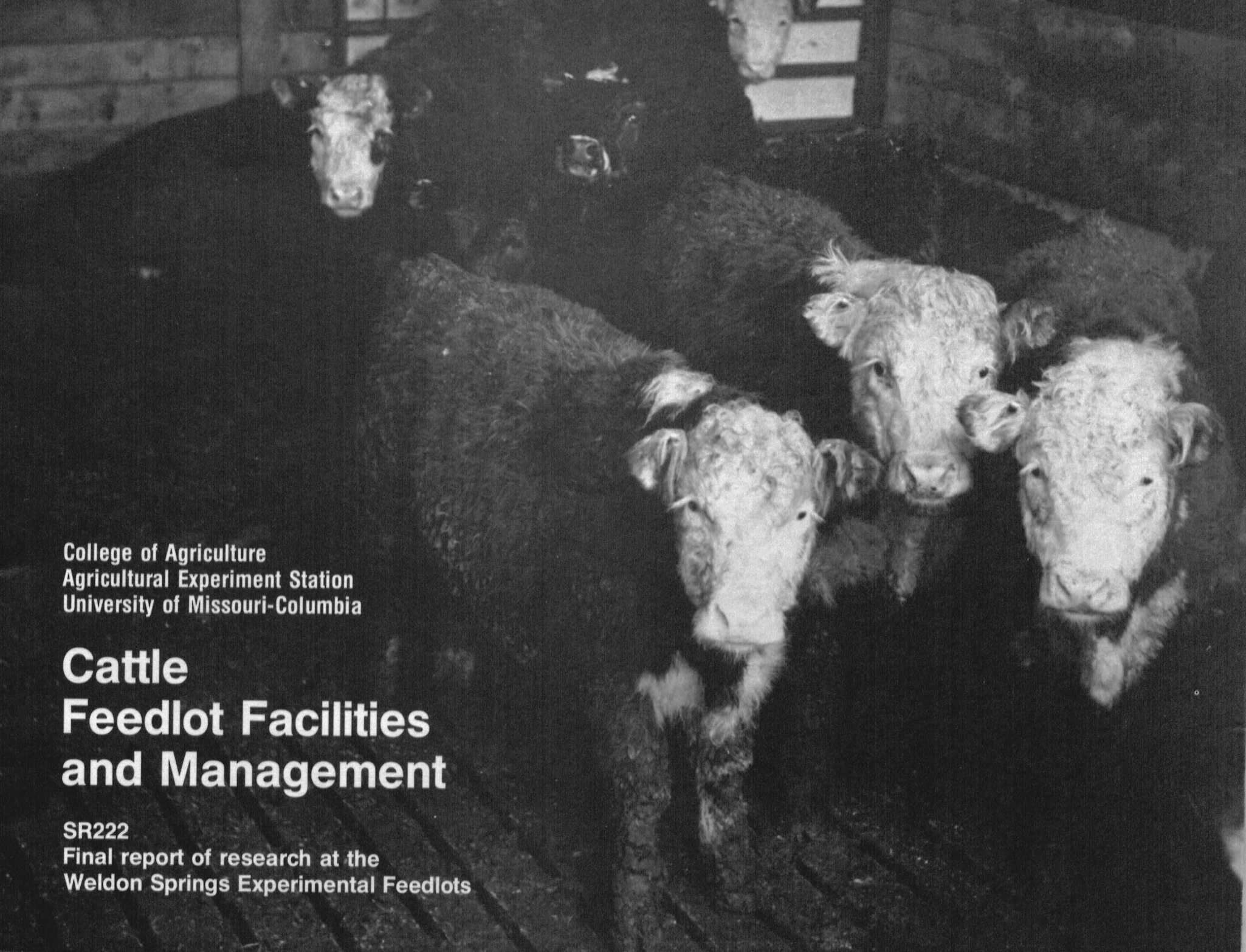


College of Agriculture
Agricultural Experiment Station
University of Missouri-Columbia

Cattle Feedlot Facilities and Management

SR222

Final report of research at the
Weldon Springs Experimental Feedlots

Authors George W. Jesse
Neil F. Meador
Albert J. Dyer

Reviewers William H. Pfander
Homer B. Sewell

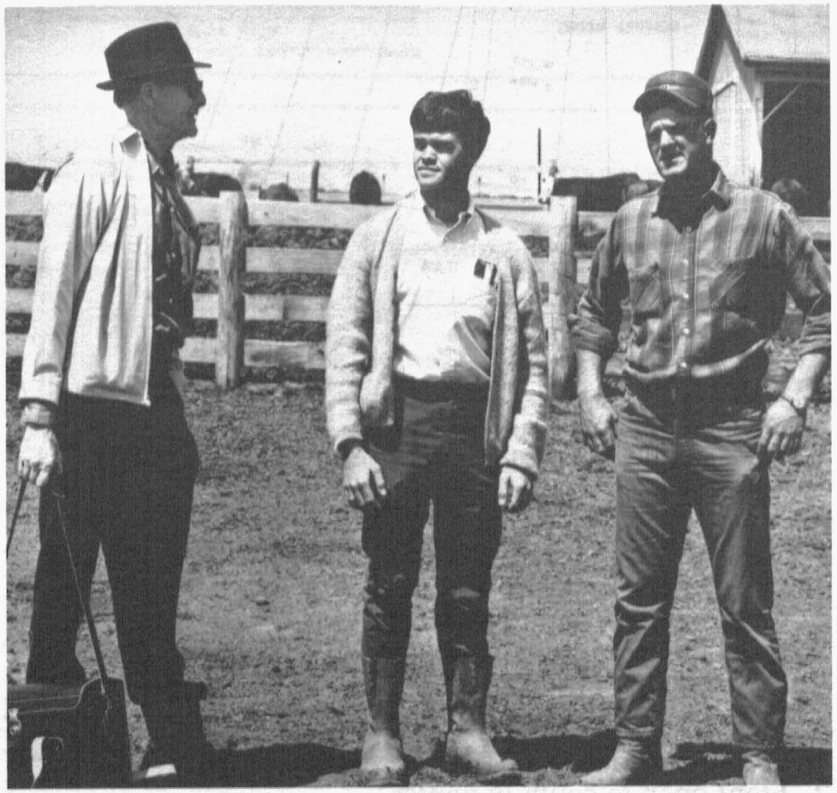
This research was designed to study the effect of facilities on the performance of cattle. The facilities were erected in 1965 with funds provided by the Agricultural Resources Development Corporation of the Metropolitan St. Louis Chamber of Commerce.

