18, 1961—175 days.

Lot no.	3	4	5	6
No. heifers per lot	10	10	9	10
Av. initial wt., lbs.	656	648	637	656
Av. final wt., lbs.	950	922	865	910
Av. daily gain per heifer, lbs.**	1.68	1.57	1.30	1.45
Av. daily ration, lbs.:				
Sorghum silage (1st 74 days)	19.2	19.3	17.6	20.0
Prairie hay (last 101 days)	3.0	3.0	3.0	3.0
Soybean oil meal	1.0	1.0	1.0	1.0
Sorghum grain	15.5	15.5	14.3	15.6
Dehydrated alfalfa pellets	.5	.5	....	....
Aureomycin, mgs.	72	....	....	72
Vitamin A, I.U.	....	....	10,000	10,000

** Highly significant differences.

Table 1 (Continued)

Av. feed per cwt. gain, lbs.:				
Sorghum silage	481	516	635	582
Prairie hay	301	110	133	119
Soybean oil meal	59	64	77	69
Sorghum grain	919	991	1093	1071
Dehydrated alfalfa pellets	30	32	....	....
Feed cost per cwt. gain[1]	$22.44	24.19	26.31	25.35
% shrink to market	1.3	1.8	1.7	1.8
Dressing %, feedlot wt.	60.6	61.2	60.7	60.5
Dressing %, pay wt.	61.4	62.5	61.7	61.7
Av. hot carcass wt., lbs.	575.7	565.9	525.3	551.2
Av. finish:				
Thickness[2]	3.3	3.0	3.2	3.2
Distribution[3]	3.8	4.2	3.9	4.0
Av. degree of marbling[4]	7.4	7.0	7.7	7.0
Av. degree of firmness[5]	3.9	3.7	3.8	3.8
Av. size of rib eye[6] (est.)	4.1	4.1	4.2	4.2
Kidney knob fat (est.), lbs.	19.2	18.3	17.8	19.8
Carcass grades:				
Top choice	....	1	....	....
Av. choice	....	....	....	....
Low choice	1	2	....	3
Top good	3	3	4	3
Av. good	4	....	1	3
Low good	2	4	2	1
Top standard	....	....	2	....
Av. carcass value (choice, 39¢; good, 37¢; standard, 36¢)	$209.33	208.63	189.35	203.20
Av. live animal value at $23 per cwt.	$215.74	208.38	195.75	205.62

1. Based on silage, $6 per ton; prairie hay, $14 per ton; dehydrated alfalfa pellets, $50 per ton; soybean oil meal, $70 per ton; sorghum grain, $1.90 per cwt.
2. 2 = thick, 3 = moderate, 4 = modest.
3. 2 = uniform, 3 = moderately uniform, 4 = modestly uniform.
4. 6 = modest amount, 7 = small amount, 8 = slight amount, 9 = traces.
5. 2 = firm, 3 = moderately firm, 4 = modestly firm, 5 = slightly firm.
6. 2 = large, 3 = moderately large, 4 = modestly large, 5 = slightly small.

Vitamin A and Dehydrated Alfalfa Fed Individually and in Combination with and without Aureomycin in a Steer Fattening Ration (Project 567). Progress Report.

D. Richardson, E. F. Smith, F. W. Boren and D. L. Follis

A previous test indicated that carotene from dehydrated alfalfa was equal to or superior to vitamin A in a fattening ration using sorghum silage, prairie hay and sorghum grain. The test also indicated a significant improvement in gains and efficiency from Aureomycin.

This is a progress report on a test comparing dehydrated alfalfa as the source of vitamin A with vitamin A individually and in combination with and without Aureomycin.

Supplements used were formulated to supply the same amount of protein and minerals in each lot. Vitamin A value of dehydrated alfalfa was figured at 400 I.U. per milligram of carotene. The level of feeding was 10,000 I.U. per head daily. Seventy milligrams of Aureomycin were supplied per head daily. At the end of 84 days, the supplement was increased 50%.

A progress report of the results for the first 133 days is shown in Table 2.

Table 2

Vitamin A and dehydrated alfalfa fed individually and in combination with and without Aureomycin.
November 30, 1961, to April 12, 1962—133 days.

Lot no.	7	8	9	10	11	12
No. steers per lot	10	10	10	10	10	10
Av. initial wt., lbs.	708	708	708	708	710	708
Av. final wt., lbs.	1044	1038	1069	1047	1056	1071
Av. daily gain, lbs.	2.52	2.48	2.71	2.55	2.60	2.73
Av. daily ration, lbs.:						
Sorghum silage	22.1	21.2	22.3	21.7	23.7	22.1
Sorghum grain	18.1	18.6	19.6	19.9	20.3	19.6
Supplement	1.2	1.2	1.6	1.6	1.6	1.6
Dehydrated alfalfa	No	No	Yes	Yes	Yes	Yes
Vitamin A	Yes	Yes	No	No	Yes	Yes
Aureomycin	No	Yes	No	Yes	No	Yes
Feed per cwt. gain, lbs.:						
Sorghum silage	876	865	781	853	911	809
Sorghum grain	717	752	723	781	781	718
Supplement	47	48	57	61	60	57
Feed cost per cwt. gain	$18.24	$18.89	$18.03	$19.49	$19.69	$18.05

The Value of Enzyme Preparations Added to Beef Cattle Rations (Project 5-662).[1]

D. Richardson, F. W. Boren, E. F. Smith and B. A. Koch

This was our second test to determine the value of various enzyme preparations added to beef cattle rations. The first involved amylase and a combination of amylase and protease. Amylase apparently depressed the appetite or feed consumption, which resulted in decreased rate of gain. The combination of amylase and protease appeared to increase rate of gain at the beginning of the test; however, gains decreased as the test progressed and ended with the average daily gain being less than for control animals. This test involved a combination of amylase and protease and also this combination plus cellulase in the wintering phase. One lot received protease only in the fattening phase.

Feed is stored nutrients. Enzymes are organic catalysts whose primary function is to break proteins, fats and carbohydrates in the feed down to constituent parts, such as amino acids, fatty acids, and simple sugars for absorption into the body. Amylase acts on carbohydrates other than crude fiber; protease on proteins; and cellulase on cellulose (fiber).

Experimental Procedure

Forty-four Hereford steer calves averaging about 540 pounds each were divided into four lots of 11 animals each. The ration ingredients used and average daily consumption are shown in Table 3. All rations were the same except for added enzyme preparations. Lot 10 received a combination of amylase, protease, and cellulase during alternate 28-day periods during the wintering phase but only protease during the fattening phase.

Results and Discussion

Results of this test are shown in Table 3. All lots receiving enzyme preparations tended to consume less silage, and gains were slightly, but not significantly, less during the wintering phase. The combination of enzymes during alternate 28-day periods was of no value. Lot 8, which received the combination of amylase and protease, gained significantly faster (P .10) during the fattening phase. Although Lot 10, which received protease during the fattening phase, was not the fastest gaining group, marbling and carcass grades of its steers were significantly higher (P .05). Cellulase was apparently of no value in the wintering or fattening phases.

Theoretically, adding enzymes or enzyme preparations should be of value; however, results have not been consistent in various tests conducted here and elsewhere. It is apparent that any practical value from the use of these products must yet be determined by further research on such things as kind and amount of enzyme to use, when and how to administer it, etc.

1. Appreciation is expressed to Rohm & Haas Company, Philadelphia, Pa., for partial support of this project and enzyme preparations used in the test.

Table 3

Added enzyme preparations in beef cattle rations.

Wintering, December 9, 1960, to March 31, 1961—112 days.

Lot number	7	8	9	10
Added enzyme preparation	None	F - 3C Amylase protease	F - 4D Amylase protease cellulase	Same as 9, fed on alternate 28-day periods
No. animals per lot	11	11	11	11
Av. initial wt., lbs.	541	540	542	541
Av. final wt., lbs.	752	746	743	736
Av. daily gain per steer, lbs.	1.89	1.84	1.80	1.74

Table 3 (Continued)

Av. daily ration, lbs.:				
Sorghum silage	34.7	34.0	33.9	32.0
Alfalfa hay	1.0	1.0	1.0	1.0
Soybean oil meal	1.0	1.0	1.0	1.0
Sorghum grain	5.0	5.0	5.0	5.0
Enzyme preparation, grams	....	3.4	3.4	3.4
Av. feed per cwt. gain, lbs.:				
Sorghum silage	1780	1848	1887	1841
Alfalfa hay	53	54.3	55.6	57.6
Soybean oil meal	53	54.3	55.6	57.6
Sorghum grain	265	271	278	288
Feed cost per cwt. gain (Does not include cost of enzymes)	$12.26	12.61	12.92	13.04

Fattening, March 31 to August 18, 1961—140 days.

Added enzyme preparation	None	F - 3C Amylase protease	F - 4D Amylase protease cellulase	P - 1 Protease
No. of steers per lot	11	11	11	11
Av. initial wt., lbs.	752	746	743	736
Av. final wt., lbs.	1000	1032	1002	989
Av. daily gain per steer, lbs.	1.77	2.05[a]	1.85	1.81
Av. daily ration, lbs.:				
Sorghum silage (1st 40 days)	23.9	22.5	22.5	21.0
Prairie hay (last 100 days)	3.0	3.0	3.0	3.0
Alfalfa hay	1.0	1.0	1.0	1.0
Dehydrated alfalfa pellets	.5	.5	.5	.5
Soybean oil meal	1.0	1.0	1.0	1.0
Sorghum grain	16.8	17.4	16.2	16.5
Enzyme preparation, grams	....	3.4	3.4	3.4
Av. feed per cwt. gain, lbs.:				
Sorghum silage	382	314	347	332
Prairie hay	169	147	163	166
Alfalfa hay	56	49	54	55
Dehydrated alfalfa pellets	28	24	27	28
Soybean oil meal	56	49	54	55
Sorghum grain	946	853	873	909
Feed cost per cwt. gain (not including enzymes and stilbestrol)[1]	$23.41	20.92	21.79	22.53
% shrink to market	2.4	1.5	1.9	2.8
Dressing %, feedlot wt.	59.8	59.5	58.7	59.5
Dressing %, pay wt.	61.2	60.3	59.9	61.2
Av. hot carcass wt., lbs.	597.8	613.7	588.7	583.6
Av. finish:				
Thickness[2]	3.3	3.2	3.7	3.5
Distribution[3]	3.5	3.4	3.0	3.2
Av. degree of marbling[4]	8.1	8.2	7.5	7.1*
Av. degree of firmness[5]	4.1	4.4	4.5	4.0
Av. size of rib eye (est.)[6]	4.4	4.6	4.7	4.3
Kidney knob fat (est.) lbs.	17.0	16.8	15.9	16.3

a. Significantly higher (P .10).

1. Based on silage, $6 per ton; prairie hay, $14 per ton; alfalfa hay, $17 per ton; dehydrated alfalfa pellets, $50 per ton; soybean oil meal, $70 per ton; sorghum grain, $1.90 cwt.

2. 2 = thick, 3 = moderate, 4 = modest.

3. 2 = uniform, 3 = moderately uniform, 4 = modestly uniform.

4. 6 = modest amount, 7 = small amount, 8 = slight amount, 9 = traces.

5. 2 = firm, 3 = moderately firm, 4 = modestly firm, 5 = slightly firm.

6. 2 = large, 3 = moderately large, 4 = modestly large, 5 = slightly small.

Table 3 (Continued)

Carcass grades:*				
Low choice	....	1	....	3
Top good	1	....	4	3
Av. good	1	....	4	2
Low good	7	8	2	1
Top standard	2	2	1	2
Av. carcass value (choice 39c, good 37c, standard 36c)	$215.73	222.64	212.96	213.85
Av. live animal value at $23.10 cwt.	$225.55	235.00	227.21	222.18

* Lot 10 significantly higher (P .05).

The Effects of Added Protein to Dry Rolled and Steam Rolled Sorghum Grain Fattening Rations (Project 370, 1961).

F. W. Boren, E. F. Smith, D. Richardson, R. F. Cox and D. Follis

Sorghum grain is used extensively in fattening rations for beef cattle. Its protein content reportedly varies from 6 to 12%. Wide differences in protein content result from variety, nitrogen supply in the soil, geographic location, moisture during a given year, and yield per acre.

Interest is increasing in the varying protein content of sorghum grain. The main question is whether the protein in sorghum grain can satisfy the entire ration protein for fattening cattle.

Objective of this experiment was to determine the value of adding various amounts of soybean oil meal to dry-rolled and steam-rolled sorghum grain fattening rations for yearling heifers.

Experimental Procedure

Fifty head of yearling heifers were allotted to 5 lots at random and assigned to the various treatments. The animals were brought to full feed in about 28 days. During this period all lots received 1 pound of soybean meal per head per day. When the heifers went on full feed grain, the supplemental protein was adjusted according to the feeding level designated (Table 4). During the full-feeding period, grain was fed free choice. The protein supplement, vitamin A, and calcium carbonate were fed daily. In lots receiving no protein, vitamin A and calcium carbonate were added to 10 pounds of grain and fed daily.

Good-quality prairie hay, fed daily, comprised the roughage portion of the ration.

Sorghum grain used in this experiment was obtained locally and averaged 9.8% crude protein.

Observations and Results

There was no significant difference in gains made by the cattle fed dry-rolled and steam-rolled sorghum grain, when supplemented with the same level of soybean oil meal. As in previous years, slightly less steam-rolled sorghum grain was consumed daily (Table 5).

Soybean oil meal supplementation at ½ pound and 1 pound daily increased gain significantly ($P < 0.05$) more than no supplementation, and gains from 1 pound supplementation were significantly greater than from ½ pound ($P < 0.07$). Average daily grain consumption increased 1 to 1½ pounds per head daily when soybean oil meal was added at either rate.

The calculated digestible protein intake of lots 13 and 14 barely satisfied minimum protein requirements, while the digestible protein intake of lots 15, 16, and 17 exceeded maximum requirements.

Based on the results of this experiment, a minimum of ½ pound of supplemental protein was necessary to obtain satisfactory and profitable gains. One pound of added protein produced the greatest gain and also

the greatest net return. Table 5 shows that lot 16 produced the highest grading carcasses ($P > 0.05$).

It appears that the supplemental protein intake should represent from 15 to 30% of the total protein intake.

Table 4

Effects of added protein to dry rolled and steam rolled sorghum grain fattening ration.

April 20, 1961, to September 7, 1961—140 days.

Lot no.	13	14	15	16	17
Treatment	Dry rolled sorghum grain	Steam rolled sorghum grain	Dry rolled sorghum grain	Dry rolled sorghum grain	Steam rolled sorghum grain
Soybean oil meal per head daily, lbs.	0	0	0.5	1.0	1.0
No. heifers per lot	10	10	10	10	10
Av. initial wt., lbs.	646	641	648	641	649
Av. final wt., lbs.	848	847	883	904	895
Total gain, lbs.	202	206	235	263	246
Av. daily gain per animal, lbs.	1.44	1.47	1.68	1.88	1.76
Av. daily ration, lbs.:[5]					
Dry rolled sorghum grain	14.6	....	15.7	15.5	....
Steam rolled sorghum grain	....	14.1	....	....	15.4
Soybean oil meal	....	....	0.5	1.0	1.0
Prairie hay	5.0	5.0	5.0	5.0	5.0
Feed required per cwt. gain, lbs.:					
Dry rolled sorghum grain	1011.6	....	932.3	822.6	....
Steam rolled sorghum grain	....	955.3	....	....	875.4
Soybean oil meal	....	....	29.8	53.2	56.9
Prairie hay	346.5	339.8	297.9	266.2	284.6
Total	1358.1	1295.1	1260.0	1142.0	1216.9
Feed cost per cwt. gain:[1]					
Dry rolled sorghum grain	$18.20	....	16.78	14.80	....
Steam rolled sorghum grain	$	17.20	....	....	15.76
Soybean oil meal	$	....	1.04	1.86	1.99
Prairie hay	$ 2.60	2.55	2.23	2.00	2.13
Total	$20.80	19.75	20.05	18.66	19.88
Av. carcass value per head[2]	$190.30	184.80	207.99	213.53	207.85
Initial cost per head[3]	$148.58	147.43	149.04	147.43	149.27
Cost of feed[4]	$ 42.07	40.69	47.12	49.08	48.90
Total cost, animal plus feed	$190.65	188.12	196.16	196.51	198.17
Profit or loss per head	$ —.35	—3.32	+11.83	+17.02	+9.68

1. Feed cost: Sorghum grain, dry or steam rolled, $1.80 per cwt.; soybean meal, $3.50 per cwt.; prairie hay, $15 per ton.

2. Carcass grade price × carcass wt.: Choice, $38 per cwt.; good, $36 per cwt.; standard, $34 per cwt.

3. Initial live wt. × $23 per cwt.

4. Feed cost per cwt. gain × total gain.

5. Each lot supplemented with 10,000 I.U. vitamin A and 30 gms. calcium carbonate per head daily; salt fed free choice. None of these included in cost of feed.

Table 5

The effects of added protein to dry rolled and steam rolled sorghum grain fattening ration. A progress report—carcass data.

April 20, 1961, to September 7, 1961—140 days.

Lot no.	13	14	15	16	17
Av. area rib eye, sq. in.	10.5	9.9	10.9	11.1	11.0
Av. fat thickness at 12th rib, in.	0.68	0.62	0.74	0.73	0.68
Av. carcass grade[1]	18.2	17.9	19.1	19.4	18.5
[1] Choice + = 21	..	..	2	2	..
Choice = 20	2	3	3	4	2
Choice − = 19	2	1	2	1	2
Good + = 18	2	2	1	3	5
Good = 17	4	1	1	1	1
Good − = 16	..	2	1	..	..
Standard + = 15	..	1	..	..	..

Factors Affecting the Feeding Value of Sorghum Silage, 1961-62 (Project 623). A Progress Report.

F. W. Boren, E. F. Smith, D. Richardson, D. L. Follis and G. E. Fairbanks

This is the second year of an experiment designed to investigate factors that affect the feeding value of sorghum silage. The Fort Hays Branch Experiment Station, the Departments of Agronomy, Dairy Science, Agricultural Engineering, and Animal Husbandry are cooperating, with feeding trials at Fort Hays and Manhattan being of the same design: both stations doing winter feeding tests, digestion trials and obtaining chemical and agronomic data. In addition, to meat animal feeding and digestion experiments, the dairy science department is feeding the same sorghum silages as used by the animal husbandry department and Fort Hays. Lactating cows are used to determine digestibility as well as to measure the effects of the silage on lactation.

Agronomic data are being collected by the Department of Agronomy.

Experimental Procedure

Forty head of choice-quality Hereford heifer calves, weighing about 440 pounds each, were randomly allotted 10 head to a lot, and randomly assigned to each of the four types of silage. Silage was fed free choice and 1.25 pounds of soybean meal were fed per head daily. Dicalcium phosphate was fed daily in the soybean meal. Salt was kept before the calves at all times.

The silage used in this experiment was the hybrid variety FS210, utilizing the sterile and fertile parent. The following design was used:

Lot 3. Fertile hybrid—The heads of the sorghum were removed in the field, immediately ahead of the ensilage field cutter, taken to the silo and ground through a hammer mill from which the screen had been removed. The field-chopped sorghum stalks and ground heads were combined at a uniform rate and ensiled.

Lot 4. Fertile hybrid (control)—Entire plant field chopped and ensiled at medium to hard-dough stage.

Lot 5. Sterile hybrid—Entire plant field chopped and ensiled at the same stage of maturity as the fertile hybrid used in lot 4.

Lot 6. Fertile hybrid—Entire plant field chopped and ensiled at 10 days past full bloom.

Upright silos were used.

Observations

The performance of the calves is shown in Table 6. Highly significant differences in average daily gains were obtained, with lot 4, fed fertile (control) silage, gaining most; lots 3 and 5 having essentially the same gain, and lot 6 producing the least gain.

All silages were readily consumed by the calves, with lot 4 having the greatest intake. Total daily dry matter intake, and pounds of feed required to produce 100 pounds of gain, were closely correlated with average daily gain.

Forage sorghum production data are presented in Table 7.

Table 6

Factors affecting the feeding value of sorghum silage.

November 21, 1961, to March 14, 1962—112-day wintering period.