Table of Contents

Final report of tests conducted at the Weldon Springs Experimental Feedlots

Page

Introduction and Acknowledgments



This report is dedicated to the late Dr. A. J. Dyer, left, department head and chairman of the Weldon Springs feedlot research project. Assistant Professor George Jesse, middle, is one of the authors of this report, and Richard Scharnhorst, right, was a herdsman on the project.

The Dean of the College of Agriculture appointed a Weldon Springs Beef Cattle Feeding Research Facility Committee in 1965. Members were A. J. Dyer, Chairman, G. B. Thompson, Robert George, Ralph Ricketts, Robert Finley and Homer L'Hote, Ex-officio. Ten tests were completed in the facilities. Financial assistance was provided by the Agricultural Resources Development Corporation of the Metropolitan Chamber of Commerce, St. Louis, Missouri.

A number of individuals were helpful in arranging for delivery of cattle, feed ingredients or supplements and in helping collect data and in supporting field days that were held in association with the tests. David Simms had primary responsibility for the 1970 and the 1970-71 tests. Four tests were the prime responsibility of George Jesse. Statistical assistance was given by Gary Krause, Martin Orr and Darrell Eklund. The cattle were fed by Richard Scharnhorst and Herman Mudd assisted with the day-to-day operations of the facility.

This report presents the combined results of the experiments. The tests represented the last major research effort of the late Dr. A. J. Dyer. Part of the material has been published previously in Special Reports 77, 97, 122 of the Agricultural Experiment Station and in the Weldon Springs Center Beef Cattle Facility Days reports of August 1, 1969, April 2, 1971 and March 22, 1973.

The primary objective of the tests reported here was to determine the effects of feedlot facilities on cattle performance. The data are based on six tests including (1) summer 1970, (2) winter 1970-71, (3) summer, 1971, (4) winter 1971-72, (5) summer 1972, and (6) winter 1972-73. The tests ranged from 107 to 168 days in length and used 927 yearling steers.

The facilities included (1) outside, flat lots (with and without shade in summer), (2) limestone-covered mound, (3) open-front confinement barn (open also in rear during summer), and (4) enclosed confinement barn with evaporative cooler (summer only) and exhaust fan ventilation. Construction and maintenance costs are not given because costs vary considerably according to location, availability of materials, and many other factors.

Procedures

The cattle were stocked at a rate to provide at least one linear foot of bunk space per steer. Cattle in outside lots were provided an average of 200 square feet of lot area (included 20 square feet of shade in some instances) and those in the confinement barn, 29 square feet each.

Cattle were weighed every 28 days after an overnight stand without feed. Cattle health was under the supervision of the University of Missouri School of Veterinary Medicine.

An auger truck equipped with electronic load cells was used to weigh, mix and deliver feed to the bunks. The amount fed was according to appetite; the intent was to keep the cattle "full" at all times. Unless otherwise stated, the cattle were fed once per day during the winter trials and twice per day during the summer trials.

Cattle gains and U.S.D.A. carcass grades were statistically analyzed.

Description of Facilities

Outside Lots

Lot 1B and 5B

1. Outside lot with a 6% slope (approximate) to the southeast
2. 20′ x 40′ shade
3. 12′ concrete apron along feed bunk

Lot 2A, 2B and 5A

1. Outside lot with a 6% slope (approximate) to the southeast
2. No shade
3. 12′ concrete apron along feed bunk

Lot 3A and 3B

1. Outside lot with a 6% slope (approximate) to the southeast
2. No shade
3. 27′ concrete apron along feed bunk

Lot 4

1. Outside lot with a limestone covered mound, 8′ high, 50′ wide at base, and 170′ long

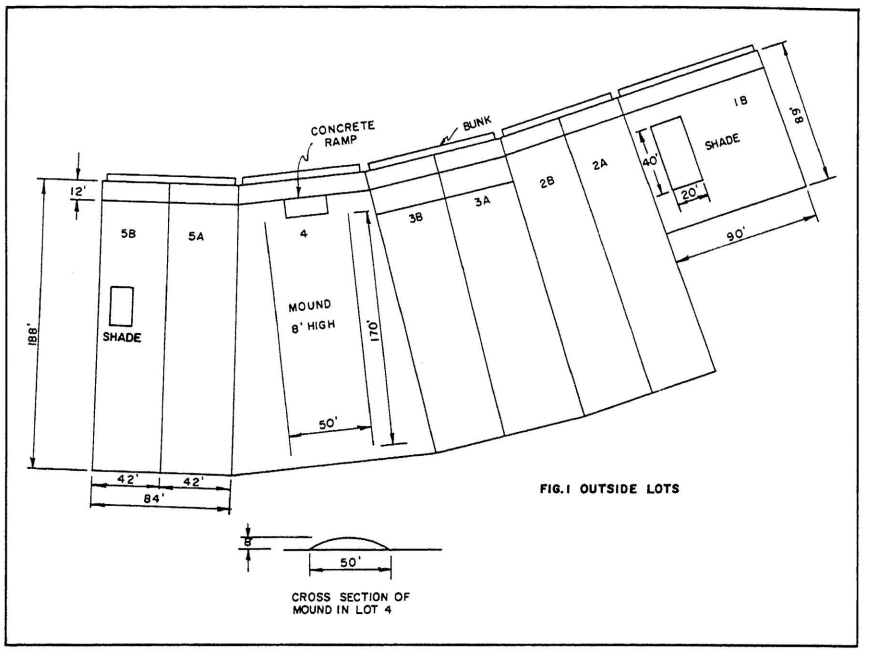


FIG. I OUTSIDE LOTS

2. Drainage tiles at lower end of the lot
3. 12′ concrete apron along feed bunk

Confinement Barn Number 1

Lot 8

1. One-third slotted floor
2. Front open to south in winter
3. Front and rear open in summer
4. 18′ wide by 26′ deep

Lot 9

1. Two-thirds slotted floor
2. Front open to south in winter
3. Front and rear open in summer
4. 18′ wide by 26′ deep

Lot 10

1. Totally slotted floor
2. Front open to the south in winter

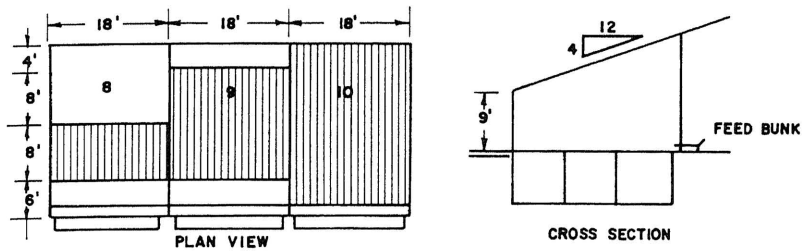


FIG. 2 OPEN FRONT CONFINEMENT BARN

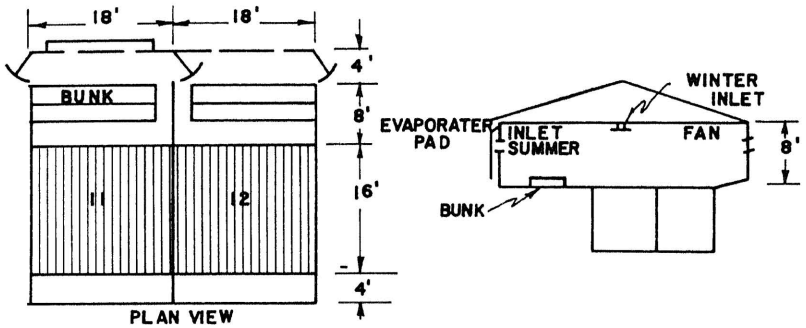


FIG. 3 TOTALLY ENCLOSED CONFINEMENT BARN

3. Front and rear open in summer
4. 18′ wide by 26′ deep

Confinement Barn Number 2

Lot 11

1. Two-thirds slotted floor
2. Enclosed confinement
3. Exhaust fan ventilation with air precooled by evaporative cooling system (in summer)
4. 18′ wide by 26′ deep

Lot 12

1. Two-thirds slotted floor
2. Enclosed confinement
3. Exhaust fan ventilation (without evaporative cooler)
4. 18′ wide by 26′ deep

Summer Test 1970

One hundred sixty-two steers were used in a 107-day summer trial that began May 5 and ended August 20, 1970.

Description of the Cattle

Angus, Hereford and crossbred steers that lacked uniformity in both quality and weight were used. Initial weights ranged from 600 to 900 lbs and grades ranged from U.S.D.A. Standard to Choice.

Pre-Test Treatment

Grass hay was fed on the day of arrival; corn silage and a pelleted protein supplement for the next six days; high-moisture corn, corn silage and protein after day seven. Oxytetracycline and neomycin were included in the drinking water for the first six days in an amount sufficient to provide 700 and 500 mg per steer per day, respectively. On the sixth day the cattle were vaccinated for Infectious Bovine Rhinotracheitis (IBR), Bovine Virus Diarrhea (BVD) and for clostridial infections including Blackleg and Malignant Edema. At the time of vaccination, they were tattooed and ear-tagged with Ritchey tags.

Design of the Test

On May 5 the cattle were randomly assigned, within weight groups, to Lots 1B, 2B, 8, 9, 10, 11 and 12. Their preliminary weights obtained on April 28 were used. The cattle were fed a finishing ration consisting of 69% high-moisture corn, 27% corn silage and 4% of a pelleted protein supplement (included diethylstilbestrol; added to provide 10 mg per head per day). Average moisture and crude protein (dry basis) of the high-moisture corn, corn silage and protein supplement were: 21.0% and 10.4%; 58.7% and 7.0%; and 9.9% and 48.4%, respectively. The steers were fed once a day until July 2, twice a day after that.

Cattle Performance

Overall, cattle performance was quite acceptable; however, as shown in Table 1, considerable variation existed between lots. Average daily gain (A.D.G.) ranged from 2.71 to 1.80 lb and feed efficiency from 824 to 991 lbs of dry matter (D.M.) per 100 lb of gain.

Outside Lots (1B & 2B). Cattle fed in the outside lot with shade (Lot 1B) gained .14 lb per day faster and required 39 lbs less dry matter per 100 lbs. of gain than those not provided shade, however, the difference was not significant. Performance of cattle in Lot 1B was essentially equal to the average of the open-front-and-rear confinement barn cattle (2.61 vs. 2.63 lbs/A.D.G. and 875 vs. 845 lb D.M./100 lb gain for Lot 1B vs. the average of Lots 8, 9 and 10).

Open-Front-and-Rear Confinement Barn (Lots 8, 9 & 10). Average daily gain and feed conversion among the three open-front barn lots of cattle were essentially equal. These cattle were the fastest and most efficient gaining on test.