Lot no.	3	4	5	6
No. heifers per lot	10	10	10	10
Silage treatment	Fertile—ground heads	Fertile—control	Sterile	Fertile—early cut
Silage dry matter content, %	25.7	29.0	25.0	20.2
Initial wt. per heifer, lbs.	441	435	436	443
Av. gain per heifer, lbs.	127	181	132	59
Final wt. per heifer, lbs.	568	616	568	502
Av. daily gain per heifer, lbs.	1.13	1.62	1.18	0.53
Av. daily ration, lbs.:				
Silage—as fed basis	32.68	34.55	31.93	33.56
Soybean oil meal	1.25	1.25	1.25	1.25
Soybean oil meal—90% dry matter	1.13	1.13	1.13	1.13
Silage—dry matter basis	8.40	10.02	7.98	6.78
Total dry matter consumption daily	9.53	11.15	9.11	7.91
Lbs. feed per cwt. gain:				
Silage—as fed basis	2892	2133	2706	6332
Soybean oil meal	111	77	106	236
Total lbs. feed required per cwt. gain—as fed basis	3003	2210	2812	6568
Lbs. feed per cwt. gain:				
Silage—dry matter basis	743	619	677	1279
Soybean oil meal—90% dry matter	100	69	95	212
Total lbs. feed required per cwt. gain—dry matter basis	843	688	772	1491
Feed cost per cwt. gain:[1]				
Silage	$ 8.66	$ 6.40	$ 8.12	$19.00
Soybean oil meal	$ 4.00	$ 2.77	$ 3.82	$ 8.50
Total feed cost per cwt. gain	$12.66	$ 9.17	$11.94	$27.50

1. Feed prices on page 2.

Table 7

Forage sorghum production data, 1961—FS210 variety.

	Fertile control		Fertile control	Sterile	Early cut
	Heads	Stalks			
Yield per acre, tons	1.68	13.32	15	10	11
% dry matter, when harvested	57.1	28.5	30.40	27.1	21.5
Dry matter yield per acre, tons	0.96	3.80	4.56	2.71	2.37
Silage dry matter, when fed, %	25.7		29.0	25.0	20.2

Field-conditioned Alfalfa Hay As It Affects the Winter Performance of Weaned Heifer Calves, 1961-62 (Project 370).

F. W. Boren, E. F. Smith, D. Richardson, G. E. Fairbanks, G. E. Thierstein and D. L. Follis

Through cooperative efforts of the Departments of Agronomy and Agricultural Engineering, fourth-cutting alfalfa hay was made available to winter-feed weaned heifer calves. The object of the experiment was to determine the effects of various field-conditioned alfalfa hays on the winter performance of heifer calves.

The following methods and/or conditioning machines were used on fourth-cutting alfalfa hay:

1. Control—mowed, raked, baled.
2. Crimped—mowed, crimped with corrugated steel rolls, raked, baled.
3. Crushed—mowed, crushed with one smooth steel roll and a spiral-grooved rubber roll, raked, baled.
4. Rotary Cut—a 12-foot trail behind twin-rotor rotary mower, which cut, lacerated, and windrowed the hay all in one operation, baled.
5. Swathed—a 12-foot self-propelled windrower with a crimper-crusher conditioning attachment, baled.

Fifty head of choice Hereford heifer calves from the Jeff Ranch, Ft. Davis, Texas, were used in this study. They were allotted, 10 head per lot, on the basis of quality and weight. Alfalfa hay was fed free choice to all lots of heifers. They were also fed 3.4 pounds of rolled sorghum grain per head per day. Salt was available to all lots.

Observations

The results of this experiment are reported in Table 8. Gains made by the heifers in lots 13, 14, 16, and 17 were not significantly different. However, gains made by heifers in lot 15 were significantly lower than in the other lots.

Although these data are from only one year's work and more experimental evidence is needed to draw positive conclusions, some observations can be made from the chemical analysis data presented in Table 9. These data were obtained by the Department of Agricultural Engineering from the five test-groups of alfalfa hay.

The lower protein content of crimped and crushed hay was apparently due to leaf-loss during raking, baling, and sampling. This characteristic was especially noticeable with crushed hay. Carotene loss was very rapid during the first 24 hours after mowing the hay. During this period approximately 40% of the initial carotene was lost and by the end of the winter feeding period (March 1, 1962) 70% of the carotene was lost. Although this is a considerable loss in carotene, the loss caused no apparent effect on average daily gains, under the conditions of this feeding trial. At the level of hay consumed, carotene intake still was over 10 times the recommended allowance.

Average daily gain was apparently affected more by level of protein than of carotene, with the higher protein hay producing the greatest average daily gain irrespective of carotene. Crude fiber appeared to affect gain. The greater the crude fiber, the less the gain.

Table 8

Winter performance of weaned heifer calves fed alfalfa hay field conditioned by various methods.

November 21, 1961, to March 1, 1962—98 days. (Progress Report.)

Lot no.	13	14	15	16	17
No. heifers per lot	10	10	10	10	10
Hay-conditioning method	Control	Crimped	Crushed	Rotary cut	Swathed crimped
Initial wt. per heifer, lbs.	393	401	396	397	395
Final wt. per heifer, lbs.	558	543	509	565	550
Av. gain per heifer, lbs.	165	142	113	168	155
Av. daily gain, lbs.	1.68	1.45	1.15[2]	1.71	1.58
Av. daily ration, lbs.:					
Alfalfa hay	13.18	11.02	11.36	12.62	12.27
Ground sorghum grain	3.39	3.39	3.39	3.39	3.39
Lbs. feed per cwt. gain:					
Alfalfa hay	784.52	760.00	987.83	738.01	776.58
Ground sorghum grain	201.79	233.79	294.78	198.25	214.56
Total feed required per cwt. gain, lbs.	986.31	999.79	1282.61	936.26	991.14
Feed cost per cwt. gain[1]	$10.69	$11.05	$14.20	$10.21	$10.85

1. Feed cost: Alfalfa hay, $18 per ton; ground sorghum grain, $1.80 per cwt.
2. Av. daily gain significantly lower than other gains.

Table 9

Chemical analysis of alfalfa hay.[1]

	Control	Crimped	Crushed	Rotary cut	Swathed crimped
Crude protein (NX6.25), %	15.96	13.06	12.73	18.41	19.33
Crude fiber, %	24.63	31.82	30.91	22.61	21.12
Carotene, mgs. per lb.	15.4	33.4	21.5	34.7	34.5

1. Average of 4 samples.

Diethylstilbestrol[1] Implant Plus Oral Chlortetracycline[2] vs. Oral Chlortetracycline Alone for Fattening Steers (Project 430).

M. M. McCartor,[3] B. A. Koch, E. F. Smith, D. Richardson and R. F. Cox

Experimental Procedure

Hereford steers used in this study were fed in outdoor dirt lots without shelter. Each steer in lot 23, described in a trace-mineral study reported elsewhere in this publication, received a 24-mg. implant of diethylstilbestrol on the first day of the feeding period. Steers in both lots received 70 mgs. of oral chlortetracycline each day during the feeding period.

The fattening ration included sorghum grain, soybean oil meal, and prairie hay. During the first 20 days each steer also received 10 pounds of sorghum silage per day. The sorghum grain fed was gradually increased until the steers went on self-feed. The soybean oil meal was spread over the grain each morning. Initially 10 pounds of prairie hay per head per day were fed. This was cut to 4 pounds per head per day after the cattle were on full feed. Each pound of soybean oil meal contained 70 mgs. of chlortetracycline (Aureomycin).

All animals had free-choice access to salt and to a mixture of salt and bonemeal. Water was always available from automatic waterers.

Shrink data were obtained under conditions outlined in the trace-mineral study reported elsewhere in this publication.

1. Stilbestrol implants were furnished by Chas. Pfizer & Co., Inc., Terre Haute, Ind.
2. Aureomycin (chlortetracycline) supplied by American Cyanamid Corp., Pearl River, N.Y.
3. Present address: Department of Animal Husbandry, Panhandle A & M College, Goodwell, Okla.

Observations

The steers that had been implanted gained significantly faster than those that had not been implanted.

The diethylstilbestrol implant apparently had no effect on shrink during shipping.

There were no significant differences in carcass characteristics measured.

Table 10

Diethylstilbestrol implants plus oral chlortetracycline vs. oral chlortetracycline alone for fattening steers.

March 17, 1961, to July 26, 1961—131 days.

Treatment	24-mg. implant plus oral chlortetracycline	Oral chlortetracycline
Lot no.	23	25
No. steers per lot	10	10
Av. initial wt., lbs.	846	814
Av. final wt., lbs.	1126	1043
Av. total gain, lbs.	280	229
Av. daily gain, lbs.	2.14	1.75
Standard error of mean	±0.09	±0.07
Av. daily ration, lbs.:		
Cracked sorghum grain	22.1	21.3
Soybean oil meal	1.0	1.0
Prairie hay	5.9	6.2
Sorghum silage	1.7	1.7
Av. feed per cwt. gain:		
Sorghum grain	1037	1217
Soybean oil meal	47	57
Prairie hay	277	354
Sorghum silage	78	97
Feed cost per cwt. gain[1]	$23.84	$28.29
Shrink data:		
Av. shrink June 2, 1961[2]		
Pounds	38.5	35.0
%	3.6	3.5
Av. shrink to market[3]		
Pounds	50.0	48.5
%	4.3	4.4
Av. overnight wt. change, lbs.[4]	+9.5	−10.5
Carcass data:		
Av. carcass wt., lbs.	682	634
Av. packer yield, %[5]	61.1	60.6
Av. U.S.D.A. grade[6]	10.9	11.2
Av. fat thickness, in.[7]	0.61	0.73
Av. rib eye, sq. in.[7]	11.71	11.16

1. Based on feed prices listed on page 2.
2. Cattle were individually weighed, loaded on trucks, hauled 60 miles, weighed off trucks, and returned to pens.
3. Cattle were individually weighed, loaded on trucks, hauled 125 miles to Kansas City, and individually weighed off trucks.
4. Cattle were fed and watered during overnight stand in Kansas City Stockyards.
5. Based on off-truck weight at Kansas City.
6. Average grade determined as follows: Low choice, 13; high good, 12; average good, 11; low good, 10; high standard, 9.
7. Measured at 12th rib.

Response of Fattening Steers to Oral or Injected Vitamin A, with Observations on Shrink (Project 430).

M. M. McCartor,[1] B. A. Koch, E. F. Smith, D. Richardson and R. F. Cox

Steers used in an antibiotic study and a trace mineral study reported elsewhere in this publication were also used in a study designed to further evaluate the use of supplemental vitamin A during the fattening period. The animals used showed no visual symptoms of vitamin A deficiency any time. However, the diets fed and the management practices followed were similar to those in studies at other stations where supplemental vitamin A was evaluated.

Experimental Procedure

May 5, 1961, 50 steers, five groups of 10 each, were randomly divided within lots. Three steers in each lot received an intramuscular injection of 250,000 I.U. of vitamin A palmitate in oil; three received a bolus containing 250,000 I.U. of vitamin A oil, and four served as controls. The vitamin A treatment was repeated each two weeks between May 5 and June 30, 1961. During that period each treatment animal received 1,250,000 I.U. of supplemental vitamin A. All cattle, including control animals, were driven down the chute and caught in the squeeze at each treatment time.

The cattle had been on a wintering ration of sorghum silage, alfalfa hay and soybean oil meal. During the fattening period they received a ration of ground sorghum grain, soybean oil meal and prairie hay. Forty of the steers used had been implanted with 24 mgs. of diethylstilbestrol per head March 17, 1961, and all 50 received 70 mgs. of chlortetracycline per head per day in their supplemental soybean oil meal. All the steers had been started on a fattening ration March 17, 1961.

Salt, either plain or trace-mineralized, and a mixture of salt and bonemeal were available at all times. Water was always available from automatic waterers.

This group of 50 steers was used also to collect data on shrink during movement of cattle.

June 2, 1961, the steers were individually weighed onto trucks and hauled 60 miles, then weighed off the trucks individually and returned to feeding pens. Climatic data follow: Minimum temperature, 63° F.; maximum temperature, 80° F.; average temperature, 72° F.; relative humidity, 100 at 6 a.m. and 88 at 2 p.m.; precipitation, 0.40 inch while the cattle were being moved; wind light from the east.

July 31, 1961, the steers were individually weighed onto trucks and hauled to Kansas City (125 miles) and individually weighed off the trucks at the stockyards. Climatic data follow: Minimum temperature, 73° F.; maximum temperature, 95° F.; average temperature, 84° F.; relative humidity, 100 at 6 a.m. and 68 at 2 p.m.; precipitation, 0; wind was moderate from the west.

Observations

Gain and carcass data are summarized in Table 11. Since control and treated steers were fed together, feed efficiency data could not be determined.

No real differences in average daily gain, carcass yield, carcass grade or carcass composition are indicated between control animals and those that received supplemental vitamin A. The supplemental vitamin A apparently had no effect on shrink of the animals during movement.

No visible differences in hair coat, joint stiffness, lacrimation, health of epithelial tissues or appetite were noted between treated and untreated animals in the same lot.

Under conditions of this test supplemental vitamin A apparently improved neither performance nor health of the cattle involved.

1. Present address: Department of Animal Husbandry, Panhandle A & M College, Goodwell, Oklahoma.

Table 11
Response of fattening steers to oral or injected vitamin A.
March 17, 1961, to July 26, 1961—131 days.

Treatment	Control	Injected vitamin A[1]	Oral vitamin A[2]
No. steers per group	20	15	14[3]
Av. initial wt., lbs.	833	842	860
Av. final wt., lbs.	1113	1122	1134
Av. total gain, lbs.	280	280	274
Av. daily gain, lbs.	2.14	2.14	2.09
Standard error of mean	±0.08	±0.09	±0.10
Shrink data:			
Av. shrink June 2, 1961[4]			
Pounds	41	38	39
Percent	3.9	3.7	3.6
Av. shrink to market[5]			
Pounds	48	55	51
Percent	4.1	4.7	4.3
Carcass data:			
Av. carcass wt., lbs.	678	689	688
Av. packer yield, %[6]	61.2	61.9	60.6
Av. USDA carcass grade[7]	11.7	11.5	11.4
Av. fat thickness, in.[8]	0.72	0.75	0.74
Av. rib eye, sq. in.[8]	11.46	11.66	11.43

1. Each steer received an intramuscular injection of 250,000 I.U. of vitamin A palmitate in oil May 5, May 19, June 2, June 16 and June 30.
2. Each steer received a bolus containing 250,000 I.U. of vitamin A in oil May 5, May 19, June 2, June 16 and June 30.
3. One steer foundered badly and was not used in calculations.
4. Cattle were individually weighed, loaded on trucks, hauled 60 miles, weighed off trucks and returned to pens.
5. Cattle were individually weighed, loaded on trucks, hauled 125 miles to Kansas City and individually weighed off trucks.
6. Based on off-truck weight at Kansas City.
7. Average grade determined as follows: Low choice, 13; high good, 12; average good, 11; low good, 10; high standard, 9.
8. Measured at 12th rib.

Trace-mineral Salt for Steers on a Fattening Ration (Concrete and Shelter vs. Dirt and No Shelter) with Observations on Shrink (Project 695).[1]

B. A. Koch, E. F. Smith, D. Richardson and M. M. McCartor[2]

Previous data reported from this station seem to indicate that supplemental dietary trace minerals may be valuable under certain feeding conditions. Those data also indicated that trace minerals might be related to weight loss during shipping. This study was designed to further determine the value of supplemental dietary trace minerals when cattle were on concrete and had shelter available and when they were on dirt with no shelter.

Experimental Procedure

A report of the wintering phase of this study along with a description of the steers used and their previous treatment is on page 3 of Kansas Circular 383, May 6, 1961.

The 40 Hereford steers used were held off feed and water 15 hours before being weighed for the fattening phase of the study. Treatment groups remained the same as for the wintering phase of the study and each animal remained in the same group. Treatment groups were as follows:

Lot 11. Plain salt (on concrete with shelter available).

Lot 12. Trace-mineral salt (on concrete with shelter available).

Lot 18. Trace-mineral salt (dirt lot, no shelter).

Lot 23. Plain salt (dirt lot, no shelter).

The fattening ration included cracked sorghum grain, soybean oil meal, and prairie hay. During the first 20 days each steer also received 10 pounds of sorghum silage per day. The amount of sorghum grain fed was gradually increased until the steers went on self-feed. The soybean oil meal was spread over the grain each morning. Initially 10 pounds of prairie hay per head per day were fed. This was cut to 4 pounds per head per day after the cattle were on full feed. Each pound of soybean oil meal fed contained 70 mgs. of chlortetracycline (Aureomycin).[3] Each steer received a 24-mg. implant of diethylstilbestrol[4] on the first day of the fattening period.

All animals had free-choice access to the designated salt and also to a mixture of that salt and bonemeal. Water was always available from automatic waterers.

The steers also were used in collecting further data on shrinkage during transport. June 2, 1961, the steers were individually weighed and hauled 60 miles. They were then weighed off trucks individually and returned to feeding pens. Climatic data were as follows: Minimum temperature, 63° F.; maximum temperature, 80° F.; average temperature, 72° F.; relative humidity, 100 at 6 a.m. and 88 at 2 p.m.; precipitation, 0.40 inch while the cattle were being moved; wind light from the east.

July 31, 1961, the steers were individually weighed onto trucks and hauled to Kansas City (125 miles), and individually weighed off the trucks at the stockyards. Climatic data follow: Minimum temperature, 73° F.; maximum temperature, 95° F.; average temperature, 84° F.; relative humidity, 100 at 6 a.m. and 68 at 2 p.m.; precipitation, 0; wind moderate from the west.

The cattle were held over night to feed and water and were sold on the Kansas City market August 1, 1961.

Observations

Results of the study are summarized in Table 12.

Trace-mineralized salt had no apparent effect on average daily gain or feed efficiency of steers fattened under conditions of this study.

Steers fed on concrete with shelter available gained somewhat faster than those on dirt with no shelter. Differences were less than during the wintering period.

No significant differences in shrink due to treatment were found when the cattle were trucked on two different occasions. Feeding and watering the cattle during the overnight stand in the stockyards changed the average weight of the cattle only slightly.

Treatment apparently did not affect carcass yield, carcass grade, or other carcass characteristics studied.

1. Partially supported by the Salt Producers Association, 33 N. LaSalle Street, Chicago 2, Ill.

2. Present address: Department of Animal Husbandry, Panhandle A & M College, Goodwell, Okla.

3. Aureomycin (chlortetracycline) was supplied by the American Cyanamid Co., Pearl River, N.Y.

4. Stilbestrol implants were supplied by Chas. Pfizer & Co., Inc., Terre Haute, Ind.

Table 12

Trace-mineral salt[1] for steers on a fattening ration (concrete and shelter vs. dirt and no shelter).

March 17, 1961, to July 26, 1961—131 days.

Treatment	Concrete lot + shelter		Dirt lot, no shelter	
	Plain salt	T-M salt	Plain salt	T-M salt
Lot no.	11	12	13	23
No. steers per lot	10	10	9[2]	10
Av. initial wt., lbs.	849	857	852	846
Av. final wt., lbs.	1154	1162	1140	1126
Av. total gain, lbs.	305	305	288	280
Av. daily gain, lbs.	2.33	2.33	2.20	2.14
Standard error of mean	±0.08	±0.12	±0.07	±0.09
Av. daily ration, lbs.:				
Cracked sorghum grain	21.6	22.1	21.7	22.2
Soybean oil meal	1.0	1.0	1.0	1.0
Prairie hay	6.0	6.0	5.9	5.9
Sorghum silage	1.7	1.7	1.7	1.7
Av. feed per cwt. gain, lbs.:				
Sorghum grain	927	948	986	1037
Soybean oil meal	43	43	45	47
Prairie hay	258	257	269	277
Sorghum silage	72	72	76	78
Feed cost per cwt. gain:[3]	$21.41	$21.84	$22.73	$23.84
Shrink data:				
Av. shrink June 2, 1961[4]				
Pounds	39.5	45.5	38.9	38.5
%	3.6	4.2	3.7	3.6
Av. shrink to market[5]				
Pounds	54.5	57.5	46.1	50.0
%	4.5	4.7	4.0	4.3
Av. overnight wt. change, lbs.[6]	+15.0	+9.5	+1.0	+9.5
Carcass data:				
Av. carcass wt., lbs.	710	709	684	682
Av. packer yield, %[7]	62.1	61.2	61.1	61.1
Av. U.S.D.A. grade[8]	11.8	11.3	11.7	11.9
Av. fat thickness, in.[9]	0.84	0.82	0.67	0.61
Av. rib eye, sq. in.[9]	11.51	11.62	11.46	11.71

1. Commercial trace-mineral salt containing not less than 0.150% manganese; 0.010% cobalt; 0.033% copper; 0.005% zinc; 0.007% iodine; 0.125% iron.
2. One steer foundered badly and was not used in gain or carcass calculations.
3. Based on feed prices listed on page 2.
4. Cattle were individually weighed, loaded on trucks, hauled 60 miles, weighed off trucks, and returned to pens.
5. Cattle were individually weighed, loaded on trucks, hauled 125 miles, and individually weighed off trucks.
6. Cattle were fed and watered during overnight stand in the Kansas City Stockyards.
7. Based on off-truck weight at Kansas City.
8. Average grade determined as follows: Low choice, 13; high good, 12; average good, 11; low good, 10; high standard, 9.
9. Measured at 12th rib.