Totally-Enclosed Confinement Barn (Lots 11 & 12). The cattle in Lots 11 and 12 gained significantly slower ($P<.05$) than all other lots of cattle; however, the difference between these two barn lots was not significant. As shown in Table 1, those cattle fed in the evaporative-cooled Lot 11 had a relatively satisfactory feed conversion in spite of the lower average gain. Humidity in this lot was high and mildew and cobwebs formed on the walls. Lot 12 in this confinement barn had an exhaust fan but no evaporative cooler. In extremely hot weather, the temperature in Lot 12 often exceeded 70° during the night. The poor average daily gain (1.80 lbs) and feed conversion (991 lbs D.M./100 lb gain) of these cattle would indicate that they were under much stress. This is supported by temperature and humidity data shown in Table 2.

Table 1. Cattle Performance, Summer Test, 1970

	Lot							
	1B	2B	8	9	10	11	12	All Lots
Number of head	38	38	16	16	16	16	16	156
Ending weight (8-20-70), lb	1034	1022	1035	1045	1060	1001	973	1025
Initial weight (5-5-70), lb	760	759	761	764	770	761	772	763
Total gain, lb/hd	274	263	274	281	290	240	201	262
A.D.G., lb/hd[a]	2.61[b]	2.47[b]	2.54[b]	2.64[b]	2.71[b]	2.23[c]	1.80[c]	–
Dry matter fed, lb/hd/day	22.4	22.5	22.6	21.8	22.3	18.7	18.6	21.6
Dry matter fed, % of body weight	2.5	2.5	2.5	2.4	2.4	2.1	2.1	2.4
Feed fed, lb/hd/day[d]								
Corn silage	8.9	8.9	9.0	8.6	8.9	7.5	7.4	8.6
High-moisture corn	22.2	22.3	22.4	21.7	22.2	18.5	18.5	21.5
Protein supplement	1.3	1.3	1.3	1.2	1.2	1.0	1.0	1.2
Feed fed, lb/cwt gain[e]	875	914	882	830	824	832	991	882
Total feed fed/hd								
Corn silage, lb	953	956	963	924	954	798	796	920
High-moisture corn, bu. of No. 2 corn	38.6	38.7	38.9	37.6	38.5	32.1	32.1	37.2
Protein supplement, lb	136	137	135	131	134	112	111	130
Carcass grade[a,f]	4.72[b]	4.59[b]	4.68[b]	4.49[b]	5.01[b]	4.14[c]	4.07[c]	–

[a]Average daily gain and carcass grade are adjusted for breed differences.
[b,c]Those lots with a common superscript are not significantly different ($P<.05$).
[d]"As fed" basis.
[e]"Dry matter" basis.
[f]U.S.D.A. carcass grades: 1 = G-, 2 = G, 3 = G+, 4 = Ch- and 5 = Ch°.

Table 2. T.H.I.[a] Hours, Summer Test, 1970

Lot	Weight Period 1	2	3	4	Total
9 (Open front and rear confinement barn)	1273	2009	3193	3100	9575
11 (Totally-enclosed confinement barn - evaporative cooled)	833	1600	2707	3147	8287
12 (Totally-enclosed confinement barn - exhaust fan)	1645	2700	4568	4971	13884

[a]Temperature-Humidity Index: Measure of comfort for humans but has been correlated with the production of certain animals. T.H.I. = .55 x dry bulb temperature + .2 x the dew point temperature + 17.5. These T.H.I. hours are above 70°.

Marketing

The test ended on August 20 and the cattle were sent to Royal Packing Co. of St. Louis, Missouri. During slaughter, lungs and livers were examined and a record made of abnormalties. After the carcasses had chilled 24 hours, they were graded by a federal grader and examined for bruises.

Carcass Grades and Visual Observations. As shown in Table

Table 3. Cattle Performance, Winter Test 1970-71

Item	Lot 2B	4	9	12	All Lots
Number of head	40	80	16	16	152
Ending weight (3-23-71), lb	1085	1088	1034	1019	1079
Initial weight (12-1-70), lb	762	779	766	765	772
Total gain, lb/hd	323	309	318	254	307
A.D.G., lb/hd[a]	2.97[b]	2.87[b]	2.75[b,c]	2.49[c]	–
Dry matter fed, lb/hd/day	21.8	21.3	20.3	20.8	21.3
Dry matter fed, % of body weight	2.4	2.3	2.2	2.3	2.3
Feed fed, lb/hd/day[d]					
Corn Silage	11.0	10.8	10.4	10.5	10.8
High-moisture corn	21.3	20.8	19.8	20.3	20.8
Protein supplement	1.1	1.0	1.0	1.0	1.0
Feed fed, lb/cwt gain[e]	757	773	716	918	777
Total feed fed/hd					
Corn silage, lb	1234	1211	1160	1178	1208
High-moisture corn, bu. of No. 2 corn	38.7	37.7	35.9	36.9	37.7
Protein supplement, lb	118	116	110	113	116
Carcass grade[a,f]	4.76[b]	4.86[b]	4.61[b,c]	4.20[c]	–

[a]Average daily gain and carcass grade are adjusted for breed differences
[bc]Those lots with a common superscript are not significantly different ($P<.05$)
[d]"As fed" basis
[e]"Dry matter" basis
[f]U.S.D.A. Carcass Grades: 1 = G, 2 = G°, 3 = G+, 4 = Ch- and 5 = Ch°

1, the slower gaining cattle in the totally-enclosed confinement barn (Lots 11 and 12) produced significantly lower grading carcasses; however, all lots of cattle averaged low Choice or higher. Among the 156 cattle that were slaughtered, two livers (1.3%) and four lungs (2.6%) were condemned. Seven sides of cattle were bruised. Those losses are far below the average among cattle.

Winter Test 1970-71

The winter test lasted 112 days, beginning December 1, 1970 and ending March 23, 1971.