The Effect of Added Calcium and Phosphorus with and without Added Protein to the Ration of Steers on Bluestem Pasture (Project 253-1).

C. L. Drake, E. F. Smith, W. S. Tsien and D. L. Follis

This experiment was designed to evaluate the desirability of supplementing bluestem pasture as indicated in the title.

Forty Hereford steer calves were divided into four lots of 10 each and fed the following experimental rations per head daily:

Lot 1. Two pounds of dehydrated molasses (a molasses product dried on soybean hulls).

Lot 2. Two pounds of dehydrated molasses and 39.1 grams of dicalcium phosphate.

Lot 3. One pound of dehydrated molasses and 1 pound of 41% corn gluten meal.

Lot 4. One pound of dehydrated molasses and 1 pound of 41% corn gluten meal plus 29.6 grams of dicalcium phosphate.

The trial was started February 18, 1961, with steers weighing about 445 pounds each. They were all pastured together on a 190-acre bluestem pasture, gathered each morning, divided into different lots and fed. This system was continued until October 5, 1961, when they were fed three times per week instead of every day. The ration was increased so three feedings provided the same ration as the previous seven.

The cattle were weighed every 28 days, and a blood sample was obtained from the jugular vein of each animal. This was analyzed for calcium and phosphorus as soon as possible after collection. Hematocrit values were also determined.

At the beginning of the trial a bone sample was obtained from the coccygeal vertebra and a tooth was extracted to determine the effects of added mineral on the amount deposited in the bone and teeth. This procedure was repeated at the completion of the third and sixth months and more samples will be obtained at slaughter. The samples were placed in a sharp freeze and will be analyzed when the project is terminated.

Average weights and daily gains are shown in Table 13.

The October 2, 1961, gains are shown to approximate a long summer grazing season and it is evident that there was an increased gain when the steers received a protein supplement at 1 pound per head per day.

March 3 was the most recent weigh period and clearly shows the effect of wintering on dry bluestem grass. Approximately 5 pounds of prairie hay were provided per head daily when the snow cover was deep, about six weeks.

Adding protein to lots 3 and 4 gave a highly significant increase in gain over lots 1 and 2 for the entire period. Gain differences between lots 1 and 2 or between lots 3 and 4 were not significant.

The following table gives average calcium, phosphorus, and hematocrit values.

Calcium, Phosphorus and Hematocrit Values

(Blood values in mgs./100 mls. blood)

Lots	Calcium	Phosphorus	Hematocrit
1	10.47	5.65	35.73
2	10.27	6.82	35.13
3	10.39	6.28	34.77
4	10.27	6.42	36.52

Table 13

Effects of added calcium and phosphorus on steers with and without protein added on pasture.

	Starting wt. 2-18-61	Wt. 10-2-61	Av. daily gain 2-18-61 to 10-2-61	Wt. 3-3-62	Av. daily gain 2-18-61 to 3-3-62
Lot 1	438	680	1.07	579	.373
Lot 2	455	689	1.04	613	.418
Lot 3	441	734	1.30	702	.690
Lot 4	457	740	1.25	710	.669

The Effects of Feeding Different Levels of Dicalcium Phosphate to Heifers on Bluestem Pasture (Project 253-2).

C. L. Drake, E. F. Smith, D. Richardson, D. L. Good and D. L. Follis

This trial was designed to study the effects of low to high levels of calcium and phosphorus supplementation for heifers grazing bluestem pasture.

Forty Hereford heifer calves were divided into four groups at random, and turned into a 140-acre pasture. Each morning the heifers were gathered and separated into four lots and fed the rations shown in Table 14.

Starting October 5, 1961, the heifers were gathered and fed three times weekly instead of each day; however, the same number of pounds of feed were fed per week. The heifers were given approximately 5 pounds of prairie hay per head per day, during the winter when there was snow on the ground, about six weeks. Heated water and a trace-mineralized vitamin A salt mixture[1] were available at all times.

Observations

The heifers lost weight during the winter months; however, they appeared to be healthy, and no signs of sickness were observed.

For the entire period on test the control heifers gained significantly more than the other three lots of heifers that received dicalcium phosphate, Table 14. There were no significant differences among the three lots receiving dicalcium phosphate.

Data from this trial indicate that dicalcium phosphate supplementation at low to high levels did not increase daily gains during a summer and winter period on bluestem pasture. During the winter months as the level of dicalcium phosphate increased, daily gain tended to decrease.

These heifers will be bred this summer, and the dicalcium phosphate levels will be maintained to study effects on gestation and calving.

1. Commercial mix containing 10% manganese, 10% iron, 14% max.—12% min., calcium, 1% copper, 5% zinc, .30% iodine, .10% cobalt. Two pounds of this mix were added to 97 pounds of salt containing 1 pound of vitamin A (10,000 I.U./gm.).

Table 14

Experimental rations and average daily gain per head.

Ration	Av. daily gain[1] 2-18-61 10-2-61	Av. daily gain[2] 10-2-61 3-3-62	Av. daily gain 2-18-61 3-3-62
LOT 1			
1 lb. dried molasses			
1 lb. 41% corn gluten meal	1.22	−.237	.623
LOT 2			
1 lb. dried molasses			
1 lb. 41% corn gluten meal			
27.1 gms. dicalcium phosphate	1.10	−.322	.529
LOT 3			
1 lb. dried molasses			
1 lb. 41% corn gluten meal			
54.1 gms. dicalcium phosphate	1.15	−.342	.550
LOT 4			
1 lb. dried molasses			
1 lb. 41% corn gluten meal			
81.1 gms. dicalcium phosphate	1.18	−.375	.553

1. Approximates a long summer grazing period.
2. Approximates a winter grazing period.

Different Methods of Managing Bluestem Pastures, 1961 (Projects 253-3 and 253-5).

E. F. Smith, K. L. Anderson, B. A. Koch, F. W. Boren and C. L. Drake

This experiment was designed to determine the effect of different stocking rates, of deferred grazing, and of pasture burning on cattle performance, productivity of pastures, and range condition as determined by plant population changes. In addition to the yearly report, a summary of cattle gains for the past 12 years of the study is included.

Experimental Procedure

Yearling Hereford steers with an average USDA feeder grade of about high good were used to stock the pastures in 1961. The steers came from near Thermopolis, Wyoming, were received about March 1, and were fed prairie and alfalfa hay in drylot until the test started.

The experimental treatment for each pasture was:

Pasture 1. Moderate stocking rate, 3.3 acres per steer.

Pasture 2. Overstocked, 2.3 acres per steer.

Pasture 3. Understocked, 4.6 acres per steer.

Pastures 4, 5, and 6. Deferred grazing at the moderate stocking rate was 3.3 acres per steer. All steers were grazed on pastures 4 and 5 from May 3 to June 30. They were then moved to pasture 6 where they remained until September 25, when all were allowed to graze in all three pastures until the close of the trial October 7.

Pasture 9. Burned March 3, 1961, moderate rate of stocking.

Pasture 10. Burned April 6, 1961, moderate rate of stocking.

Pasture 11. Burned April 28, 1961, moderate rate of stocking.

The steers were gathered about 3 p.m., held over night without feed or water and weighed the following morning, about 7 a.m.

Observations

The results are reported in Tables 15, 16, and 17.

Steer gains appeared to be lowered by deferred grazing and overstocking. This was the first season in 12 years that steer gains on the non-burned pasture (no. 1) exceeded gains made by steers on the mid- or late-spring-burned pastures. Forage was sufficient on all burning treatments to permit the entire pasture to be burned, which hadn't occurred for several years.

Yields of vegetation were measured in small areas protected from grazing by wire cages, located in a randomized manner within range sites. The cages were placed in new locations each year, to reflect previous management rather than effects of the previous year's cage. Protected areas were clipped at the close of the grazing season, so they represented the full season's growth. Experiments have shown that maximum range forage yields are obtained from one cutting made at the close of the growing season.

The components of yield were considered here as forage, weeds, and mulch. The burned pastures, of course, lacked the mulch found in the unburned ones.

It will be seen that the closely grazed pasture yielded less forage and had less mulch than the moderate or lightly stocked one and that the burned pastures, which had no mulch at all, yielded significantly less forage than all unburned ones except the overstocked one. Moisture-measuring devices have been established to permit detailed study of amounts of soil moisture under the different treatments.

Table 15

Yearly account of cattle gains under different methods of grazing pastures; 12-year summary, 1950-61. Average gain per steer in pounds for the summer season of approximately 150 days.

Pasture no.	1	2	3	4, 5, 6	9	10	11
Management	Normally stocked	Over-stocked	Under-stocked	Deferred rotated	Early-spring-burned	Mid-spring-burned	Late-spring-burned
1950	221	210	214	205	216	254	230
1951	242	256	290	234	243	265	254
1952	246	209	228	197	251	278	283
1953	226	194	233	197	205	217	234
1954	261	237	236	214	270	271	306
1955	270	224	253	213	282	305	307
1956	179	184	168	154	212	234	216
1957	243	236	244	209	261	256	279
1958	208	207	207	198	222	270	253
1959	252	241	262	203	254	275	295
1960	267	242	255	235	299	289	314
1961	255	217	227	187	243	245	237
Average	239	221	234	203	246	263	267

Table 16

A comparison of different methods of managing bluestem pastures.
May 3, 1961, to October 7, 1961—157 days.

Pasture no.	1	2	3	4, 5, 6	9	10	11
Management	Moderately stocked	Over-stocked	Under-stocked	Deferred	Early-spring-burned	Mid-spring-burned	Late-spring-burned
No. steers per pasture	18	26	13	55	13	13	13
Acres in pasture	60	60	60	3—60[1]	44	44	44
Acres per head	3.3	2.3	4.6	3.3	3.4	3.4	3.4
Initial wt. per steer, lbs.	451	468	466	465	469	470	450
Final wt. per steer, lbs.	706	685	693	652	712	715	687
Gain per steer, lbs.	255	217	227	187	243	245	237
Daily gain per steer, lbs.	1.62	1.38	1.45	1.19	1.55	1.56	1.51
Gain per acre, lbs.	77	94	49	57	71	72	70

1. Three 60-acre pastures.

Table 17

Vegetation yields, disappearance of vegetation, botanical composition, and range condition of bluestem pasture under different management practices, 1961.

Pasture no.		1	2	3	4, 5, 6	9	10	11
Range site	Yield of vegetation in pounds of air-dry forage per acre, 1961							
Ordinary upland	—Forage	4658	3102	5655	4227	2952	2454	2681
	Weeds	247	406	273	225	247	203	101
	Mulch	2892	1019	2037	1697			
Limestone breaks	—Forage	2795	1814	3580	3448	1803	1874	1916
	Weeds	229	366	101	97	238	137	163
	Mulch	1453	739	2478	1408			
Range site	Disappearance of vegetation in pounds of air-dry forage per acre, 1961							
Ordinary upland	—Forage	1978	2154	2231	1951	1581	1093	1530
	Weeds	88	236	141	158	112	148	7
	Mulch	520	392	194	254			
Limestone breaks	—Forage	1206	1155	741	1308	798	944	946
	Weeds	73	236	....	52	86	46	117
	Mulch	452	419	1283	248			
Range site	Remainder after grazing							
Ordinary upland	—Forage	2680	948	2424	2276	971	1361	1151
	Weeds	186	170	132	97	135	55	194
	Mulch	2372	672	1843	1453			
	Total	5238	1790	4399	3826	1106	1416	1345
Limestone breaks	—Forage	1589	659	2839	2140	1005	930	970
	Weeds	156	130	101	45	152	91	46
	Mulch	1001	820	1195	1160			
	Total	2746	1109	4135	3345	1157	1021	1016
Range site	Botanical composition and range condition, 1961							
Ordinary upland	—% decreasers	57.4	45.4	43.6	54.3	43.0	67.2	69.7
	% increasers	26.1	29.3	33.7	31.2	24.5	15.6	15.8
	% range condition	69.8	57.2	56.6	65.6	55.9	83.2	83.3
Limestone breaks	—% decreasers	62.4	49.1	65.1	72.4	58.6	66.2	75.3
	% increasers	21.1	32.7	17.0	15.4	20.1	17.5	17.7
	% range condition	80.5	72.1	82.7	90.5	79.3	85.8	90.5

Supplemental Cobalt for Heifers on Fattening Rations, 1961-62, Progress Report (Project 253-6).

E. F. Smith, F. W. Boren, D. Richardson and C. L. Drake

The 40 heifer calves, 10 per lot, used in this experiment were good to choice grade Herefords from near Ft. Davis, Texas, and were assigned on a random weight basis to their treatments. All lots received all the prairie hay they would consume, and ground corn was gradually increased until they were on full feed. Soybean meal was fed as the protein supplement, with ground limestone added to supply a tenth of a pound per head daily and enough vitamin A was added to supply 10,000 I.U. per head daily. In addition to the above ration two of the lots received cobalt, in the form of cobalt sulfate, in their soybean meal to supply 1 mg. of cobalt per head daily.

The results of the trial to date are reported in Table 18. The cobalt added to the diets of lots 21 and 22 apparently had no effect.

Table 18

The value of supplemental cobalt[1] in the ration of fattening heifers.

December 4, 1961, to March 24, 1962—110 days.

Lot no.	19	20	21	22
Treatment	Control	Control	Cobalt	Cobalt
No. heifers per lot	10	10	10	10
Initial wt. per heifer, lbs.	379	379	378	381
Daily gain per heifer	1.63	1.64	1.70	1.63
Daily ration per heifer, lbs.:				
Ground corn	6.9	7.3	7.3	7.3
Soybean meal[2]	1.4	1.4	1.4	1.4
Prairie hay	6.4	6.6	6.9	6.9
Salt, free choice				
Feed per cwt. gain, lbs.:				
Ground corn	423	445	429	448
Soybean meal	86	85	82	86
Prairie hay	393	402	406	423
Feed costs per cwt.[3] gain	$15.54	$16.07	$15.64	$16.34

1. Cobalt was mixed with the soybean meal fed to lots 21 and 22 in the form of $CoSO_4 \cdot 7H_2O$ at the rate of 1 mg. of cobalt daily.
2. The soybean meal of all lots was fortified to furnish per head daily a tenth of a pound of ground limestone and 10,000 I.U. of vitamin A daily.
3. Feed prices may be found on inside back cover.

The Value of Chlortetracycline[1] for Steers on a Wintering, Grazing and Fattening Program (Project 5-663 and 253-6).[2]

E. F. Smith, B. A. Koch, D. Richardson and F. W. Boren

Twenty good to choice Hereford steer calves from near Ft. Davis, Texas, were randomly divided into two lots. One group served as the control; the other was treated in a similar way except that each animal received 70 mgs. of chlortetracycline (aureomycin) daily.

All of the animals were implanted with 24 mgs. of stilbestrol in the ear at the start of the wintering period. Both groups were fed in drylot during the winter and received all the prairie hay they would eat—4 pounds of alfalfa hay and 5 pounds of sorghum grain per head daily. The chlortetracycline was mixed with the sorghum grain for lot 21. The steers were grazed on bluestem pasture during the early summer with no other feed. Chlortetracycline was fed to lot 21 mixed with the salt. The

1. This project was partially supported by a grant from the American Cyanamid Company, Pearl River, N.Y., and the chlortetracycline (aureomycin) was also supplied by it.

Table 19
The value of chlortetracycline for steer calves on a wintering, grazing and fattening program.

Wintering, December 2, 1960, to May 11, 1961—160 days.

Lot no.	20	21
Treatment	Control	Chlortetracycline
No. steers per lot	9[1]	10
Initial wt. per steer, lbs.	526	519
Daily gain per steer, lbs.	0.79	0.92
Daily ration per steer, lbs.:		
Sorghum grain	5.0	5.0
Alfalfa hay	4.0	4.0
Prairie hay	8.3	8.4
Salt	.05	.05
Stilbestrol implant, 24 mgs.	Yes	Yes
Chlortetracycline, 70 mgs. per head daily	No	Yes
Feed per cwt. gain, lbs.:		
Sorghum grain	633	543
Alfalfa hay	506	435
Prairie hay	1051	913
Feed cost per cwt. gain[2]	$22.74	$19.59
Phase II—Grazing, May 11 to August 7, 1961—88 days.		
Initial wt. per steer, lbs.	653	666
Daily gain per steer, lbs.	1.36	1.07
Chlortetracycline, 70 mgs. per steer, supplied in the salt	No	Yes
Phase III—Fattening, August 7 to November 9, 1961—94 days.		
Initial wt. per steer, lbs.	773	761
Daily gain per steer, lbs.	3.39	3.27
Daily ration per steer, lbs.:		
Ground corn, self-fed	17.3	17.2
Soybean meal	1.0	1.0
Prairie hay	2.8	2.1
Alfalfa hay	8.2	8.2
Salt	.05	.05
Stilbestrol implant, 24 mgs.	Yes	Yes
Chlortetracycline, 70 mgs. per steer	No	Yes
Feed per cwt. gain, lbs.:		
Corn	510	526
Soybean meal	29	31
Hay	324	315
Feed cost per cwt. gain[2]	$14.81	$15.15
Summary of Phases I, II and III, December 2, 1960, to November 9, 1961—342 days.		
Final wt. per steer, lbs.	1092	1068
Daily gain per steer, all phases	1.65	1.61
Feed cost per cwt. gain[2]	$16.07	$16.45
Dressing %	60.1	61.3
Carcass grades:[3]		
Av. choice	....	2
Low choice	1	....
High good	5	2
Av. good	3	5
Av. carcass grade[4]	7.2	7.1
Marbling score[5]	6.8	7.2

1. One steer died during the summer and was omitted from the results.
2. Feed prices may be found on page 2; summer bluestem pasture cost was $15 per steer.
3. Carcass data not obtained on one steer in lot 21.
4. The U.S.D.A. grade, av. choice, was assigned a numerical grade of 5; low choice, 6; high good, 7; av. good, 8.
5. Degree of marbling: a score of 7 indicates small amount; the higher the number, the less marbling.

steers were finished on grain in drylot from August 7 to November 9, 1961. All steers were reimplanted with 24 mgs. of stilbestrol August 7. The steers were self-fed corn after they reached their maximum grain intake. Some difficulty was experienced in getting lot 21 on feed, and one steer in this lot foundered. His performance was average and he remained in the test; this may have affected the performance data of this group.

Observations

Results of this test are reported in Table 19.

The chlortetracycline (aureomycin) increased gains slightly during the winter, but the gains were lower for this lot during the summer, with no difference in fattening or total gain. There was no statistically significant difference in any of the period gains. Other information collected on the two groups did not show any apparent benefit from aureomycin.

Improvement of Beef Cattle Through Breeding Methods (Project 286).

W. H. Smith, J. D. Wheat, H. Spies and H. A. Gottlieb

The purebred Shorthorn cattle breeding program was continued during 1961 according to the breeding program initiated in 1949. Inbreeding of the two lines has been continued. The Wernacre Premier line is in its fourth generation, and the Mercury line will enter its fourth generation of inbreeding during 1962. The inbreeding plan has been basically to continue successive generations of half-sibbing in both lines.

This experimental project was initiated to study the inheritance of production traits in beef cattle, to evaluate the effects of inbreeding in cattle, and to explore the feasibility of using inbred lines of beef cattle for the breeding improvement of their production traits. Many production data have been collected on each of the inbred lines as it has progressed; however, no extensive line crossing has been attempted because of the relatively low level of inbreeding which has prevailed to date and the limited number of breeding animals in the project during its progress.

The management of these experimental cattle includes weighing each cow and calf immediately following parturition. Summer pasture breeding is practiced and the calves are born during the spring and summer each year. The calves are not creep fed during the suckling period. All calves are weaned, weighed, and scored for type when they are approximately six months of age and the standardized weaning age for weaning weight correction is 180 days. Calves are placed on individual feeding trials for record-of-performance tests for 182 days shortly after they are weaned. The final age upon completion of the feeding trial is near 365 days. Body weight gain and feed consumption records are maintained on all individual calves during the feeding period. The calves are scored for type or conformation as yearlings when they are taken off the prescribed feeding test.

The full-feed ration for the bulls consists of 75% cracked corn and 25% chopped alfalfa hay; that for the heifers, 55% cracked corn and 45% chopped alfalfa hay. All calves are fed twice daily by means of individual feeders while the feed test is in progress.

Production data for the 1960 calves are summarized in Table 20. The Wernacre Premier line was established and committed to inbreeding earlier than the Mercury line; hence the Wernacre Premier calves have been somewhat more highly inbred than the Mercury calves during the project's progress. The 1961 calves have not completed their feeding tests at the time of this report, so production data for them are not included. Twenty-six calves of the 1961 calf crop are being individually fed.

No abnormality that definitely can be attributed to inbreeding has occurred in either of the inbred lines. The incidence of still-born calves has been higher in the Mercury line during the last two years than during previous periods. No definite conclusions yet can be made regarding this observation, as one sire and many of the dams involved as parents of

Table 20

Summary of the 1960 Shorthorn calves from indicated inbred lines.

Tattoo no.	Coefficient of inbreeding	Birth weight	Adjusted weaning weight	Weaning score	Initial weight	Final weight	Total gain	Average daily gain	Final score	TDN per cwt. gain
					Mercury Line—Bulls					
025	13	69	344	2+	406	850	445	2.45	2−	379
027	17	60	372	2	370	795	425	2.34	2−	342
029	18	57	370	2−	380	815	435	2.39	2	360
033	18	55	383	2	352	735	383	2.10	3+	377
035	16	70	367	2+	350	731	381	2.09	2+	346
039	20	61	332	2−	300	625	325	1.79	2−	337
041	28	60	364	2	345	775	430	2.36	2−	342
047	18	67	368	2−	300	720	420	2.31	2−	326
051	16	63	405	2	340	730	390	2.14	2	436
053	18	93	406	1−	432	835	403	2.21	2	456
057	10	65	364	1−	377	795	418	2.30	2+	442
061	16	66	366	2+	317	670	353	1.94	2	371
075	7	80	346	1−	313	730	417	2.29	2+	360
031	16	62	317	2−	330	765	435	2.39	2	456
Average	17	66	365	2+	351	755	404	2.32	2	381
					Heifers					
021	19	65	393	2+	370	692	322	1.77	1−	410
023	19	56	350	2	330	642	312	1.71	1	481
043	16	66	370	1−	350	611	261	1.43	1	336
045	16−	57	347	2	285	520	235	1.29	2−	474
059	19	60	397	2−	382	733	351	1.93	1	427
063	16	65	281	2−	242	620	378	2.08	2	400
065	20	70	285	3	267	477	210	1.15	3	562
069	12	72	400	1−	383	732	349	1.92	1	514
077	9	70	372	2+	297	655	392	2.15	2+	322
Average	16	65	355	2	323	631	312	1.71	2+	436
					Wernacre Premier Line—Bulls					
083	34	76	402	3+	275	667	392	2.15	3+	322
					Heifers					
037	30	72	492	3+	380	632	252	1.38	2−	454
055	38	65	485	3+	405	702	297	1.63	2−	515
067	34	67	463	3+	370	620	250	1.37	2−	610
071	24	64	421	2−	334	626	292	1.60	2−	404
Average	32	67	465	3+	372	645	273	1.50	2−	496

still-born calves during the last two years were not afflicted with this difficulty or fault in previous breeding performance.

Data on the weaning weight of all calves in both inbred lines were analyzed during the past year. These data were collected from 1950 through 1960, inclusive, and are summarized according to inbred line and year in Table 21.

All analyses were computed separately on each of the two inbred lines. It was necessary to develop calf-weaning-weight correction factors for age of calf, sex of calf, and age of dam for each inbred line so actual weaning weights could be adjusted for comparisons.

In the Wernacre Premier inbred line, the eight-year-old dams possessed the largest average calf weaning weight, adjusted for age of calf. The following constants were obtained for cow ages 2 through 13 compared with eight-year-olds: 2 = +153; 3 = +72; 4 = +80; 5 = +55; 6 = +53; 7 = +25; 8 = 0; 9 = +33; 10 = +65; 11 = +69; 12 = 59; and 13 = 39. In the Mercury inbred line, the calf weaning weights were adjusted to the nine-year-old dams which had an average calf weaning weight, adjusted for age of calf, of 384 pounds. The following constants were obtained: 2 = +90; 3 = +63; 4 = +40; 5 = +40; 6 = +27; 7 = +15; 8 = +27; 9 = 0; 10 = +42; 11= +35; and 13 = +15. There were no available records on twelve-year-old dams for this inbred line.

The average weaning weights, adjusted for age of calf and age of dam, for heifer and bull calves were compared on a within-line basis to obtain the correction values for sex of calf. It was determined that 61 pounds and 18 pounds needed to he added to the actual weight of heifer calves to correct them to a bull calf equivalent in the Wernacre Premier and Mercury lines, respectively.

Table 21

Yearly averages for weaning weight, inbreeding of calf and inbreeding of dam.

Year	Number of calves	Average weaning weight* (lbs.)	Average inbreeding of calf (%)	Average inbreeding of dam (%)
		Wernacre Premier Line		
1950	21	496	10.28	0
1951	11	473	11.77	0
1952	14	471	16.28	4.97
1953	9	459	12.89	1.74
1954	6	440	18.63	6.89
1955	9	440	20.73	7.61
1956	8	500	25.51	8.06
1957	5	469	25.23	7.27
1959	9	426	28.36	18.47
1960	6	443	32.34	22.54
Grand averages	....	460	18.03	6.10
		Mercury Line		
1951	14	424	0	0
1952	10	410	0	0
1953	13	400	3.22	0
1954	13	413	7.17	0
1955	18	385	11.66	0
1956	15	426	11.63	0.21
1957	25	416	11.92	2.73
1958	17	374	18.72	8.14
1959	19	363	19.34	7.49
1960	23	361	16.38	7.77
Grand averages	....	395	11.25	3.20

* Adjusted for age of calf, age of dam, and sex of calf. (180 standardized weaning age, mature cow and bull calf equivalent according to specific inbred line-correction factors.)

Analyses of variance indicated that the within-year level of inbreeding of the calves did not affect calf weaning weight significantly in either inbred line. Examination of the yearling summary of the calf weaning weights for both lines portrays a general trend of decreasing weaning weight with increased level of inbreeding of calves. Level of inbreeding of calves is confounded with year effects, so an intricate evaluation of inbreeding is not possible with these data. The analyses of variance indicated that the effect of years on calf weaning weight was highly significant in both inbred lines.

The following within-year simple correlations were calculated for the Wernacre Premier line and Mercury line, respectively; birth weight of calf and average daily gain to weaning, .33 and .34; birth weight and weaning weight (adjusted for age of calf), .51 and .47; actual weaning weight and weaning score, .40 and .57. All of these correlation coefficients are highly significant.

The analyses reported on this purebred Shorthorn cattle breeding project are not conclusive and additional data will be collected as the project progresses. The preliminary findings discussed here indicate the problems involved in evaluating animal production data. None of the corrections used in this study for adjustment of calf weaning weight procedures is recommended for use by cattle breeders at this time.

The growth rate and feed consumption data for the project cattle are undergoing analyses currently. The results of these studies will be reported in the future.

Record of Performance Testing Program for Beef Cattle

Walter Smith and V. E. McAdams

Introduction

Performance in beef cattle includes all traits that contribute to the efficient production of beef with quality appeal to the consumer. The systematic measurement of economically important production traits and the use of such procedures comprise what is known as Record of Performance. The goal of these procedures is to identify the genetically superior individuals within a herd so that maximum genetic improvement can be made through their selection and breeding. Performance should be a guide to beef herd improvement in Kansas.

Principles of Record of Performance

Differences between individual animals are due to two major causes, genetic and environmental. The observed performance of an individual animal for each trait is the result of the heredity that it receives from both parents and the environment in which it is produced.

The inherited differences with regard to the ability of cattle to grow rapidly, mature early, convert feed to meat efficiently, reproduce efficiently, and to produce desirable carcasses provide the basis for selection for improvement through breeding methods.

Record of Performance is useful primarily to provide a basis for comparisons among cattle handled alike within a herd and not for comparing differences between herds. Genetic differences between herds do exist; however, uncontrollable environmental effects eliminate the possibility of an evaluation of these genetic differences in most instances. Minimum standards for level of performance with regard to the various production traits have been advocated in some broad-scale Record of Performance programs. Because of the tremendous variation in environmental conditions and production programs, standards of performance involving comparisons between herds are likely to be erroneous. Performance records are useful for selecting the high producers and for culling undesirable animals. Maintaining production records on cattle produced in a herd helps to identify the best performing individuals and gives information about the breeding value of the sires and dams that produced them. The performance of all individuals should be measured in order to identify those that are above average in total merit.

The impact of Record of Performance for the entire beef cattle industry will depend mainly on its adoption by purebred breeders in the production of herd sires. Commercial beef breeders can make the most effective use of Record of Performance in the selection of herd bulls on the basis of records from within purebred herds that are on a systematic Record of Performance program. Commercial producers may use production records as a guide to cull cows or bulls and to select replacement heifers.

Attention That Each Trait Should Receive

Beef cattle breeders are concerned with the important problem of determining the emphasis placed on each trait in selection procedures. Generally speaking, the heritability, the relative economic importance, and the genetic association with other traits determine the attention which should be devoted to a given trait in a selection program. The number of traits undergoing selection limits the emphasis which may be placed on a given trait; therefore, the greater the number of traits selected for, the less intensely can selection be practiced for any single trait. Beef cattle production traits vary with regard to their individual heritability and economic value. Traits of high heritability respond more to selection than those of low heritability, and greater attention should be given to traits of higher economic value.

Rate of Improvement from Selection

The factors that determine the rate of breeding improvement as a result of selection are: (1) Heritability, (2) selection differential, (3) genetic association among traits, and (4) generation interval.

Heritability is generally defined as the proportion of the differences measured or observed between animals that is transmitted to their offspring. Theoretically, heritability for a trait may vary from 0 to 100%. Heritability estimates are obtained under carefully controlled environmental conditions, with adjustments being made for known major environmental sources of variation. The heritability value for a given trait may be expected to vary to some limited extent in different herds due to existing genetic variability and the uniformity of the environment. There have been many heritability estimates reported from studies made on data obtained on numerous different research herds. The estimates presented in Table 1 probably represent average expectations for many herds, provided the general environment is similar for all cattle within the herd. These estimates are recommended for reference to Kansas beef cattle breeders pursuing Record of Performance programs.

Table 1

Beef cattle: economically important traits

Trait	Heritability %
Calving interval (reproductive efficiency)	10
Birth weight	40
Weaning weight	30
Cow maternal ability	40
Feedlot gain	45
Pasture gain	30
Efficiency of gain	40
Final feedlot weight	60
Conformation score:	
Weaning	25
Slaughter	40
Carcass traits:	
Carcass grade	30
Rib eye area	70
Tenderness	60
Cancer eye susceptibility	30

Selection differential is the difference between the selected individuals and the average of all the animals in a herd from which they were actually selected. It is influenced by the proportion of the total selected, the number of traits selected for, and the prevailing variation present in the initial or total group. Selection differentials having high values can usually be obtained in sire selection because of the relatively low proportion of males selected for breeding purposes.

Genetic associations may or may not exist among traits. In the event of no association between two or more traits, the traits are inherited independently. On the other hand, a genetic association between traits may be either positive or negative. If positive, the rate of overall improvement is facilitated as the positive genetic association tends to lead toward an automatic improvement of those traits as selection is practiced for one or a larger proportion of them. Negative genetic associations hamper or decrease improvement rates under selection because selection in the desired direction for one of the related traits results in a degree of selection in an undesired direction for one or more other traits. In a sense, negatively genetically associated traits are antagonistic in selection procedures. Current beef cattle breeding research findings do not indicate major negative genetic associations among the various traits; however, more conclusive evidence regarding genetic associations among traits will become available in the future from results of extensive beef cattle selection experiments now in progress.

Generation interval is long in beef cattle. It averages nearly five years in most herds. Beef cattle also possess low reproductive rates as evidenced by the prevailing natural single birth, with percentage of calf crop weaned appreciably lower than 100% in most breeding herds.

Long generation interval, low reproductive rate, and the relatively large number of traits involved in beef cattle limit the amount of selection that can be practiced in the species. This means that the expected rate of genetic improvement in beef cattle is relatively slow. The primary encouraging factor is that most of the economically important traits possess reasonably high heritability values.

Heritability estimates may be interpreted to mean that they are the part of the difference between the selected individuals and the average of the population from which they were selected which is actually transmitted to the offspring. Heritability estimates in conjunction with selection differentials may be used to predict genetic improvement for a given generation interval. For example, if the selected bull and heifer calves were 30 pounds heavier than the herd average in weaning weight, their progeny would be expected to average nine pounds heavier than if no selection has been practiced for that trait. (heritability x selection differential or 30% x 30# = 9#)

Economically Important Traits

Traits important in the profitable production of desirable beef should be evaluated and considered in a Record of Performance Program. The traits generally included are:

(1) Fertility or reproductive performance.

(2) Mothering or nursing ability.

(3) Conformation as related to carcass desirability and structural soundness.

(4) Rate of growth.

(5) Efficiency of growth.

(6) Longevity.

Fertility or Reproductive Performance

The heritability of fertility in beef cattle is quite low. Fertility is a complex trait with both environmental and genetic influences as measured or observed in breeding herds. Improved measures of both female and male fertility are needed to evaluate fertility in breeding herds. Research is under way on this problem; however, immediate simplification is unlikely.

Because of the importance of reproductive performance in efficient production, attention must be given to it in breeding programs. The culling of open cows on some systematic basis is usually a sound economic practice which also provides some benefit to improving herd fertility; however, it certainly does not appear to be a complete, or even a satisfactory solution.

If at all possible, herd bulls should be selected from parents which have known good fertility records. This procedure has a major handicap in that fertility is not completely expressed until maturity, which limits this selection to the progeny of older cows and bulls.

Mothering or Nursing Ability

There has been an increasing tendency for quite some period of years to slaughter beef cattle at younger ages. Weaning weight or pre-weaning growth has become more important because it now comprises a higher percentage of total growth.

Nursing or mothering ability of cows is reflected and evaluated in the weaning weight of calves.

The repeatability of the weaning weight of calves as a characteristic of cows is quite high, according to research findings. That justifies culling or selecting cows on the basis of single or limited calf production records. Although a single production record is by no means a perfect indicator of lifetime production, cows that rank in the lower one-fourth of the herd, on the basis of a single normal adjusted production record, will not likely be average or better on the basis of lifetime production.

Differences in mothering ability may be evaluated quite accurately at comparatively young calf ages; however, it is usually most convenient to weigh calves at the age they are weaned, which is approximately 200 days.

Several environmental factors affect calf weaning weights: age of calf, age of dam, sex of calf, location and management of herd, season of year, creep-feeding, and other miscellaneous factors. In most instances a breeder can effectively adjust for age of calf, age of dam, and sex of calf. Since there are no effective ways to correct for the other influences, comparisons in cow productivity should be restricted to a within-herd, within-season, and within-calf feeding management basis.

The weight of a calf at the time it is weaned is referred to as the calf's actual weaning weight. When the actual weight is corrected for age of calf, age of dam, and sex of calf, it is known as an adjusted weaning weight and may then be used to compare maternal abilities among cows within a herd.

The adjustment of calf weaning weights requires that each animal be identified and that essential records be maintained.

Individual cows must be identified by some permanent method. The following are satisfactory:

(1) Hide brand numbers (applied according to State Brand Laws).

(2) Horn brands (as used in purebred herds).

(3) Ear tattoos.

(4) Ear tags.

(5) Neck chains.

Cow identification is necessary to maintain individual cow production records and also to provide information relative to the age of dam in calf weaning weight adjustment procedures. The dam's age is usually expressed as the nearest year at the time the calf was born.

Calves should be identified with ear tattoos immediately after they are born. A record of each calf's sex, tattoo, birth date, and its dam's identification number must be maintained. New-born calves may also be identified with ear tags, in addition to tattoos, to facilitate identification, as tattoos are usually more difficult to read.

It is not necessary to weigh calves at birth, although actual birth weight may be used in computing pre-weaning average daily gain.

Sire identification of calves is generally not available under pasture breeding conditions in large commercial cow herds. Sire identification should be included as part of the information on calf records when it is available. Sire records are maintained to compare calves by different bulls. This information provides a basis for establishing progeny-testing procedures in breeding herds.

At weaning time, a satisfactory scale is necessary to weigh each calf. Each calf's tattoo or identification number and actual weight should be recorded. The actual weaning weights must then be corrected for age of the calf, age of dam, and sex of calf. These corrections are not complicated and may be made while a calf is confined on the scale.

Calves should also be scored for type and conformation. The USDA feeder grade scoring system is satisfactory for this purpose.

Correcting Weaning Weight for Age of Calf

Calf ages are easily computed with a calendar chart. The standardized ages most commonly used are 200 days, 205 days and 210 days. If the actual age deviates more than 50 days from the standardized age, there is little justification for attempting to adjust for age. In most herds it will be necessary to wean the calves in more than one group according to age on separate dates to avoid large deviations between actual and standardized weaning ages.

The adjustment of weaning weight for age of calf may be made by using each calf's average daily gain from birth to weaning, multiplied by the calf's actual age deviation from standard. This correction value is then added to or subtracted from the calf's actual weaning weight, depending on whether the calf is younger or older than the standard age. This method of adjustment is probably the most acceptable recommendation for all herds that have not had calf age corrections developed for them.

Pre-weaning average daily gain is computed by subtracting the actual or assumed constant birth weight from the actual weaning weight and dividing the remainder by the actual age. Average birth weight is nearly 70 pounds for heifer calves and 74 for bull calves. Constant or assumed birth weight values should be near those if they are used. The main objection to using average daily pre-weaning gain to correct for age is that it necessitates individual computations, and they are not convenient when corrections are made while calves are confined on scales.

Weaning weight for age of calf may also be adjusted by use of herd regression coefficients (regression of weight of calf on age of calf). These regression coefficients indicate the average effect of one day of age on weaning weight within the range of ages existing among the calves that are weaned. Regression coefficients have been computed on a large volume of data provided by the Ramsey Commercial Angus herd at De Graff, Kansas. These data involved calves not creep-fed and those creep-fed.

The average effect on one day of age for calves noncreep-fed was 1.36 pounds; and that for creep-fed calves, 1.42 pounds. Corrections for age of calves may be computed by multiplying the value appropriate for the management by age deviations from standard.

Correcting Weaning Weight for Age of Dam

Ages of dams influence weaning weights of beef calves. Weaning weight tends to increase with age of dam until production maturity is reached at approximately 6 to 8 years. Following maturity, weaning weight of calves declines with advancing age. The effects of ages of dams must be corrected to compare weaning weights of calves from dams of differing ages.

The influence of age of dam was studied in data provided by the Ramsey Ranch under both noncreep-feeding and creep-feeding conditions. The two appeared to be quite different, so it is recommended that the appropriate adjustment value be used for each method of calf management.

Adjustment values follow:

Age of dam	Calves noncreep-fed, pounds	Calves creep-fed, pounds
2	+60	+96
3	+49	+54
4	+31	+33
5	+23	+28
6	0	+ 9
7	0	0
8	0	0
9 and older	+20	+20

These correction values are based on adjustment of calf weaning weight to "mature dam" equivalent and are recommended for use where individual herd adjustments are not available.

Correcting Weaning Weight for Sex of Calf

Sex of calves influences weaning weights. Bull calves tend to be heavier than steers, and heifers, lighter than steers. A correction for sex of calf is necessary to compare cow production records.