Description of the Cattle

The cattle consisted of 163 Angus, Hereford and crossbred steers purchased on order and shipped from Lockwood, Missouri. Their weights ranged from 500 to 900 lbs on the initial weigh day.

Pre-Test Treatment

The steers were fed hay on the day of arrival and corn silage thereafter; a pelleted protein supplement was added on day five. Tetracycline Hydrochloride (Polyotic) was administered for the first week in the drinking water to provide 3 mg per pound of steer per day. On the eighth day, the steers were tattooed, ear tagged and vaccinated for IBR, BVD, Blackleg, Malignant Edema, Enterotoxemia and Parainfluenza.

Design of the Test

On December 1, 152 steers were randomly assigned, within weight groups, to Lots 2B, 4, 9 and 12. Eleven steers were excluded from the test because they were either too heavy or too light. All the cattle were fed the same ration: 70% high-moisture corn, 27% corn silage and 3% of a pelleted protein supplement. The supplement included diethylstilbestrol added to provide 10 mg per head per day. Average moisture and crude protein (dry basis) of the high-moisture corn, corn silage and protein supplement were: 21.5 and 11.0%; 62.4 and 7.8%; and 9.5 and 53%, respectively.

Cattle Performance

The health of the cattle was excellent and no deaths occurred. Average daily gain by lot ranged from 2.49 to 2.97 lb and feed conversion ranged from 716 to 918 lb of dry matter per 100 lb of gain (Table 3).

Outside, Flat Lot (Lot 2B). As indicated in Table 3, those cattle fed in the outside lot without a mound were the fastest gaining. However, the only significant difference was between the daily gain (2.97 lb) of cattle in Lot 2B and the daily gain (2.49 lb.) of cattle in Lot 12, the totally-enclosed lot.

Mounded Lot (Lot 4). Because of the mild winter the lots remained relatively dry; hence the mounded lot was not fully tested. Cattle performance was essentially equal to that in the other outside lot. Cattle used the mound when the lot was

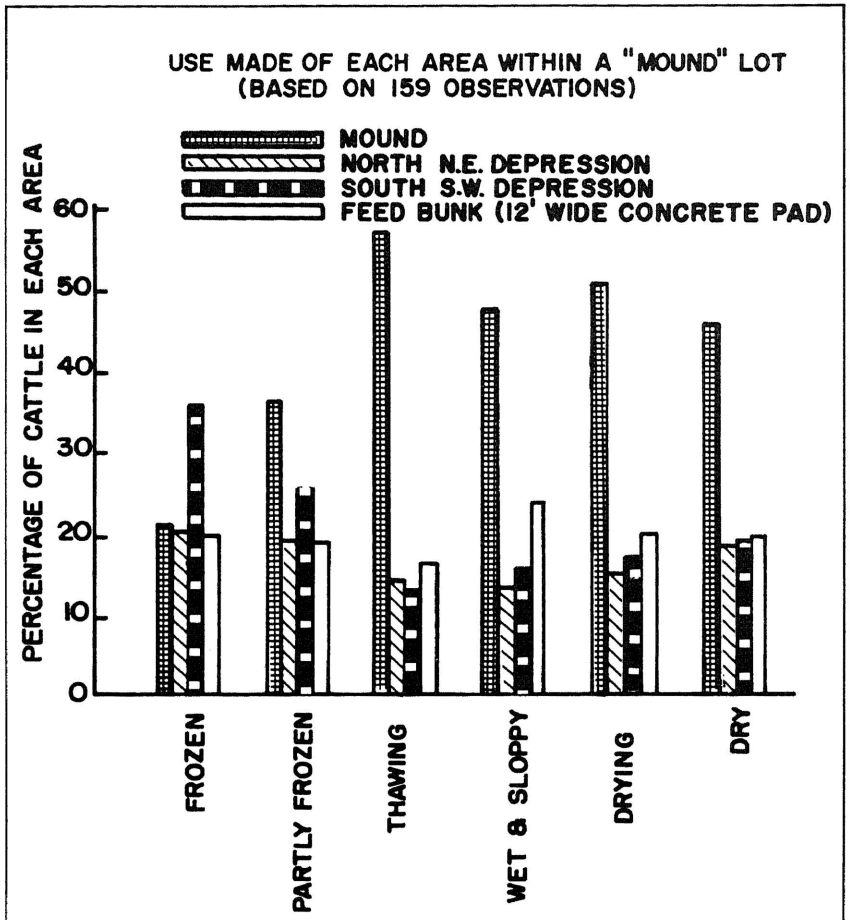


FIG. 4 EFFECT OF LOT CONDITION ON USE OF THE MOUND

muddy and sloppy due to rain, snow or thawing (Figures 4 and 5). They also used the mound as a windbreak during low temperatures and cold winds. When the ground was frozen or dry, the cattle used the entire lot.

Open-Front Confinement Barn (Lot 9). Although the rate of gain of cattle in Lot 9 was intermediate and not significantly