Commercial herds usually include steer and heifer calves, whereas the male calves in purebred herds are predominantly bulls. Commercial breeders usually adjust calf weaning weights to a "steer equivalent" basis and purebred breeders to a "bull equivalent." Evidence indicates that whether calves are creep-fed influences the adjustment for sex and the respective correction values to be used. Correction values based on studies made on the Ramsey herd records follow:

(1) Noncreep-fed calves

	"Bull equivalent," pounds	"Steer equivalent," pounds
Bulls	0	....
Steers	+24	0
Heifers	+48	+24

(2) Creep-fed calves

	"Bull equivalent," pounds	"Steer equivalent," pounds
Bulls	0	....
Steers	+40	0
Heifers	+80	+40

These corrections for sex of calf are recommended for Kansas beef cattle breeders. It is suggested that commercial breeders adjust to a "steer equivalent" basis and purebred breeders to a "bull equivalent."

Procedures of Adjusting Beef Cattle Weaning Weight and the Use of Weaning Weight Records

The general procedure for weaning calves is relatively simple. If calf weaning weights are to be compared, the actual weaning weights must be adjusted for age of calf, age of dam, and sex of calf, as previously discussed. Adopting a program involving calf weaning weight records also requires preliminary planning and establishing a method to identify individual animals. Records relative to calf birth dates, sex, and identification and age of the dams of calves are basic. A standardized weaning age near 200 days should be established and calves not deviating from it in excess of 50 days may be weaned in a single group.

When calves are weaned, groups should be handled uniformly with regard to time of gathering and period of holding in advance of grading and weighing. After separating the calves from their dams, the calves can be scored for feeder calf grade by dividing them into grade groups prior to weighing. Each grade group should be handled individually during weighing so that each calf's grade is known at the time it is identified and weighed. A calf's grade or conformation is thus accomplished without individual calf identification while the scoring is being done. Metal ear tags are often impossible to read on animals not confined in a chute. Scoring after weighing is a handicap because it necessitates excessive physical movement of working personnel and slows down the working operation.

Calves must be identified when they are weighed. In most instances calves can be conveniently placed in a squeeze chute individually prior to weighing. It is convenient to vaccinate calves if a squeeze chute is used in the weaning operation.

After the calves are identified individually, they should be weighed. The scale weight is referred to as the actual weaning weight. After correcting for age of calf, age of dam, and sex of calf, the weaning weight is said to be adjusted and different calves or cow production records may be compared. These comparisons should be restricted to a within-year, within-herd, within-season, and within-calf management basis, as previously described, because environmental influences attributable to these sources cannot ordinarily be adjusted or corrected.

The adjustment of weaning weight for age of calf should be done as previously described. Correcting on the basis of average daily pre-weaning gain is the most satisfactory method for herds not analyzed for individual herd adjustment values. The corrections derived from the Ramsey Ranch data are applicable to Angus herds in which calves are noncreep-fed or creep-fed.

After correcting weaning weight for age of calf, it should be adjusted for age of dam and sex of calf. The adjustments computed on the Ramsey herd data are recommended. Separate corrections must be used for noncreep- and creep-feeding conditions.

Weaning weight or cow production records may be used for purposes of culling cows and in the selection of replacement heifers and bulls.

In most herds that are being held constant or increased with regard to cow numbers there is limited or no opportunity to cull cows on the basis of production records. If production culling is practiced, it increases the replacement rate, which is an added production cost. Additionally, actual and adjusted production records are not identical and the former is directly related to profitability. Mature cows which calve early in season contribute immensely to high actual production. Calf weaning weight is a trait which should be given consideration in the selection of breeding replacements in cattle herds. The selection of heifers in many herds is based largely upon weanling characteristics, as the excess is marketed at that time.

The amount of selection or the selection differential which can be achieved for any given trait in heifers is relatively small, because of the high percentage which must be retained for breeding replacements. In most cow herds the percentage of the total which are culled because of reasons of age, injury, or disease, failure to reproduce, and death loss is approximately 20% under conditions where cow numbers are being maintained constant. This removal rate in conjunction with normal calf sex ratios and percent of calf crop necessitates the keeping of approximately 50% of the heifers for replacements under these conditions.

Weaning weights and USDA feeder calf grades among calves within a herd are not perfectly correlated, although the two traits appear to be positively related. This means that some calves with heavy adjusted weaning weights will be culled because of unacceptable type or feeder calf grade.

Some calves having comparatively high adjusted weaning weights also will not be selected because of low actual weaning weights, which may be due to the age of the calves or the age of their dams. The light-weight weanling heifer has the penalty of inadequate size for breeding as a yearling and the production of a calf at approximately two years of age.

Beef cattle breeders can achieve large selection differentials for specific traits such as calf weaning weight, in selecting sires. This is due to the relatively lower percentage of bull calves needed for breeding purposes. Selection differentials for production traits in the case of sires should be at least twice as large as those for heifers in most herd selection procedures. This means that beef cattle breeding improvement depends mainly on sire selection. Heifer selection and cow culling procedures are certainly secondary to it as selection techniques.

Growth Rate

Size in beef cattle, which is a function of growth rate, is an economically important trait because of its association with feed efficiency or economy of gain and with fixed costs that are regulated on a per head or unit of time basis. In most instances growth rate is measured in time constant, post-weaning feeding tests. Research findings indicate that this trait can be appraised thus satisfactorily. The level of nutrition used for feeding tests can vary with different production systems; however, the feeding management must be standardized at specific locations where the growth records of animals are compared. A post-weaning period of at least 140 days is required to measure growth rate. This minimum time requires rather uniform initial weights, condition, ages, and previous treatments with regard to the cattle involved. Experimental results show that final weight at 12 to 18 months, standardized for age differences, is a better measure of growth rate than any individual component of final weight because the components, such as birth weight, pre-weaning gains, and post-weaning gains, are likely to possess a previous treatment effect type of relationship to each other, even as associated in an individual animal. These component relationships are usually balanced or cancelled out in the total-yearling or long-yearling weight.

Final weight at a standard age of approximately 18 months appears to be a satisfactory measure of growth rate for most purebred herd managerial practices. Bulls being performance tested under those age specifications can be fed a low level of concentrates during the initial wintering period and a high level of concentrates either on grass or in the drylot during their yearling summer. This procedure develops bulls at a high enough level of feeding and over a long enough period of time for genetic differences in growth rate to be expressed for fairly accurate appraisal. This management also parallels most phases of that applied to the commercial production of slaughter cattle. Final weight and grade near normal market age in beef cattle seem to be of appreciable interest to industry. The use of post-weaning gain information as a single measure of growth could favor poor pre-weaning environment because poor environment in one period tends to be followed by increased rate of gain under improved environment in the next phase.

The use of a higher level and shorter feeding period is an alternative program for measuring growth rate in bulls. The length of the feeding period may vary from five to six months, but it must be standardized at specific locations. In this program the ration should consist of 50 percent or more concentrates and the final adjusted age will be near 365 days.

Research indicates that reasonably high levels of nutrition are desirable to appraise growth rate accurately. If lower levels of nutrition are employed, the growth period measured should be longer.

In general, feedlot feeding at high levels of nutrition is applicable for performance testing of prospective herd sire replacements. Because such a high percentage of heifers must be kept for breeding replacements, there is not much opportunity to select among heifers for differences in growth rate. Additionally, a high percentage of commercial breeding heifer replacements must be selected at the time of weaning because the excess is disposed of or marketed shortly thereafter. It appears that very little can be gained from feeding heifers at high levels of nutrition as an aid in performance testing.

Economy of Gain

Economy of gain is an important trait in the profitable production of beef cattle. It is a difficult trait to measure, as it requires individual feeding; neither research workers nor cattle breeders have practical techniques that are not costly in evaluation of cattle gain composition.

Current available information on the production of beef cattle indicates that economy of gain is desirably related to rate of gain in cattle of the same general size. At present it appears that rate of gain is a reliable indicator of economy of gain, so breeders should depend on rate of gain to evaluate economy of gain instead of resorting to individually feeding young bulls.

Research work indicates that the more rapidly gaining individuals among cattle in a feedlot tend to make the most economical gains; however, there is not conclusive information relative to variable mature sizes of cattle to justify recommendations with regard to total production merit.

The details of the techniques employed in a program that entails measuring and evaluating growth rate in beef cattle are not of great importance; however, they should be standardized on a farm or ranch location, generally a single herd where individuals are compared. The restrictions on justifiable comparisons are practically the same for both growth rate and mothering ability in beef cattle. The standardization of method does not remove a large portion of the environmental effects due to location, season, years, and differences in feed composition.

Conformation

Conformation in beef cattle is related to carcass desirability, structural soundness, and longevity. Production traits other than these, which have a direct relationship with conformation, should be measured by the indicators previously discussed rather than by items of conformation. Basically, maximum attention is given to longevity, and beefiness or meat cuts, in regard to conformation.

Considerable research is in progress to develop new techniques in measuring differences in proportions of fat and muscling in beef cattle. Research may present some new tools that will result in improved techniques for conformation; however, at this time it is recommended that cattle breeders use the best current procedures to appraise the major items of conformation.

It is recommended that conformation scores be used. Skeletal structural soundness, beefiness or thick natural fleshing, and satisfactory finish or condition at specified ages should be given consideration.

Scores for conformation should be obtained at the time of weaning and at 12 to 18 months. The yearling score is probably the most important, so greatest emphasis should be placed on it.

A scoring system may be simple or include considerable detail. Simple scoring techniques tend to group individuals of equal desirability without indicating items of superiority or inferiority. The detailed system indicates individual conformation merit better. A breeder should use a systematic scoring system, choosing a method which most effectively serves him in evaluating conformation in his herd.

Scoring can be done by an individual person or a committee consisting of several. In the event that a committee is used, its average score should be considered the final measurement value and it is important that each person work independently during the scoring process.

Many carcass traits can be measured only by observing carcasses. It is apparent that progeny test data must be relied on to select those traits. Comparing bulls with regard to genetic transmitting ability on the basis of desirability of carcass traits among their steer progeny is the only reliable technique available at present.

Record of Performance as an Additional Tool

Record of Performance procedures can lead to more economical production and improved consumer desirability of beef through the breeding improvement of beef cattle. Progress should not be expected to be rapid because of biological principles involved. Some breeders are unable and others are not willing to participate in the adoption of systematic programs. Record of Performance, as a technique for the industry, will establish its position or functional status through its trial adoption and observed usefulness by both the purebred and commercial cattle interests.

The basic goals of Record of Performance are not realistically different from those that have long been sought by leading breeders. The techniques involved are not to be regarded as "revolutionary" substitutes for outdated practices, but instead as an additional tool to facilitate the

progress of production objectives. The principal features of a desirable Record of Performance program follow:

1. All individual animals be given equal opportunity to demonstrate their productivity.
2. Systematic, recorded information be maintained on all animals in a herd.
3. Records be adjusted for major environmental influences, where procedure is applicable, so that individuals can be compared.
4. Production records be used to select replacement breeding stock and to cull on the basis of performance.
5. Nutritional and other managerial practices be both practical and compatible with those of commercial beef production.

This discussion does not involve extensive or numerous specific recommendations. It has been prepared to explain principles and to describe basic limitations of the principles. Maintaining records on animals does not alter their breeding or transmitting merit, nor is environmental advantage transmitted. Records must identify genetically superior individuals if breeding improvement is to be accomplished.

An Orally Active Progestin[1] for Estrus Control in Beef Heifers.

H. G. Spies,[2] G. B. Marion,[3] F. W. Boren,[2] J. S. Norwood[2] and E. P. Call[3]

An orally active progestin (provera) was fed to 66 feedlot heifers for 20 days. The seven lots (10 per lot in five lots and 8 per lot in two lots) were assigned to treatments of no-hormones (10 heifers), 150 mgs. per head per day (20 heifers), or 210 mgs. per head per day (36 heifers). The hormone was fed once a day in 20 pounds of supplement per lot. Grain was kept before the heifers at all times. For 70 days before, during, and following the hormone feeding, the heifers were observed twice daily for heat and their ovaries were examined once weekly by rectal palpation for follicular development and ovulation. Provera inhibited ovulation during treatment in 88% (49/56) of the heifers. There was no difference in the number of heifers ovulating during treatment due to dosage level fed (150-mg. level 10% [2/20] vs. 210-mg. level 13% [5/36]). Five of the seven heifers that ovulated during treatment did so before the sixth day following the start of feeding, suggesting the hormone may not have blocked all ovulations where treatments began late in the cycle. Seventy percent (14/20) of the heifers on the 150-mg. level returned to heat within six days post feeding vs. 65% (13/20) of the heifers on the 210-mg. level. Most of the heifers that returned to heat did so between two and five days following feeding; however, 8 of 40 were not observed in heat during 30 days following provera feeding. Also, one of the 10 untreated heifers was not detected in heat during a 70-day period. However, examination of the ovaries at slaughter indicated these heifers were cycling, and that one of the biggest problems involved was detecting heat. This was also indicated by a failure to observe nearly 75% of the heifers in heat during 21 days before provera feeding, although rectal palpation indicated they were cycling.

All heifers were bred 48 hours after hormone feeding and again at the time they were detected in heat. Slaughter near 3 and 25 days post breeding indicated fertility was extremely poor in both hormone-treated and nonhormone-fed heifers; therefore, little can be concluded in this study regarding fertility following hormone feeding. Fat feedlot heifers may tend to have poor conception rates; however, the association between fat at the 12th rib (taken from carcass at slaughter) and conception rate was nil in this study ($r = .033$).

The experimental design also permitted a comparison of certain reproductive traits for heifers fed no supplemental protein (basic ration provided 9% digestible protein), ½ pound supplemental protein, and 1

1. Provera generously supplied by the Upjohn Co., Kalamazoo, Mich.
2. Dept. of Animal Husbandry, K.S.U.
3. Dept. of Dairy Science, K.S.U.

pound supplemental protein. There was no difference in size of follicular development or incidence of ovulation for the three different protein levels. Large follicle size averaged 12.3, 12.0, and 11.8 mm. in diameter for the 9% protein, ½ pound extra protein and 1 pound extra protein groups, respectively; while the incidence of cyclic ovulations was 100% for the three protein levels.

The following problems associated with estrus control in beef cattle remain: (1) Difficulty in detecting heat; (2) proper levels of hormone for maximum heat control, synchronization and conception rates post feeding; (3) differences in the response of cows (dry and nursing) compared with heifers; (4) an economical way of administering the hormone under range conditions.

Swine

Antibiotics in Swine Growing-Finishing Rations (Project 110).

B. A. Koch and Ju Tung Yu[1]

Antibiotics, both individually and in various combinations, are used quite extensively in swine rations. This test was designed to further determine the value of a mixture of antibiotics under specific conditions. At slaughter, stomachs of animals in this study were examined by Dr. William Griffing of the Veterinary School for evidence of gastric ulcers.

Experimental Procedure

Pigs used were both barrows and gilts, either Duroc or Black Poland China breeds. All pigs used in the study were approximately the same age when they went on test. The heavier pigs were assigned to lots 1, 2 and 3. The slower growing pigs (runts) were assigned to lot 4. They were self-fed the basal ration listed in Table 22 while confined on a concrete floor. The ration was ground and pelleted. Water was available from automatic waterers at all times. Fog nozzles were used to keep the pigs cool during warm weather. Individual pigs were removed from the test pen when they weighed approximately 230 pounds.

Observations

Adding a single antibiotic or a mixture of antibiotics apparently had no effect on rate of gain or feed efficiency of pigs in pens 1, 2 or 3.

1. Present address: Taipei, Taiwan, Republic of China.

Table 22

Basal ration fed to pigs receiving different amounts and different combinations of antibiotics.

Ground sorghum grain	1544 lbs.	T.M. (5% zinc)	1 lb.
Soybean oil meal	202 lbs.	Vit. A (10,000 I.U./gm.)	200 gms.
17% dehydrated alfalfa meal	60 lbs.	Vit. D (15,000 I.U./gm.)	20 gms.
Molasses	50 lbs.	Vit. E (20,000 I.U./lb.)	1 lb.
Meat scraps	60 lbs.	B-complex (Merck 58-A)	2-lbs.
Fish meal	40 lbs.	Methionine	2 lbs.
Dicalcium phosphate	15 lbs.	Lyamine (20% lysine)	2 lbs.
Limestone	8 lbs.		
Salt	10 lbs.		

Plus antibiotics as indicated in Table 23.

Table 23

Antibiotics in swine growing-finishing rations.

Treatment	No antibiotic	Aureomycin 5 mgs./lb.	Combination[1] 30 mgs./lb.	Combination[1,2] 30 mgs./lb.
Ration number[3]	38	33	39	39
No. pigs	14	13[4]	14	13[4]
Av. initial wt., lbs.	77	77	79	59
Av. final wt., lbs.	226	236	234	223
Av. days on tests	74	78	74	81
Av. daily gain, lbs.	2.01	2.04	2.09	2.01
Av. feed efficiency, lbs.	309	312	318	303
Av. feed cost per cwt. gain	$10.48	$10.86	$11.29	$10.76

1. Antibiotics per lb. of feed: Aureomycin, 15 mgs.; Terramycin, 5 mgs.; Bacitracin, 5 mgs.; and Penicillin, 5 mgs.
2. Poor-doing pigs (runts).
3. All rations were self-fed as 3/16-inch pellets.
4. One pig not used in calculating gain data.

Pigs in lot 4 gained as well and were as efficient as those in the other three lots even though they had grown more slowly before going on test. Under the conditions of this study, antibiotics did not improve the performance of healthy pigs, but slow-growing pigs apparently responded to antibiotics in their ration. Doctor Griffing found evidence of gastric ulcers in pigs from all groups.

Corn vs. Sorghum, Pellets vs. Meal, and Soybean Oil Meal vs. a Mixed Protein for Growing-Finishing Pigs (Project 110).

B. A. Koch

Growing-finishing pigs, confined and fed on concrete, were used in a factorial-type experiment designed to study several problems at one time.

Experimental Procedure

One hundred forty feeder pigs weighing approximately 60 to 80 pounds each and averaging 12 weeks of age were randomly divided by weight into groups of 14 pigs each. The pigs had been vaccinated previously for hog cholera and had been wormed with piperazine. All pigs had been on concrete from birth and they had been raised under complete confinement.

Each group of 14 pigs was placed in a pen 7 feet wide by 28 feet long with 16 feet of the pen under roof. Complete rations, either meal or pellets, were self-fed. An all-steel three-hole self-feeder was used in each pen. Water was always available from automatic waterers. Fog

Table 24

Basal rations fed to growing-finishing pigs in comparing corn vs. sorghum grain, pelleted vs. meal rations, and soybean oil meal vs. a mixture of proteins.[1,2]

Ration no.	30, 31, 32, 33	39, 40	34, 35	36, 37
Corn or sorghum, lbs.	1,544	1,544	1,522	1,624
Soybean oil meal, lbs.	202	202	403	318
Dehydrated alfalfa meal, lbs.	60	60		
Molasses, lbs.	50	50		
Meat scraps, lbs.	60	60		
Fish meal, lbs.	40	40		
Dicalcium phosphate, lbs.	15	15	20	24
Limestone, lbs.	8	8	20	16
Salt, lbs.	10	10	10	10
Trace-mineral (5% zn.), lbs.	1	1	1	1
Vitamin A, I.U.	2,000,000	2,000,000	3,000,000	3,680,000
Vitamin D, I.U.	300,000	300,000	300,000	150,000
Vitamin E, I.U.	20,000	20,000		20,000
B-complex supplement, lbs.[3]	2	2	2	2
D-L Methionine, lbs.	2	2		
Lyamine (20% lysine), lbs.	2	2		
Aurofac 1.8-1.8, lbs.	6		6	6
Aureomycin, gms.		30		
Terramycin, gms.		10		
Bacitracin, gms.		10		
Penicillin, gms.		10		

1. All rations prepared by the Department of Flour and Feed Milling Industries.
2. All rations fed as 3/16-inch pellets.
3. Merck 58-A: 2.0 gms. riboflavin; 6.0 gms. niacin; 3.68 gms. D-pantothenic acid; and 20.0 gms. choline chloride per pound of supplement.

Table 25

Data from comparisons of corn vs. sorghum, pellets vs. meal, and soybean oil meal vs. mixed protein for growing-finishing pigs.