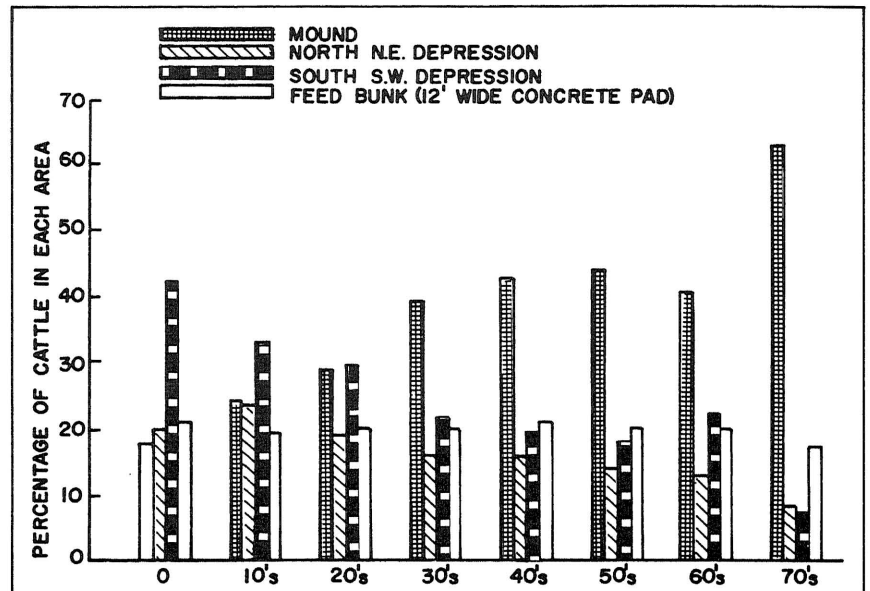


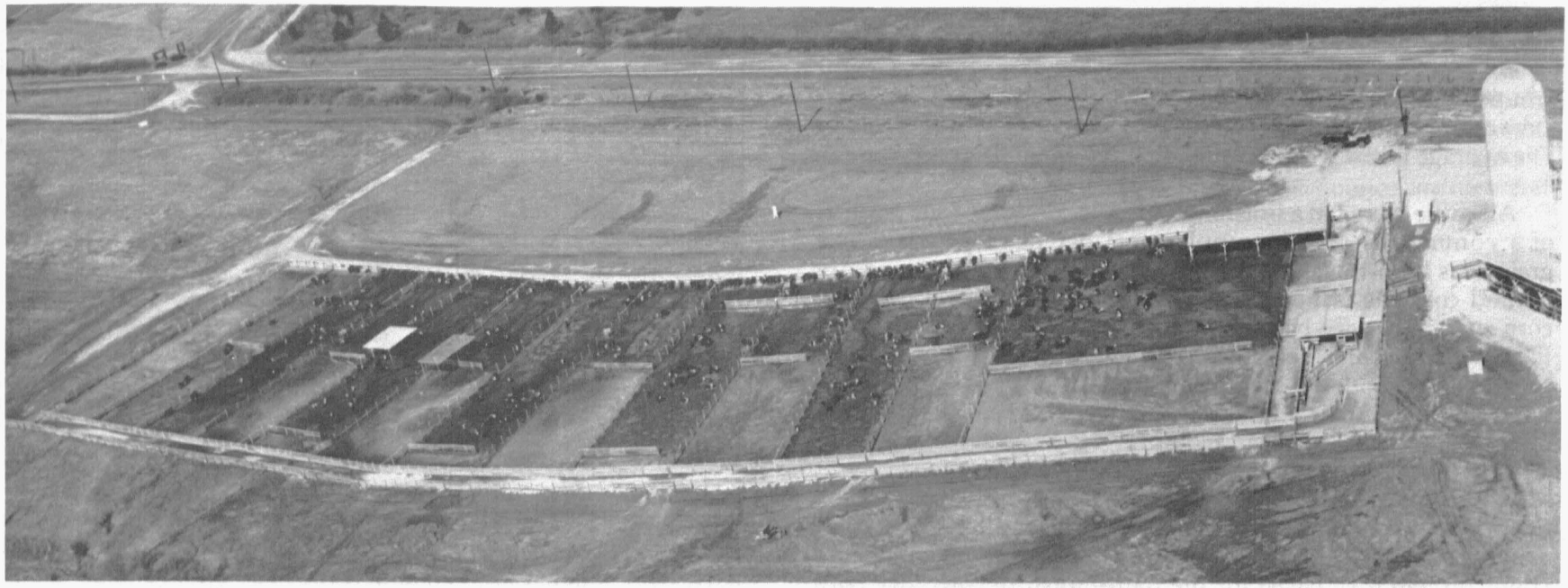
FIG. 5 EFFECT OF TEMPERATURE °F ON USE OF THE MOUND

different from that of cattle in the outside lots or those in the totally-enclosed barn, their feed conversion was substantially better. As shown in Table 3, the Lot 9 steers consumed the least dry matter per hundredweight; hence, it can be deducted that the cattle in the open front confinement barn must have used less energy for voluntary activity than the outside cattle.

Totally-Enclosed Confinement Barn (Lot 12). Cattle in Lot 12 had the lowest average daily gain (2.49 lbs) and the poorest feed conversion (918 lb D.M./100 lb gain). The cause(s) of this poor performance is unknown.

Marketing

The test ended on March 23. However, due to a field day held on April 2, the cattle were held over for the demonstration. The 80 steers in Lot 4 were shipped to Royal Packing Company of St. Louis, Missouri on April 16 and the remaining 72 head on April



22. Visual observations of the vital organs (lungs, liver and heart) were made during slaughter and carcass grades obtained the day after slaughter.

Carcass Grades and Visual Observations. Cattle finished in Lot 4 were the highest grading with all lots averaging low Choice as shown in Table 3. A statistical difference ($P<.05$) in average carcass grades was found between Lots 2B and 12 and between Lots 4 and 12. Four of the 152 steers slaughtered were found to possess abscessed livers; two each from Lots 2B and 4. Six sides were bruised (all from Lot 4) and two lungs condemned, one from Lot 2B and one from Lot 12.

Summer Test 1971

A 112-day trial that included 88 steers began July 7 and ended October 27, 1971.

Description of the Cattle

One hundred yearling steers, 90 Herefords and 10 Hereford-Angus crossbreds, were purchased at the Kansas City auction. A few of the cattle were horned.

Pre-Test Treatment

The cattle were delivered on June 18 and given access to grass hay and medicated water. High moisture corn, a commercial protein supplement[1] and hay were fed beginning on day two. Hay was fed for 12 days. Medication of the water with chlorotetracycline[2] was discontinued after five and one-half days since there was no sickness.

[1]Purina's BIR-4 (Built-In-Roughage). Use of this supplement does not in any way constitute endorsement of the product by the University of Missouri.
[2]Polyotic

Design of the Test

On July 7, 88 steers were allocated at random, within weight groups, to Lots 1B 9, 11 and 12 based on their July 1 weights. Extremely light and heavy cattle were excluded from the test. The average initial weight per lot on July 7 ranged from 717 to 726 lb.

All cattle were fed a finishing ration of corn plus four pounds of a commercial protein supplement[1] per head per day. The grain was high-moisture ground corn the first 62 days and dry shelled corn the last 50 days. The conversion from wet to dry corn was necessary because the concrete block silo had to be filled with the high-moisture corn when the crop was ready; thus, feeding from it had to be discontinued. The ration change was completed in five days (September 7-11, 1971) with only minor complications (some scouring).

Corn samples were analyzed monthly at the University of Missouri Experiment Station Chemical Laboratory to determine the percent moisture and protein. The protein supplement was analyzed per five-ton batch delivered. Average moisture and crude protein (dry basis) for the high-moisture corn, dry corn and the protein supplement were: 25.7% and 11.3%; 11.7% and undetermined; and 10.6% and 34.3%; respectively. The cattle were fed twice daily according to appetite, with the intent to keep some feed before the cattle at all times.

Cattle Performance

The general health of the cattle was excellent. No cattle died and only a few had minor colds which seemed to follow abrupt changes in the weather. About 30% of the cattle contacted pinkeye shortly after arrival at the feedlot. These cattle were treated on June 29 and most animals had recovered by July 13. Some steers had loose stools for a short time after the ration was changed from high-moisture to dry corn.

The average daily gain for all cattle was 2.96 lb for the 112-day test and the carcasses averaged low Choice. Although not statistically analyzed, feed efficiency is indicated in Table 4.

Table 4. Cattle Performance, Summer Test 1971

Item	Lot 1B	Lot 9	Lot 11	Lot 12	All Lots
Number of Head	40	16	16	16	88
Ending weight (10-27-71), lb	1059	1037	1015	1051	
Initial weight (7-7-71), lb	718	726	720	717	720
Total gain, lb/hd	341	356	317	298	331
A.D.G., lb/hd	3.04[a,b]	3.18[a]	2.83[b,c]	2.67[c]	2.96
Dry matter fed, lb/hd/day	19.9	18.6	17.6	17.2	18.8
Dry matter fed, % of body weight	2.2	2.1	2.0	2.0	2.1
Feed fed, lb/hd/day[d]					
Corn, grain	18.7	17.2	16.1	15.7	17.4
Protein supplement	4.1	4.0	4.0	4.0	4.0
Feed fed, lb/cwt gain[b]	655	584	623	644	634
Total feed fed/hd					
Corn (grain), bu. of No. 2 corn	37.3	34.4	32.2	31.3	34.8
Protein supplement, lb	458	449	459	442	452
Carcass grade[f]	3.85[a]	4.75[b]	4.81[b]	4.38[a,b]	4.28

[a,b,c]Those lots with a common superscript are not significantly different (P<.05)
[d]"As fed" basis
[e]"Dry matter" basis
[f]U.S.D.A. carcass grades: 1 = G-, 2 = G°, 3 = G+, 4 = Ch- and 5 = Ch°

Outside Lot (Lot 1B). Cattle fed in the outside lot with shade gained significantly faster (P<.05) than those in the enclosed barn with exhaust fan ventilation (Lot 12—3.04 vs. 2.67 lb/day gain. However, feed efficiency was poorer for the cattle in Lot 1B (655 vs. 644 lb D.M./100 lb gain).

The outside cattle gained slightly less than those in the open-front-and-rear confinement Lot 9 (3.04 vs. 3.18 lb/day) and more than those in the evaporative-cooled Lot 11 (3.04 vs. 2.83 lb/day); however, neither difference was significant.

Open-Front-and-Rear Confinement Barn (Lot 9). The cattle in Lot 9 were the fastest gaining (3.18 lb/day) and most efficient converters (584 lb feed/100 lb gain) on test. The cattle in the open-front-and-rear confinement barn gained .43 lb more per day than those in the totally-enclosed confinement barn (Lots 11 and 12)—3.18 vs. 2.75 lb/day. The difference was significant (P<.05).

Totally-Enclosed Confinement Barn (Lots 11 & 12). As in previous tests, the cattle fed in the enclosed barn without the evaporative cooler (Lot 12) made the slowest average daily gains of all (2.67 lb/day). Differences in gain between the cattle in the evaporative-cooled lot and those in the exhaust-fan-ventilated

Table 5. Carcass Data, Summer Test 1971

Item	Lot 1B	9	11	12	All Cattle
Number of head	40	16	16	16	88
Days on feed	137	139	139	139	
Date of slaughter	Nov. 2	Nov. 4	Nov. 4	Nov. 4	
Live weight, lb	1076	1083	1053	1017	1062
Chilled carcass weight, lb[a]	648	663	641	627	646
Dressing percent	60.2	61.2	60.9	61.7	60.8
No. abscessed livers	4	2	0	3	9
No. condemned lungs[b]	3	3	1	1	8
No. carcasses bruised[c]	10	6	6	2	24

[a]The chilled carcass weight of Lot 1B is an actual weight and represents a 2.58 percent shrink. Actual chilled weights of Lots 9, 11 and 12 were not obtained; therefore, they were calculated based upon the same shrink as those carcasses from Lot 1B.
[b]Includes only those lungs condemned due to infection or indications of previous infections.
[c]According to a U.S.D.A. grader. Most, however, were due to grub damage.