Ration no.	30	31	32	33	34	35	36	37	39	40
Crude protein level, %	16.6	16.1	16.1	16.2	17.5	17.7	15.4	14.8	16.4	16.0
Pen no.	1	2	3	4	5	6	7	8	12	13
Grain	Corn	Corn	Sorghum	Sorghum	Corn	Sorghum	Corn	Sorghum	Sorghum	Sorghum
Preparation	Pellet	Meal	Meal	Pellet	Meal	Meal	Pellet	Pellet	Pellet	Meal
No. of pigs	13[1]	14	14	14	13[1]	13[1]	13[2]	14	13[1]	14
Av. on-test wt., lbs.	69	69	75	74	71	76	75	82	59	58
Av. off-test wt., lbs.	226	231	229	225	236	227	231	236	223	217
Av. days on test	79	85	81	77	79	80	74	73	81	88
Av. daily gain, lbs.	1.99	1.90	1.91	1.97	2.01	1.89	2.11	2.12	2.01	1.81
Standard error of mean	±0.04	±0.06	±0.05	±0.06	±0.06	±0.07	±0.08	±0.06	±0.04	±0.06
Av. feed efficiency, lbs.	326	353	363	326	330	341	311	302	303	351
Av. cost per cwt. gain	$11.02	$11.58	$12.27	$11.34	$ 9.90	$10.50	$ 9.67	$ 9.63	$10.76	$12.11
Feed cost per ton	67.60	65.60	67.60	69.60	60.00	61.60	62.20	63.80	71.00	69.00

1. One pig not used in calculating gain data.

Table 26

Summary: pellets vs. meal for growing-finishing pigs.

Preparation	Pellet	Meal
Rations[1]	30, 33, 36, 37, 39	31, 32, 34, 35, 40
Pens	1, 4, 7, 8, 12	2, 3, 5, 6, 13
No. pigs	67	68
Av. on-test wt., lbs.	72	70
Av. off-test wt., lbs.	228	228
Av. days on test	77	83
Av. daily gain, lbs.	2.04	1.90
Av. feed efficiency, lbs.	314	348

1. See Table 24.

nozzles were used to cool the pigs in hot weather. No bedding was used. Floors were scraped clean daily but not washed.

All rations were prepared in the Department of Flour and Feed Milling Industries as needed. Rations were handled in 50-pound paper bags. Basic formulae of rations fed are listed in Table 24.

Individual animals were removed from test lots as they reached approximately 230 pounds.

Table 27

Summary: corn grain vs. sorghum grain for growing-finishing pigs.

Grain	Corn	Sorghum
Rations[1]	30, 31, 34, 36	32, 33, 35, 37
Pens	1, 2, 5, 7	3, 4, 6, 8
No. pigs	53	55
Av. on-test wt., lbs.	71	77
Av. off-test wt., lbs.	231	229
Av. days on test	79	78
Av. daily gain, lbs.	2.00	1.97
Av. feed efficiency, lbs.	330	333

1. See Table 24.

Observations

Table 25 summarizes the average performance of pigs in each experimental lot. Per ton feed costs include $3.60 for paper bags.

Pelleted rations are compared with meal rations in Table 26. Pigs eating completely pelleted rations gained somewhat faster than those eating similar rations in meal form. Average feed efficiency also favored the completely pelleted rations. Part of the difference in feed efficiency was due to an observable but unmeasurable difference in feed wastage. Pigs eating pelleted rations wasted very little, while those eating meal rations consistently wasted an unmeasurable amount. Design and adjustment features of the feeders did not entirely prevent feed waste when meal rations were fed.

Table 28

Summary: mixed proteins vs. soybean oil meal protein as supplemental protein sources for growing-finishing pigs.

Preparation	Mixed protein	Soybean oil meal
Rations[1]	30, 31, 32, 33	34, 35, 36, 37
Pens	1, 2, 3, 4	5, 6, 7, 8
No. pigs	55	53
Av. on-test wt., lbs.	72	76
Av. off-test wt., lbs.	228	232
Av. days on test	80	76
Av. daily gain, lbs.	1.94	2.03
Av. feed efficiency, lbs.	342	321

1. See Table 24.

Rations built around corn grain or sorghum grain are compared in Table 27. Under conditions of this study pigs eating either corn or sorghum grain made similar average daily gains and feed efficiencies during the growing-finishing period.

Table 28 summarizes results obtained when supplemental protein came either from soybean oil meal or from a combination of soybean oil meal and animal protein sources. Differences in average daily gain and average feed efficiency are small and not significant.

Kansas Swine Improvement Association Testing Station

B. A. Koch and W. A. Moyer[1]

The seventh group of pigs tested in the Kansas Swine Testing Station completed their test during the 1961-62 winter. The Animal Husbandry Department and the Extension Service cooperate in managing and supervising the station. All expenses incurred in testing are paid by breeders or producers who have pigs tested.

Production data on boars and barrows are collected while the animals are growing from 60 to 200 pounds bodyweight. All animals receive the same pelleted ration during the growing period. Boars meeting station requirements are sold at public auction. Barrows are slaughtered in the Animal Husbandry Department's meats laboratory where carcass information is collected.

Table 29 summarizes data collected during the 1961 summer test and the 1961-62 winter test. Table 30, taken from the M.S. thesis of Mr. Ju Tung Yu, animal husbandry department graduate student, summarizes results from three years of testing. Table 31 lists the basic ration being fed to pigs during the testing period.

A serious problem during the 1961-62 winter test was stomach ulcers in a number of pigs. Stomach ulcers are a problem throughout the Midwest swine-producing area. A number of experiment stations have formal projects to study stomach ulcers of swine. The Kansas State Veterinary School is studying the problem, with Dr. Embert Coles in charge.

For further information about the swine-testing program, contact your county agent, the Kansas Swine Improvement Association, The Extension Service, or the Department of Animal Husbandry. The last three are at K-State in Manhattan.

1. Extension swine specialist.

Table 29

Swine testing results (1961-62).

	Summer 1961	Winter 1961-62
BOARS		
No. completing test	71 (29 herds)	49 (23 herds)
Av. daily gain, lbs.	1.84 (2.29-1.52)	1.77 (2.44-1.50)
Av. backfat, in.	1.06 (1.48-0.64)	0.99 (1.14-0.70)
Av. efficiency, lbs.	2.72 (3.06-2.48)	2.96 (3.24-2.41)
Av. age at 200 lbs., days	146 (175-120)	154 (179-122)
Cost to breeder	$50.00	$58.00
Av. sale price	$189.48 ($440-$40)	$199.32 ($380-$60)
BARROWS	Summer 1961	Winter 1961-62
No. slaughtered	43 (29 herds)	25 (23 herds)
Av. slaughter wt., lbs.	196 (208-188)	191 (208-178)
Av. age at 200 lbs., days	165 (194-145)	174 (208-150)
Av. carcass backfat, in.	1.47 (1.83-1.11)	1.38 (1.70-1.05)
Av. loin eye, sq. in.	3.66 (5.05-2.68)	3.92 (5.12-3.25)
Av. lean cuts, %	50.02 (55.5-46.2)	52.2 (55.4-46.5)
U.S.D.A. No. 1	34 head	23
U.S.D.A. No. 2	8 head	2
U.S.D.A. No. 3	1 head	0

Table 30
Test station results (3 year summary).[1]

Breed	No.	Av. daily gain, lbs.	Feed efficiency, lbs.	Age at 200 lbs.	Backfat, in.
BOARS					
D	56	1.92	273	149	1.19
H	68	1.79	282	152	1.08
Y	57	1.82	274	150	1.07
P	23	1.74	288	157	1.11
L	15	1.78	288	146	1.10
B	11	1.79	286	146	1.05
S	19	1.73	288	160	1.03
	249	1.82	280	151	1.10

Breed	No.	Av. carcass length, in.	Av. lean cuts, %	Av. loin eye area, sq. in.
BARROWS				
D	36	28.8	47.4	3.38
H	42	29.1	49.3	3.77
Y	32	29.8	48.0	3.62
P	14	28.1	48.2	3.95
L	8	30.9	49.6	3.82
B	5	29.2	46.6	3.85
S	9	28.6	48.6	4.15
	146	29.2	48.3	3.69

1. Taken from Master's thesis of Mr. Ju Tung Yu, Taipei, Taiwan, Republic of China.

Table 31
Kansas swine testing ration (Prepared in University feed mill).

Sorghum grain	1544 lbs.
50% meat scraps	60 lbs.
44% soybean oil meal	200 lbs.
60% fishmeal	40 lbs.
17% dehydrated alfalfa meal	60 lbs.
Cane molasses	50 lbs.
Iodized salt	10 lbs.
Dicalcium phosphate	15 lbs.
Calcium carbonate	10 lbs.
Trace minerals (5% zinc)	1 lb.
B-complex vitamins (Merck 58-A)	2 lbs.
Vitamin A (10,000 I.U. per gram)	300 grams
Vitamin D (15,000 I.U. per gram)	20 grams
Vitamin E (20,000 I.U. per lb.)	1 lb.
Aurofac 1.8-1.8	6 lbs.
Arsanilic acid (Pro-gen)	1 lb.
DL-methionine	2 lbs.
Lyamine (20% lysine)	2 lbs.

Approximate analysis: 15% crude protein; 0.75% calcium; 0.62% phosphorus.

This ration is fed to boars and barrows until they weigh approximately 200 pounds. The boars are taken off test at 200 pounds and carried on a higher fiber ration (15% alfalfa) until sale time.

The barrows are taken off test at approximately 210 pounds body-weight, shrunk over night and slaughtered. Arsanilic acid is removed from the barrow ration prior to slaughter as per F.D.A. regulations.

The ration is pelleted and self-fed at all times.

Sheep

Garden City Lamb Feeding Experiments, 1961-1962 (Project G.C. 111).

Myron Hillman, A. B. Erhart and Carl Menzies

Lambs

The 638 white-face feeder lambs used in these tests were received October 18, 1961, at the Zuni Indian Reservation south of Gallup, N.M. Average purchase weight was 71.2 lbs. per head. They arrived in Garden City, October 20, and weighed 64.1 lbs. per head off the cars.

General Procedure

Beginning October 21, half the lambs were given Aureomycin[1] in their drinking water at 35 mgs. per head daily and compared with the other half that received no antibiotic until November 14, when both groups went on experimental feeds.

During the pre-test period the lambs were fed dry sudan hay and chopped forage sorghums the first 10 days and sudan hay plus sorghum silage the next 14 days. The lambs gained approximately what they had shrunk during shipment.

Lambs in lot 1 were self-fed a complete pelleted ration of 35% sorghum grain and 65% alfalfa hay. A mixed self-fed ration consisting of a whole sorghum grain and dehydrated alfalfa pellets was fed to lot 7. A ratio of 25% grain and 75% alfalfa pellets was fed at the start of the test. The grain was gradually increased over 50 days until a ratio of 45% grain and 55% alfalfa pellets was reached. Alfalfa straw was supplied free choice to lots 1 and 7.

Comparisons of whole sorghum grain, whole barley, ground pelleted sorghum grain, ground pelleted barley, a mixture of ½ whole sorghum grain and ½ whole barley and a mixture of ground pelleted ½ barley and ½ sorghum grain were made among lots 2, 3, 4, 5, 6 and 8. All these lambs were fed forage sorghum silage (all they would clean up), approximately ¾ lb. of alfalfa hay per head per day, and 1/10 lb. cottonseed meal.

Lot 9 was fed whole sorghum grain and alfalfa hay with no additional supplement.

Lambs in lot 10 were fed the standard ration minus the cottonseed meal; lot 11 was fed the standard ration minus the alfalfa hay. An additional 1/10 pound of protein supplement plus ground limestone was given to lot 11.

Lambs in lot 12 were grazed on volunteer wheat pasture. All lambs were implanted with 3 mgs. stilbestrol[2] at the start of the test.

Feed Prices

Complete pellet (35% grain, 65% hay)	$36.25 per ton
Dehydrated alfalfa pellets	40.00 per ton
Alfalfa hay	20.00 per ton
Alfalfa straw	5.00 per ton
Sorghum silage	7.00 per ton
Cottonseed meal	74.00 per ton
Sorghum grain	1.75 per cwt.
Barley grain	1.75 per cwt.
Pelleting grain	8.00 per ton
Mixing grain	.10 per cwt.
Grinding grain	.15 per cwt.
Pelleting	.30 per cwt.
Salt	1.50 per cwt.
Wheat pasture	.01 per head per day

1. Water-soluble Aureomycin powder furnished by American Cyanamid Co.
2. Furnished by Chas. Pfizer & Co., Inc., Terre Haute, Ind.

Table 32

Whole sorghum grain, whole barley, pelleted sorghum grain, pelleted barley, and a mixture of whole, ½ sorghum grain with ½ barley and the same mixture pelleted.

Lot no.	2	3	4	5	6	8
Treatment	Pelleted sorghum grain	Pelleted barley	Pelleted ½ barley ½ sorghum grain	Whole ½ barley ½ sorghum grain	Whole barley	Whole sorghum grain
No. of lambs	50	50	50	50	50	50
Days on feed	88	88	88	88	88	88
Av. initial wt., lbs.	71.3	70.8	71.0	71.6	71.0	72.0
Av. final wt., lbs.	108.4	109.3	108.0	109.6	110.7	106.8
Av. total gain, lbs.	37.1	38.5	37.0	38.0	39.7	34.8
Av. daily gain, lb.	.42	.44	.42	.43	.45	.40
Daily feed per lamb, lbs.:						
Whole sorghum grain	....	....	....	....	....	....
Pelleted sorghum grain	1.34	....	....	....	....	....
Whole barley	....	....	....	....	1.34	1.34
Pelleted barley	....	1.34	....	....	....	....
Whole ½ barley, ½ sorghum	....	....	....	1.34	....	....
Pelleted ½ barley, ½ sorghum	....	....	1.34	....	....	....
Alfalfa hay	.72	.72	.72	.72	.72	.72
Forage sorghum silage	3.39	3.40	3.40	3.39	3.36	3.62
Cottonseed meal	.10	.10	.10	.10	.10	.10
Salt	.02	.02	.02	.019	.02	.017
Av. lbs. feed per cwt. gain:						
Whole sorghum grain	....	....	....	....	....	338.5
Pelleted sorghum grain	317.5	....	....	....	....	....
Whole barley	....	....	....	....	296.7	....
Pelleted barley	....	305.9	....	....	....	....
Pelleted ½ barley, ½ sorghum	....	....	318.4	....	....	....
Whole ½ barley, ½ sorghum	....	....	....	310.0	....	....
Alfalfa hay	170.8	164.7	171.4	166.8	159.7	182.2
Forage sorghum silage	804.0	779.0	810.5	785.0	745.3	914.4
Cottonseed meal	23.7	22.8	23.8	23.2	22.2	25.3
Salt	5.1	4.7	4.9	4.5	4.8	4.3
Av. feed cost per cwt. gain	$12.34	$11.93	$12.41	$10.84	$10.35	$12.01
Av. feed cost per lamb	$ 4.58	$ 4.59	$ 4.59	$ 4.11	$ 4.10	$ 4.18
Cost per lamb start of test	$10.34	$10.27	$10.30	$10.38	$10.30	$10.44
Av. total cost per lamb	$14.92	$14.76	$14.89	$14.49	$14.40	$14.62
Av. total cost per cwt.	$13.76	$13.50	$13.78	$13.22	$13.01	$13.69

Observations

Gains for the 24-day, pre-test period were almost identical. There were no differences in the general appearances of lambs that obtained Aureomycin in their water. Weather conditions were favorable. No serious illness and no death loss occurred in either lot.

All rations, listed in Table 32, produced similar gains. There was a slight difference in the cost to produce 100 pounds of gain. Whole barley slightly increased rate of gain and produced cheaper gain more efficiently. Pelleting the mixture of ½ barley, ½ sorghum grain had no advantages over feeding it whole. This does not agree with 1960-61 work. Then, pelleting the grain increased rate of gain and feed efficiency.

Lambs in lot 1, fed a complete pelleted ration, gained faster and more efficiently than lambs fed other drylot rations. The feed cost per cwt. gain was higher than for most other lots except 7 and 11. Lambs in lot 7, fed sorghum and dehydrated alfalfa pellets, had the second fastest gain, and gained very efficiently. The dehydrated pellets made their cost of gain much higher.

The ration of whole sorghum grain and alfalfa hay fed to lot 9 produced reasonably good gains. This ration produced a cheaper gain than did the standard ration using silage and a protein supplement.

From lots 10 and 11, it appears that a protein supplement and alfalfa hay are needed in a lamb's ration. The ration fed lot 11 contained no

Table 33

Self-fed complete pelleted ration, sorghum grain with dehydrated alfalfa pellets, sorghum grain with alfalfa hay, and the standard ration compared with lambs.

Lot no.	1	7	9	8
Treatment	Self-fed complete pellet	Self-fed sorghum grain, dehydrated alfalfa pellet	Sorghum grain, alfalfa hay	Standard ration
No. lambs per lot	50	49	50	50
Days on feed	88	88	88	88
Av. initial wt., lbs.	71.7	72.0	70.8	72.0
Av. final wt., lbs.	117.6	114.9	107.9	106.8
Av. total gain, lbs.	45.9	42.9	37.1	34.8
Av. daily gain, lbs.	.52	.48	.42	.40
Daily feed per lamb, lbs.:				
Complete pellets	4.02	....	....	....
Whole sorghum grain	....	1.44	1.34	1.34
Alfalfa hay	....	....	2.55	.72
Pelleted dehydrated hay	....	2.35	....	....
Forage sorghum silage	....	....	....	3.62
Cottonseed meal	....	....	....	.10
Salt	.02	.02	.015	.017
Straw	.16	.18	....	....
Av. lbs. feed per cwt. gain:				
Complete pellets	770.4	....	....	....
Whole sorghum grain	....	296.0	317.5	338.5
Alfalfa hay	....	....	604.3	182.2
Pelleted dehydrated hay	....	482.7	....	....
Forage sorghum silage	....	....	....	914.4
Cottonseed meal	....	....	....	25.3
Salt	4.2	4.7	3.5	4.3
Straw	30.2	37.8	....	....
Av. feed cost per cwt. gain	$14.15	$15.06	$11.73	$12.01
Av. feed cost per lamb	6.49	6.46	4.35	4.18
Cost per lamb start of test	10.39	10.44	10.27	10.44
Av. total cost per lamb	16.88	16.90	14.62	14.62
Av. total cost per cwt.	14.35	14.71	13.55	13.69

alfalfa hay. It produced the slowest and least efficient gain, and cost the most to produce a cwt. gain. Lot 10, fed a ration with no protein supplement, gained slightly faster than lot 11, much more efficiently and at less cost. The standard ration containing both hay and supplement excelled in all respects, except cost per cwt. gain. Gains in lot 10 cost the least.

Wheat pasture did not produce so rapid gains as previously, but its cost per cwt. gain was still lowest.

Only one lamb died (lot 7) throughout the experiment.

Table 34

Whole sorghum grain with alfalfa hay, whole sorghum grain with cottonseed meal, standard ration, and wheat pasture compared with fattening lambs.

Lot no.	8	10	11	12
Treatment	Standard ration	No cottonseed meal	No alfalfa hay	Wheat pasture
No. lambs per lot	50	50	50	50
Days on feed	88	88	88	88
Av. initial wt., lbs.	72.0	71.8	72.5	71.1
Av. final wt., lbs.	106.8	105.2	98.2	97.6
Av. total gain, lbs.	34.8	33.4	25.7	28.5
Av. daily gain, lbs.	.40	.38	.29	.32
Daily feed per lamb, lbs.:				
Whole sorghum grain	1.34	1.34	1.34	....
Alfalfa hay	.72	.72	....	....
Forage sorghum silage	3.62	3.46	4.14	....
Cottonseed meal	.10	....	.20	....
Salt	.017	.02	.02	....
Ground limestone	....	....	.015	....
Wheat pasture	....	....	....	free choice
Av. lbs. feed per cwt. gain:				
Whole sorghum grain	338.5	352.7	458.4	....
Alfalfa hay	182.2	189.8	....	....
Forage sorghum silage	914.4	911.1	1417.1	....
Cottonseed meal	25.3	....	68.5	....
Salt	4.3	5.4	7.8	6.31
Ground limestone	....	....	5.25	....
Wheat pasture	....	....	....	free choice
Av. feed cost per cwt. gain	$12.01	$11.41	$15.73	$ 3.24
Av. feed cost per lamb	4.18	3.81	4.04	.92
Cost per lamb start of test	10.44	10.41	10.51	10.31
Av. total cost per lamb	14.62	14.22	14.55	11.23
Av. total cost per cwt.	13.69	13.52	14.81	11.27

Investigations of Milk-fat Lamb Production for Western Kansas (Project 584).

Myron Hillman, Carl Menzies, and Evans Banbury

This project at the Colby Branch Experiment Station is in cooperation with the Department of Animal Husbandry, Kansas State University.

In it 350 fine wool ewes are handled in a typical Kansas early-lambing program. The ewes are bred to purebred Hampshire rams and all lambs are sold in the spring as milk-fat lambs.

General objectives are to determine the value of various management practices, types of pasture, feeds, feed additives and combinations of these to maintain a commercial ewe flock, and to produce milk-fat lambs for a spring market under western Kansas conditions.

Ewe Flushing Test (Spring, 1960)

Experimental Procedure: 150 two-year-old ewes were divided into two groups April 25, 1960, and fed different rations until May 12, or 17 days. One group was given a low-energy ration of 2 pounds of alfalfa hay per ewe per day; the other, a normal ration of 2 pounds alfalfa hay, 3 pounds sorghum silage, and ¼ pound whole sorghum grain per ewe per day. May 13 each group was divided into six lots along with 200 yearling ewes. These six lots were fed the following ration 40 days:

Lot 1. Drylot—¾ pound whole wheat, 1¼ pounds alfalfa hay and free-choice sorghum silage. (Av. daily ewe silage consumption 5.6 pounds.)

Lot 2. Drylot—¾ pound whole sorghum grain, 1¼ pounds alfalfa hay and free-choice sorghum silage. (Av. daily ewe silage consumption 5.6 pounds.)

Lot 3. Cereal crop pasture, ½ pound whole sorghum grain.

Lot 4. Cereal crop pasture.

Lot 5. Buffalograss pasture, ½ pound whole sorghum grain.

Lot 6. Buffalograss pasture.

Two Hampshire rams were turned with each lot at night from May 28 to June 21, 1960. Rams were rotated to a new group twice each week. June 22, the end of the flushing period, all six lots were turned together and grazed during the day on buffalograss pasture. All 12 rams were turned with ewes each night until September 1.

Results and Discussion

Table 35 gives results of pre-flushing two-year-old ewes, and of flushing on weight gain of two-year-old and yearling ewes.

Table 35

Effect of pre-flushing and/or flushing on weight gain or loss.

Lot no. and ration	2-year-old ewes: No. of ewes	Av. pre-flushing wt. loss per ewe, lbs.	Av. flushing gain per ewe, lbs.	2-year-old and yearling ewes: No. of ewes	Av. flushing gain per ewe, lbs.
Lot 1				58	16.7
Low energy	13	−11.9	20.9		
Normal	12	− 8.1	20.1		
Lot 2				59	16.0
Low energy	13	−11.3	21.4		
Normal	12	− 7.3	16.8		
Lot 3				58	12.8
Low energy	13	−12.9	12.1		
Normal	12	− 7.3	12.4		
Lot 4				58	10.6
Low energy	12	−12.5	9.1		
Normal	13	− 6.3	6.6		
Lot 5				58	16.2
Low energy	12	−11.8	18.2		
Normal	13	− 9.4	17.3		
Lot 6				59	14.6
Low energy	12	−11.9	15.0		
Normal	13	− 8.2	12.4		
All lots					
Low energy	75	−12.0	16.2		
Normal	75	− 7.8	14.2		

Ewes on the low-energy pre-flushing ration lost an average of 4.2 pounds each more than ewes fed the normal ration, but gained an average of 2 pounds more than the normally fed ewes during the flushing period. Gain response to flushing by yearling ewes is not shown separately but is included with the two-year-old ewes in the righthand column of Table 36.

Table 36 gives lambing performance of two-year-old ewes fed two different pre-flushing rations.

Two-year-old Ewe Lambing Performance

Pre-flushing treatment	No. ewes	No. ewes lambed	Total lambs	No. single lambs	No. twin lambs	% lamb crop
Low energy	75	74	98	50	48	131
Normal	75	73	92	54	38	124

There was no general difference in cumulative percentages of ewes lambing in a given time. About 90% of the two-year-old ewes lambed within the first 30 days of lambing season. Lambing data are not given separately for two-year-old and yearling ewes for the six different flushing lots. Table 37 gives the combined performance.

Table 37

Lambing performance for two-year-old and yearling ewes

Lot no.	No. of ewes	No. ewes lambed	Total lambs	No. single lambs	No. twin lambs	% lamb crop
1	58	53	59	47	12	101.7
2	59	58	65	51	14	110.2
3	58	54	70	38	32	120.7
4	58	53	59	47	12	101.7
5	58	56	63	49	14	108.6
6	59	57	67	47	20	113.6

Cumulative percentage ewes lambing by periods after first lamb birth, October 22, 1960

Lot no.	Days after October 22				
	10	20	30	40	100
1	15.5	36.2	82.8	89.7	91.4
2	18.6	40.7	84.8	91.5	98.3
3	20.7	46.6	81.0	82.8	93.1
4	10.3	22.4	69.0	81.0	91.4
5	31.0	55.2	84.5	91.4	96.6
6	17.0	33.9	81.4	84.8	96.6

Ewes in Lot 3 had more twins and produced more lambs. Five ewes in each of lots 1 and 4 failed to lamb, perhaps from causes other than treatment. There was little difference in cumulative percentage of ewe lambing after the first 40 days of lambing season. Ewes in lot 4 were later than other lots during the early part of the lambing season.

Ewe Pre-lambing Treatment Test (Fall 1960)

Experimental Procedure: The 350 ewes were divided into three lots according to age and prior treatment September 27, 1960, and fed as follows until October 31, or lambing, whichever came first.

Lot no.	No. of ewes	
7	117	Buffalograss pasture, ¼ pound whole sorghum grain.
8	117	Buffalograss pasture, ¾ pound whole sorghum grain.
9	116	Rye pasture, ¼ pound whole sorghum grain.

Results and Discussion

Ewes grazed on rye pasture, lot 9, produced both single and twin lambs that were heavier at birth than ewes in lot 7 or 8. As in 1959 the difference narrowed as lambing season progressed and pre-lambing treatment became farther removed from date of lambing. Ewes fed ¾ pound or ¼ pound whole sorghum grain on buffalograss pasture produced lambs that weighed about the same at birth.

Table 38

Lamb creep rations, consumption, feed cost, and gains during 1960-1961.

November 3, 1960, to June 20, 1961.

Lot no.	1	2	3	4	5	6
Ration	Sorghum grain, alfalfa hay	Rolled barley, complete pelleted alfalfa hay	Sorghum grain, alfalfa hay	Sorghum grain, dehy. alf. pellets, alfalfa hay	Sorghum grain, dehy. alf. pellets, alfalfa hay	Complete pelleted 65% sorghum grain, 35% alfalfa hay
No. lambs per lot	59	57	57	55	54	62
Total lamb days	9784	9601	8597	9640	9531	9408
Av. lamb birth wt., lbs.	9.6	9.9	9.8	9.8	9.9	9.7
Av. lamb market wt., lbs.	101.0	102.4	106.5	102.2	100.4	104.8
Av. total gain, lbs.	91.4	92.5	96.7	92.4	90.5	95.1
Av. daily gain, lbs.	.54	.55	.62	.56	.52	.60
Av. market age, days	170.0	168.1	156.6	165.5	173.8	158.3
Av. daily feed consumption, lbs.:						
Sorghum grain	1.28	....	1.21	1.28	1.34	....
Alfalfa hay	.57	.68	.30	.22	.13	....
Rolled barley	....	1.21	....	....	....	....
Dehydrated alfalfa pellets	....	....	....	.39	.34	....
Complete pellets	....	.03	....	....	....	2.10
Av. lbs. feed per cwt. gain:						
Sorghum grain	239	....	195	229	257	....
Alfalfa hay	106	123	49	39	25	....
Rolled barley	....	219	....	....	....	....
Dehydrated alfalfa pellets	....	....	....	70	65	....
Complete pellets	....	5	....	....	....	349
Lbs. feed per cwt. gain	345	347	244	338	347	349
Av. feed cost per cwt. gain	$4.82	$5.36	$3.37	$5.43	$5.48	$8.03
Av. feed cost per lamb to market	$4.39	$4.98	$3.27	$5.03	$4.97	$7.63

1. Lot 3. Rye pasture only to Jan. 5, supplement until removed from rye pasture Jan. 23 to Feb. 24; with access to whole sorghum grain creep and alfalfa hay following adjustment after Jan. 5. Access to heavily grazed rye pasture from Feb. 24 to May 1.

2. Lot 4. Whole sorghum grain, dehydrated alfalfa pellets, and access to alfalfa hay in creep after March 6.

Average lamb birth weights, lbs.

Lot no.	First 10 lambs 10-26-60	First 30 lambs 11-8-60	First 60 lambs 11-15-60	All single lambs	Twin lambs
7	8.6	9.5	9.8	10.1 (86 lambs)	7.7 (23 sets)
8	9.2	9.6	9.9	10.2 (93 lambs)	8.3 (15 sets)
9	10.1	10.4	10.5	10.6 (100 lambs)	8.5 (14 sets)

Lamb Feeding Tests (1960-1961, Winter)

Experimental Procedure: To study the value of various feeding rations in fattening suckling lambs for spring market, ewes and lambs were divided into six lots (lots 1 to 6) as nearly as possible according to lamb age and prior ewe treatment. Following lamb birth approximately one week was taken to adjust ewes to feed and lambs before placing them into their respective lots. Lambs were docked with elastic bands when one to two days old and knife castrated when six to seven days old.

Ewes, daily nursing rations: sorghum silage, 1 pound whole sorghum grain and 1¼ pounds alfalfa hay were the same in lots 1, 2, 5, and 6. Lot 3 animals were on rye pasture. When not on rye their ration was the same as lots 1, 2, 5, and 6. In lot 4, the ewes were fed sorghum silage, 1 pound whole sorghum grain, and 1¼ pounds of dehydrated alfalfa pellets (17% protein with 100,000 units of vitamin A guaranteed per pound).

The lamb creep rations are listed in Table 38. Dehydrated alfalfa pellets were the same as those fed to ewes in lot 4.

Feed prices

	Per ton
Whole sorghum grain	$27.00
Alfalfa hay	30.00
Dehydrated alfalfa pellets	50.00
Barley	28.00
Rolling of barley, $15 per cwt.	34.50
45% sorghum grain, 55% alfalfa hay, pelleted	46.00
Processing	7.50
Bags	2.00
Delivery	2.00

The average sale age by lots varied from 156.6 days (lot 3) to 173.8 days (lot 5).

Highest average daily lamb gains were produced in lot 3 that received rye pasture and lot 6, on the all-pelleted ration. Those two reached market weight 12 to 15 days sooner than lambs on other rations. Lamb lots 1, 2, 4, and 5 made similar average daily gains.

Although lambs in lot 5 on an all-pelleted ration gained faster than any except those in lot 3, the cost per 100 pounds gain was considerably higher in lot 6 than in any other lot.

In costs to produce 100 pounds gain the value for the rye pasture (lot 3) was omitted. Comparing lot 3 with lot 1 indicates that the rye pasture replaced 2,083 pounds of sorghum grain and 2,946 pounds of alfalfa hay (or rye pasture was worth $1.45 of the total feed cost to produce 100 pounds of gain). Lambs in lot 3 were given rye pasture only to January 5. They were then adjusted to a creep of whole sorghum grain plus alfalfa hay. From January 23 to February 24, they were removed from rye pasture. After February 24, the lambs again had access to heavily grazed rye pasture plus creep feed to May 1.

Ewe Flushing Test—Spring 1961

Experimental Procedure: 344 ewes were divided into two groups (A and B) April 24, 1961, and fed different rations 17 days until May 11. Group A was given a low-energy ration while group B was on a normal ration. Rations are given following the tables.

May 11, 1961, lots A and B were divided equally into six lots and adjusted to flushing rations until May 14. From May 14 to June 22 (40 days) the six lots were fed different flushing rations.

Twelve Hampshire rams were used to breed the ewes. Breeding season started May 22, eight days after the ewes were placed on the different flushing rations. The twelve rams were divided into six pairs and were with the ewes during nights but removed each morning. Each pair of rams was rotated to a different ewe lot twice weekly. At the end of the flushing period, June 22, all ewes were turned together and grazed on buffalograss pasture. All rams were turned with the entire flock each night until the end of the breeding season, September 1.

Results and Discussion

Summary of pre-flushing lots[1] (April 24 to May 11, 1961)[2]

Lot no.	No. of ewes in lot	Av. ewe wt., lbs. 4-24-61	Av. lbs. ewe wool clip 5-2-61	Av. ewe wt., lbs. 5-11-61	Av. loss or gain, lbs.
A	172	124.6	10.0	112.6	−2.0
B	172	121.9	10.1	115.8	+4.0

1. Lot A. 2 lbs. alfalfa hay only.
   Lot B. 2 lbs. alfalfa hay; ½ lb. whole sorghum grain; and 3 lbs. silage.
2. 17 days.

Lot A, which received the low-energy ration during pre-flushing, lost an average of 2 pounds per ewe, while lot B (normal ration) gained 4 pounds per ewe. The ewe loss in weight was much greater the spring of 1960 than the spring of 1961, with identical rations each year. In 1960, the low-energy ration group lost 12 pounds per ewe while the normal ration group lost 7.8 pounds per ewe. The final variation between lots was practically the same for both years. Lot A, fed the low-energy ration during pre-flushing, gained 4.1 pounds more per ewe during the flushing period than lot B.

Summary of ewe flushing lots[1] (flushing period, 5-14-61 to 6-22-61)[2]

Ewe flushing lot no.	No. of ewes	Av. total gain per ewe, lbs.	Av. daily gain (40-day flushing period), lb.
1	58	17.3	.433
2	57	9.9	.248
3	56	8.0	.200
4	57	8.0	.200
5	57	11.1	.278
6	57	12.1	.303

1. Rations during flushing period:
   Lot 1. ¾ lb. whole sorghum grain, full feed of alfalfa hay. (Average daily alfalfa hay consumption per ewe, 4.8 lbs.)
   Lot 2. ¾ lb. whole sorghum grain, 1¼ lbs. alfalfa hay, full silage. (Average daily silage consumption per ewe, 5.5 lbs.)
   Lot 3. ½ lb. whole sorghum grain, cereal crop pasture.
   Lot 4. Cereal crop pasture only.
   Lot 5. ½ lb. whole sorghum grain, buffalograss pasture.
   Lot 6. Buffalograss pasture only.
2. Weighed May 11, allowed to adjust to flushing ration until May 14.

During the flushing period ewes in lot 1 gained decidedly more than those on any other ration tested. Lot 3 and 4 ewes were the low gainers during the flushing period. This was also true in the spring of 1960. Supplementing cereal crop pasture or buffalograss pasture with ½ pound of whole sorghum grain did not increase ewe gains over pasture only in 1961, contrary to 1960 results. An explanation for the difference is not apparent. Gains in general were lower for 1961 spring flushing than for the 1960 spring flushing period. Summaries will be made after the 1961-62 lambing season to determine the effects of the different flushing treatments used in 1961 upon lambing dates and lambing percentages, which will then be reported in the 1962 annual report.

Summary of ewe flushing performance as affected by pre-flushing treatment (flushing period, 5-14-61 to 6-22-61)[1]

Ewe flushing lot[2]	Ewe pre-flushing lot[3]	No. of ewes	Av. total gain per ewe, lbs.	Av. daily gain (40-day flushing period), lb.
1	A	29	19.2	.480
	B	29	15.4	.385
2	A	29	11.4	.275
	B	28	8.4	.210
3	A	29	10.2	.255
	B	27	5.4	.135
4	A	29	11.9	.298
	B	28	4.0	.100
5	A	28	13.1	.328
	B	29	9.3	.233
6	A	28	12.9	.323
	B	29	11.3	.283
All lots	A	172	13.1	
	B	170	9.0	
Flushing increase for pre-flushing A ration			+4.1	

1. Weighed May 11, allowed to adjust to flushing ration until May 14.
2. Rations during flushing period:
   Lot 1. ¾ lb. whole sorghum grain; full feed of alfalfa hay. (Average daily alfalfa hay consumption per ewe, 4.8 lbs.)
   Lot 2. ¾ lb. whole sorghum grain; 1¼ lbs. alfalfa hay; full silage. (Average daily silage consumption per ewe, 5.5 lbs.)
   Lot 3. ½ lb. whole sorghum grain, cereal crop pasture.
   Lot 4. Cereal crop pasture only.
   Lot 5. ½ lb. whole sorghum grain, buffalograss pasture.
   Lot 6. Buffalograss pasture only.
3. Daily rations during pre-flushing:
   Lot A. 2 lbs. alfalfa hay only.
   Lot B. 2 lbs. alfalfa hay; ½ lb. whole sorghum grain; 3 lbs. silage.

Lamb Feeding Tests (1961-1962, Winter)

Experimental Procedure: To study the value of various feeding rations in fattening suckling lambs for spring market, ewes and lambs were divided into six lots (lots 1 to 6) as nearly as possible according to lamb age and prior ewe treatment. Following lamb birth, approximately one week was taken to adjust ewes to feed and lambs before placing them into their respective lots. Lambs were docked with elastic bands when one to two days old and knife castrated when about five to seven days of age.

The lot treatments were:

Lot no.	Nursing ewe daily ration	Lamb ration creep
1	1 lb. whole sorghum grain 1¼ lbs. alfalfa hay Full silage	Whole sorghum grain Alfalfa hay
2	1 lb. whole barley grain 1¼ lbs. alfalfa hay Full silage	Whole barley grain Alfalfa hay
3	1 lb. whole sorghum grain 1¼ lbs. alfalfa hay Full silage	Whole sorghum grain Wheat hay
4	1 lb. whole sorghum grain 1¼ lbs. alfalfa hay Full silage	Complete pelleted ration (45% ground sorghum grain and 55% ground sun-cured alfalfa hay) Alfalfa hay
5	Rye pasture (when not on rye fed same as lot 1)	Rye pasture (when weather permitted) Whole sorghum grain Alfalfa hay
6	1 lb. whole sorghum grain 1¼ lbs. alfalfa hay Full silage	Whole sorghum grain Alfalfa hay (Weaned lambs at 8 to 10 weeks of age)

Results of the above tests now in progress will be summarized as completed, and reported in the 1962 annual report.

Corn, Sorghum Grain, Wheat, Rye and Barley Each as a Concentrate in Complete Pelleted Rations Compared with a Standard Nonpelleted Sorghum Grain and Alfalfa Hay Ration for Self-feeding Fattening Lambs (Project 236).

Myron Hillman, D. Richardson and R. F. Cox

This test duplicates one last year, which was designed to study various grains in complete pelleted rations compared with a standard nonpelleted ration. Previous work has shown that a complete pelleted ration composed of 30 to 40 percent concentrate produced faster, more efficient lamb gains than a nonpelleted ration of the same composition.

Experimental Procedure

The 144 fine-wool type wether lambs used in these tests were obtained at Clovis, N.M., October 28. They were shorn and drenched with a commercial fine particle-size Phenothiazine drench. November 16, the lambs were ear tagged, weighed, divided into six lots of 24 lambs each and self-fed the following rations for 65 days.

Lot 1. 35% sorghum grain and 65% alfalfa hay, pelleted.
Lot 2. 35% corn and 65% alfalfa hay, pelleted.
Lot 3. Mixed nonpelleted ration of 45% ground sorghum grain and 55% chopped alfalfa hay.
Lot 4. 35% barley and 65% alfalfa hay, pelleted.
Lot 5. 35% wheat and 65% alfalfa hay, pelleted.
Lot 6. 35% rye and 65% alfalfa hay, pelleted.

All lambs were implanted with 3 mgs. of stilbestrol[1] at start of test. In addition to the above ration each lot received 5 lbs. of chopped alfalfa hay each day. Salt was supplied free choice.

The grain used in rations was purchased in bulk. The sorghum grain used in lot 3 was run through a coarse screen grinder. Hay used in the pellets was average quality, first cutting, ground through ¼-inch screen. The hay used in lot 3 was of the same quality, but chopped.

Feed prices and processing charges used in determining feed cost per cwt. gain were: sorghum grain, \$1.70 per cwt.; corn, \$1.08 per bu.; barley, \$.96 per bu.; wheat, \$1.95 per bu.; rye, \$.93 per bu.; baled alfalfa hay, \$15 per ton; grinding hay, \$5 per ton; chopped hay for lot 3, \$3 per ton; grinding grain for lot 3, \$2 per ton; grinding grain, mixing and pelleting rations, \$6 per ton. With prices and charges indicated, feed costs per ton for each lot were: Lot 1, \$30.90; lot 2, \$32.51; lot 3, \$29.30; lot 4, \$32.93; lot 5, \$41.75; lot 6, \$30.62. These are bulk prices; if bags were used, they would increase cost \$2 to \$3 per ton.

Results and Discussion

Results are shown in Table 39.

There was little difference in rate of gain among lambs fed different pelleted rations. Lambs fed wheat consumed more feed per head daily, gained faster, and gained most efficiently of all. However, gains on the wheat ration cost most because of high wheat prices.

Lambs in lot 3, fed the loose ration, consumed less feed per head daily, but gained as efficiently as those in lot 1. Gains in lot 3 were cheaper than those of any lambs fed pelleted rations. There were more deaths in this lot due to overeating. The ration was self-fed and the lambs presumably separated the concentrate from the roughage.

The pelleted ration requires less labor to feed and the management

1. Furnished by Chas. Pfizer and Co., Inc., Terre Haute, Ind.

Table 30

Corn, sorghum grain, wheat, rye, and barley in complete pelleted rations vs. a standard nonpelleted ration for self-feeding fattening lambs.

November 16, 1961, to January 21, 1962—65 days.

Lot number	1	2	3	4	5	6
Ration fed	Pelleted: 35% sorghum grain, 65% alfalfa hay	Pelleted: 35% corn, 65% alfalfa hay	Nonpelleted: 45% ground sorghum grain, 55% chopped alfalfa hay	Pelleted: 35% barley, 65% alfalfa hay	Pelleted: 35% wheat, 65% alfalfa hay	Pelleted: 35% rye, 65% alfalfa hay
No. lambs per lot[1]	20	21	18	24	23	23
Initial wt. per lamb, lbs.	65.8	65.2	64.7	65.7	66.5	64.9
Final wt. per lamb, lbs.	101.2	103.3	90.9	104.6	106.6	100.9
Total gain per lamb, lbs.	35.4	38.1	26.2	38.9	40.1	36.0
Av. daily gain per lamb, lbs.	.54	.59	.40	.60	.62	.55
Lbs. feed per lamb daily:						
Complete pelleted ration	3.69	3.87	......	3.92	4.00	3.77
Chopped alfalfa hay	.18	.17	1.56	.15	.15	.16
Ground sorghum grain	......	......	1.30	......	......	......
Total feed per lamb daily	3.87	4.04	2.86	4.07	4.15	3.93
Lbs. feed per cwt. gain	712.3	690.8	711.5	683.8	672.1	709.8
Feed cost per cwt. gain	$11.01	$11.13	$9.83	$11.25	$14.03	$10.86
Av. % yield[2]	49.5	48.1	49.0	48.3	48.5	49.3
Av. U.S.D.A. carcass grade[3]	9.5	9.6	8.7	9.7	9.3	9.4

1. Four lambs in lot 1; 3 from lot 2; 6 from lot 3; and 1 from each of lots 5 and 6 died from overeating.
2. Based on hot dressed carcass weight and individual lamb weight at Manhattan just prior to shipment.
3. Based on prime, 14; choice, 11; good, 8; utility, 5; and cull, 2.

of feeding lambs is less difficult. Lambs will consume more pounds of feed per day; therefore, gains are higher than when a loose ration is fed, but the cost of gains is higher because of the processing cost.

Fifteen lambs died from overeating during the test—6 in lot 3; 4 in lot 1; 3 in lot 2; 1 each in lots 5 and 6, and 0 in lot 4. The lambs were not vaccinated for overeating when put on feed. There was about ½ U.S.D.A. carcass grade variation among lots and 1.4 percent variation in yield among lots.

Heritabilities, Genetic, and Phenotypic Correlations Between Carcass and Live Animal Traits in Sheep (Project 347).

Myron Hillman, Carl Menzies, John D. Wheat, D. L. Mackintosh and R. A. Merkel

This is a contributing project to the North-Central-50 Regional Sheep Breeding Project. The Kansas State Project was initiated to determine relationships between various carcass measurements and live animal traits, to estimate heritability of these traits, and to determine how findings may be applied to selection and breeding of meat-type lambs.

Experimental Procedure

In 1959-60, 10 Hampshire rams were bred to 100 yearling Western ewes. The ewes were divided into 10 equal lots and one ram was randomly assigned to each lot. One ram was sterile, so his ewes were randomly assigned to the other nine lots. The nine rams sired 77 lambs.

In 1960-61, 10 different Hampshire rams were used on the same ewes and 99 lambs resulted from these matings. Experimental rams were used from June 1 to August 15, each year, and then clean-up rams were turned with the ewes, hence the relatively small experimental lamb crop.

The ewes were on a bromegrass pasture during the spring and summer months and were on rye pasture from the last week in September until they lambed. Three weeks before lambing, each ewe received ½ pound of grain daily. After the ewes lambed, they were put into a drylot and fed sorghum silage free choice, and approximately 1.5 pounds of alfalfa hay and 1 pound of grain per head daily.

As soon as the lambs would eat it, they were started on a pelleted creep ration, and remained on it until they were slaughtered. All lambs were slaughtered when their unshorn feedlot weights were from 95 to 100 pounds. They were shorn and held off feed approximately 12 hours before slaughter.

In August, when the rams were taken from the ewes, each was subjectively scored for certain conformation traits by a five-man committee. At that time each ram was weighed and in 1960-61 the rams were probed for fat and muscle depth over the second lumbar vertebra. The probe depth for each ram was corrected for weight (by regression).

Five scores (among those taken for each ram), weight, and loin depth probe were used in correlating ram scores with each other and with some production and carcass traits in the lambs. Before they were slaughtered, the shorn lambs were subjected to 13 objective measurements to the nearest tenth of an inch. Birth weight, average daily gain, and market age were corrected for type of birth, sex, and type of rearing.

These 176 lambs also were used in a lamb carcass quality study (Project 580) conducted by meats researchers at Kansas State University. From this study subjective carcass scores, carcass measurements and weights of cuts were obtained. The rack was physically separated and the lean, fat and bone were weighed to the nearest gram. Loin eye area and back fat thickness were measured from tracings.

Procedure followed in handling ewes and rams the past two years is outlined in Kansas Circulars 378 and 383.

Results and Discussion

There were only a few significant correlations between ram scores and lamb traits. The depth of loin probe had the highest relationship with lamb traits. It was negatively correlated with lamb's market age (—.60);

as depth of loin probe increased the lamb reached market weight sooner. Loin probe was positively correlated with loin eye area (.39), length of right forecannon (.68), and weight of loin (.53). Length of leg of ram was highly correlated with depth of heart (.63), circumference of right forecannon (.57), depth of loin eye (.50), and width of loin eye (.48). Muscling score was negatively correlated with birth weight (−.50).

Most of the ram scores or traits were significantly correlated with each other. The highest correlation was ram weight with depth of loin probe (.99). This relationship indicates that heavier rams have deeper longissimus dorsi muscles. Muscling score was highly correlated with general type score (.87).

Table 40 gives the correlation, for both years, between production and carcass traits in lambs.

Market age was negatively correlated with birth weight. The heavier lambs at birth gained far more rapidly and reached market weight sooner. Birth weight was negatively correlated with carcass grade, feathering, and marbling. These relationships indicate that larger lambs at birth gained faster, reached market weight sooner, therefore, they were younger and didn't have the quality carcass that a more mature lamb does.

Objective measurements taken on the live lambs were correlated with carcass traits. Data from each of the two years were analyzed separately.

Table 40

Correlations between production and carcass traits in lambs.

	Birth weight		Av. daily gain		Market age	
	1st yr.	2nd yr.	1st yr.	2nd yr.	1st yr.	2nd yr.
Market age	−.44[1]	−.62[2]	−.92[2]	−.91[2]		
Av. daily gain	.38[2]	.53[2]				
Carcass grade	−.24[2]	−.15[1]	−.49[2]	.00	.47[2]	.14
Feathering	−.09	−.12	−.38[2]	0.06	.38[2]	.18
Marbling	−.22[2]	−.19[2]	−.36[2]	.01	.33[2]	.04
Firmness	−.19[1]	.19[1]	−.38[2]	.28[2]	.37[2]	−.27[2]
Grams of lean in rack	.20[2]	.21[2]	−.03	.33[2]	.06	−.38[2]
Grams of bone in rack	.36[2]	.34[2]	.22[2]	.35[2]	−.20[2]	−.39[2]
Loin eye depth	....	.05	....	.27[2]	....	−.33[2]

1. P < .05.
2. P < .01.

Circumference of right forecannon was the most highly correlated trait with gram of bone in the rack (.36) (.40). Length of right forecannon, length of body and length of rump were positively correlated with gram of bone in rack, which is a good indicator of the total bone in carcass.

Length of rump was significantly correlated with the weight of leg (.39) (.60). Also, circumference of right forecannon and circumference of right hind leg were positively correlated with weight of leg. The relationship of these measurements with weight of leg could be used in selecting lambs with high cut-out value, because weight of leg makes up approximately 30 percent of the total carcass weight.

Length of rump was also significantly correlated with grams of lean in the rack (.23) (.16), which is also one of the best indicators of total lean in the carcass.

Width of second lumbar vertebra was significantly correlated with carcass traits that are associated with the fat in the carcass. These traits are weight of rack, back fat thickness, grams of fat in rack, and weight of loin.

Feathering was positively correlated with marbling and with carcass grade. Marbling was also positively correlated with carcass grade, grams of fat in the rack and percentage of fat in the longissimus dorsi. The percentage of fat in longissimus dorsi was negatively correlated with birth weight, positively correlated with market age, negatively correlated with average daily gain. These significant relationships indicate that a

lamb with a heavy birth weight, that had a fast daily gain, will reach market weight sooner and will have less fat in longissimus dorsi and, therefore, have less marbling.

Carcass grade correlated with weight of leg more than with any of the other wholesale cuts. Weight of shoulder was significantly correlated with weight of leg (.46) (.57), also with weight of rack, weight of loin, and grams of fat in the rack.

Heritability estimates based on paternal half-sib correlation were made on all lamb measurements and traits (Table 41).

Sire effects were significant (P < .01) in the following lamb traits: weight of loin, marbling, feathering, average daily gain, market age, birth weight, length of rump, and length of right forecannon.

The sire difference in rib eye area was significant (P < .05).

Table 42 gives the results on the 10 yearling Hampshires and their lambs.

Table 41

Heritability estimates based on paternal half-sib correlations.

Weight of loin	.46	Grams of lean in rack	.16
Marbling	.39	Grams of bone in rack	.10
Feathering	.57	Firmness of carcass	.14
Av. daily gain	.54	Market age	.53
Birth weight	.60	Backfat thickness	.21
Rib eye area	.39	Length of body	.09
Length of rump	.50	Length of right forecannon	.51
Weight of shoulder	.08	Weight of breast	.02

Table 42

1960-61 data on ten yearling Hampshire rams and their lambs.

Ram number	1	2	3	4	5	6	7	8	9	10
Ram type score[1]	80	78.8	71.6	92.1	78.8	82.3	86.8	86.8	78.3	60.0
Wt. of ram, lbs., 9-2-60	198	161	163	270	189	229	224	222	170	147
Ram probe fat depth at 2nd lumbar, in.	.30	.40	.40	.35	.30	.40	.30	.20	.30	.20
Ram probe loin eye depth at 2nd lumbar, in.	1.75	1.60	1.40	2.15	1.60	1.50	1.90	2.10	1.70	1.20
Ram loin eye depth corrected[2]	1.7	1.5	1.5	2.2	1.6	1.9	1.8	1.9	1.5	1.4
Total number of lambs	12	11	13	10	10	8	7	12	11	10
Number twin lambs	6	4	6	4	2	2	2	6	4	2
Av. birth wt., lbs.[3]	10.8	9.2	9.0	10.7	9.9	10.6	10.4	9.6	10.0	8.9
Av. daily gain, lbs.[3]	.78	.67	.68	.69	.66	.77	.72	.68	.67	.65
Av. age at slaughter	126	135	129	128	133	119	121	130	132	136
Av. rib eye area, 12th rib, sq. in.	2.3	2.2	2.3	2.3	2.4	2.6	2.4	2.5	2.2	2.4
Av. fat thickness, 12 rib, in.	.37	.34	.30	.39	.34	.30	.29	.33	.30	.32
Av. marbling score[4]	5.9	6.1	5.8	5.2	5.0	5.4	5.8	5.4	6.1	5.6
Av. USDA carcass grade[5]	14.2	14.4	14.4	14.2	14.1	13.8	13.8	14.1	14.4	14.4

1. Average general type score, with perfect score, equals 100.
2. Ram loin depth probe corrected for weight (by regression).
3. Not corrected for sex or type of birth.
4. Higher score means more marbling.
5. Carcasses graded by USDA graders: Prime, 14; choice, 11; good, 8; etc.

Meat

The Relation of Feathering and Overflow Fat of Lamb Carcasses to the Grade of the Lamb, Degree of Marbling, and Market Value of the Lamb (Project 580).

D. L. Mackintosh, R. A. Merkel and C. S. Menzies

This project was undertaken the spring of 1960 to attempt to determine the relationship, if any, of internal fats, overflow, and feathering to the degree of marbling in the longissimus dorsi muscle, the grade of the carcass, and the relationship of marbling to the palatability of the meat. Eighty-eight lambs were slaughtered in 1960; 120 in 1961; and about 80 will be slaughtered this spring.

The Hampshire rams crossed on western ewes produced highly acceptable lambs weighing 95 pounds in 82 to 178 days in 1960 (average 138 days), and from 96 to 147 days (average 121 days) in 1961. All lambs graded average choice or prime, with a fair range in marbling. Lambs by Suffolk rams and out of the same ewes are being studied this year.

Correlation coefficients for both 1960 and 1961 data show a highly significant relationship between feathering, fat streaking in the flank, estimated marbling, actual marbling, overflow fat, and thickness of fat. Feathering also was significantly correlated with most other factors, both years; overflow fat was highly correlated with grade, yield, marbling, and kidney and pelvic fat, but not with other 1960 data. Marbling and percentage of fat in the longissimus dorsi were highly related to all palatability factors in 1960, but much less so in 1961. In general, external indices of quality used in grading lamb are highly satisfactory with "A" (young) maturity lambs.

The Relation of Packaging Material to the Keeping Quality of Frozen Pork (Project 424).

D. L. Mackintosh, R. A. Merkel, J. L. Hall, Dorothy L. Harrison and L. Anderson

Fresh pork sausage is used by an increasing number of families with home storage units. Several years of research here indicate that with salt, pepper and sage added before sausage is stored, its maximum storage life is 6 to 9 months at 0° F., and then only when tested packaging materials are used (Polyethylene, Plyofilm, Cellophane, or Aluminum Foil). Poor packaging materials reduce storage life of sausage to as little as 30 days. Addition of antioxidants to the sausage increased the storage life from about 6 to 9 months in our tests. Antioxidants have little influence when used with poor wrapping materials. High peroxide values in test sausage early in the storage period have been common the last two years. The processing equipment has been modified, and a study is now under way to try to determine why the high peroxide values occur.

The Effect of Level of Dietary Iron on Pork Muscle Characteristics.

R. A. Merkel, D. L. Mackintosh, J. L. Hall, Dorothy L. Harrison, Mercedes Hunsader, D. G. Topel and D. H. Kropf

Increasing undesirable muscle characteristics in pork carcasses make any method to alter or improve pork muscle quality desirable. Effects of various levels of dietary iron and copper (or NaCl) on pork muscle were investigated in this experiment.

Procedure

Barrows and gilts (28 of each), averaging 43 pounds, were randomly divided into 7 lots to receive treatments indicated in Table 43. The con-

Table 43

The effect of level of dietary iron on pork muscle characteristics (lot averages).*

Lot no.	1	2	3	4	5	6	7
Ration	Control[1]	Control +0.4 gm. EDTA per lb.	Low iron	Control +260 mgs. Fe +23.2 mgs. Cu per lb.	Control +500 mgs. Fe +53.2 mgs. Cu per lb.	No salt group[2]	Control + salt[3]
Initial wt., lbs.	48.6	49.0	46.1	37.1	37.9	40.4	37.5
Final wt., lbs.	205.0	210.4	209.8	207.6	201.0	205.2	209.8
Av. daily gain, lbs.	1.46	1.41	1.55	1.42	1.32	1.30	1.30
Feed per lb. gain, lbs.	3.83	3.27	2.86	3.19	3.07	3.18	3.15
Muscle characteristics:[4]							
Expressible water, %	42^{6}	39^{6}	38^{6}	41^{6}	42^{6}	43^{6}	45^{6}
pH, 24 hours	$5.53^{6,7}$	5.48^{6}	$5.54^{6,7}$	$5.51^{6,7}$	$5.56^{6,7}$	$5.55^{6,7}$	5.58^{7}
Ether extract, %	2.69^{6}	$2.93^{6,7}$	$2.99^{6,7}$	$2.98^{6,7}$	3.89^{7}	3.98^{7}	$3.19^{6,7}$
Total moisture, %	73.90^{6}	73.84^{6}	73.90^{6}	73.76^{6}	73.11^{6}	73.10^{6}	73.72^{6}
Myoglobin, mgs./gm.	0.93^{7}	0.90^{7}	0.60^{6}	$1.00^{7,8}$	$1.07^{7,8}$	$1.11^{7,8}$	1.17^{8}
Color intensity[5]	$4.93^{6,7}$	4.97^{7}	5.34^{8}	$4.82^{6,7}$	$4.75^{6,7}$	$4.81^{6,7}$	4.65^{6}

* All values with same superscript are not significantly different at 5% level of probability.
1. Includes 40 mgs. Fe and 6.8 mgs. Cu per lb. ration.
2. Received no added salt in ration.
3. Control ration until 180 lbs. live weight, then 10% NaCl in ration until reaching slaughter weight.
4. Average value from 10 locations on 5 different muscles.
5. Munsell value. Higher number indicates **lighter** color.
6, 7, 8. See first footnote, introduced by asterisk (*).

trol ration was essentially a sorghum grain-protein supplement ration. The EDTA added to lot 2 ration may tie up iron in a pig's system and thus affect muscle characteristics. Rations fed to the low-iron lot contained about half the recommended dietary allowance for iron. Iron and copper were added to some rations to determine if that would increase myoglobin, the muscle pigment, or change color intensity of pork muscle.

Rations were pelleted and fed free choice to pigs in concrete-floored feeding pens. Water was softened so essentially no iron was available from it. Animals were individually taken off feed at 205 to 210 pounds and slaughtered after holding for 24 hours. After chilling for 24 hours at 30-34° F., standard cutting procedures were used.

Muscle samples were removed as follows:

A. **Longissimus dorsi** (loin eye muscle)
   1. Anterior sample—opposite 3rd rib to 10th rib.
   2. Center—10th rib to 1st lumbar vertebra.
   3. Posterior—lumbar section.

B. **Psoas major** (tenderloin)

C. **Rectus femoris** (a ham muscle)
   1. Ventral
   2. Dorsal

D. **Biceps femoris** (a ham muscle)
   1. Ventral
   2. Dorsal

E. **Semimembranosus** (a ham muscle)
   1. Ventral
   2. Dorsal

Expressible water, 24 hr. pH, ether extract (fat), total water, myoglobin (muscle pigment), and red color intensity were determined for these samples.

Results

The greatest average daily gain and best feed efficiency were achieved in the group of pigs receiving lower than the required iron level. Slowest gains were observed in the lots where NaCl consumption was altered and in groups receiving the high level of added iron and copper.

Percentages of expressible water and of total water in pork muscle were not altered by any treatment used. Pigs receiving the high level of salt after reaching 180 pounds (lot 7) had a higher average 24-hour muscle pH than those receiving the agent that may tie up iron (lot 2). Muscle samples from pigs of lots 5 and 6 had higher intramuscular fat content than those from lot 1. A lighter average muscle color and less muscle pigment were noted in pigs receiving the low dietary level of iron and copper. This is explained by insufficient iron being available for the animal to synthesize myoglobin. The highest myoglobin concentration and the most intense muscle color were noted in pigs receiving the 10% salt ration before being slaughtered, possibly as a result of stress caused by this abnormal treatment. It appears that certain muscle characteristics can be altered by some of the treatments used in this study.