Table 6. Performance of Steers with Liver Abscess, Summer Test 1971

Lot	Steer No.	Total Gain lb	A.D.G. lb	Ending wt. lb 10-27-71
1B	81	273	2.44	1080
1B	83	297	2.65	992
1B	89	349	3.12	1126
1B	95	348	3.11	1060
Avg. (4 hd)		317	2.83	1065
1B Avg. (40 hd)		340	3.04	1059
9	18	342	3.05	994
9	70	314	2.80	994
Avg. (2 hd)		328	2.93	994
9 Avg. (16 hd)		356	3.18	1082
12	55	306	2.73	1026
12	66	299	2.67	1075
12	97	320	2.86	1020
Avg. (3 hd)		308	2.75	1040
12 Avg. (16 hd)		299	2.67	1015
Avg. Abscessed Liver Steers (9 hd)		316	2.83	1041
Avg. All Test Cattle (88 hd)		331	2.96	1051

lot were not significant. However, cattle in Lot 11 gained 100 lb on 22 lb less dry matter (622 vs. 644 lb).

The combined performance (A.D.G.) of cattle in Lots 11 and 12 was significantly less ($P<.05$) than the gain made by cattle in the outside lot (2.75 vs. 3.04 lb/day). Data in Table 4 indicate that the appetities of cattle in Lots 11 and 12 were not good, compared to other lots of cattle. As a consequence, gains were slower.

Marketing

The test ended on October 27, 1971 and the cattle were slaughtered on November 2 and 4. The cattle were weighed on arrival at the slaughter plant. Individual hot carcass weights and visual observations of vital organs (lungs, heart and liver) were recorded. U.S.D.A. carcass grades were obtained the day after slaughter.

Carcass Grades. The outside cattle (Lot 1B) graded significantly lower ($P<.05$) than those in the open-front-and-rear confinement barn (Lot 9) and those in the totally-enclosed confinement barn with the evaporative cooler (Lot 11)—3.85 vs. 4.75 and 4.81, respectively. Although not statistically different the Lot 1B cattle also graded lower than those cattle in the totally-enclosed barn lot with the exhaust fan (3.84 vs. 4.38). An explanation is not available for a comparatively low percentage of those in Lot 1B grading Choice or higher (42.50% vs. 69 to 88% for the other lots).

Slaughter Weights and Visual Observations. The cattle averaged 1062 lbs upon arrival at Royal Packing Company. The average hot carcass weight was 663 lb. A pencil shrink of the hot carcass weight was used to determine the average dressing percentage of 60.8 (see Table 5).

Nine steers (10.2%) had abcessed livers. Although the incidence of bad livers was low for all lots, there were no liver abcesses in cattle from the evaporative-cooled Lot 11 (Table 5). Gains made by those steers with condemned livers are shown in Table 6. There was no correlation of abcessed livers with poor cattle performance.

The number of carcasses damaged by grubs (Table 5) was extremely high, averaging 27%.

Winter Test 1971-72

Various feedlot facilities were compared from December 14, 1971 to April 18, 1972 (126 days).

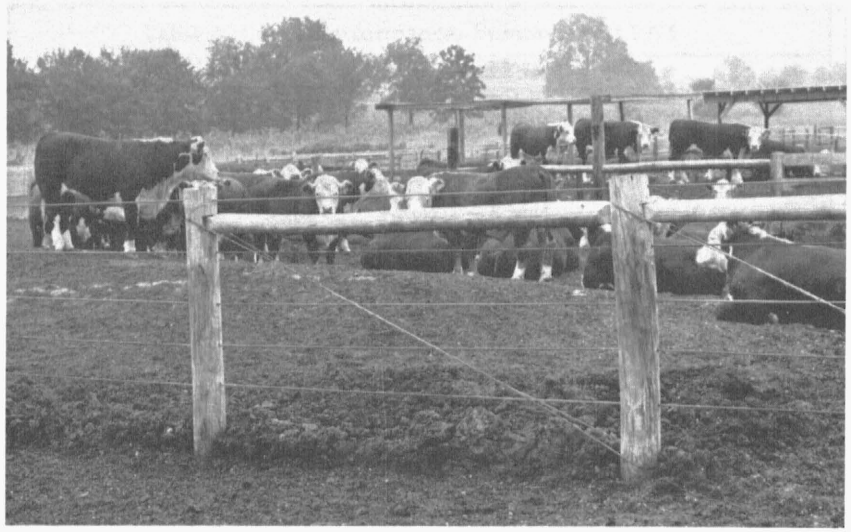
Description of the Cattle

One hundred ninety-six black white-faced yearling steers were used; some were of dairy breeding. The cattle were thin and lacked uniformity in conformation and size.

Pre-Test Treatment

The cattle were delivered on November 16 and given access to grass hay and medicated water. In previous tests, hay was fed only for one day and then corn silage was fed. In this test, the silo unloader failed and until it was repaired on day four, hay was fed. High-moisture corn was added to the ration on day five and a pelleted protein supplement on day 15. Normally the protein supplement would have been fed with the corn silage from the beginning; but in this case it was delayed because a bulk storage bin was not available at the start of the test. Medication of the water with chlorotetracycline (Polyotic) was discontinued after five days since there was no sickness and the cattle seemed thrifty. The treatment level was approximately one mg of drug per lb of body weight.

The cattle were vaccinated and identified on November 22 and 23. Vaccines included IBR, BVD, Leptospirosis, Blackleg and Malignant Edema. Steers were identified with a tattoo and a rubber ear tag. A check weight of each steer was obtained on December 2. At that time, the cattle averaged 727 lb and the range was 408 lb; from 484 to 892 lb.



This limestone covered mound in Lot 4 gave the cattle a dry place to rest. In the background is a shade in Lot 5.

Design of the Test

Cattle were assigned at random within weight groups, based on their December 2 weight, to Lots 2A, 4, 8, 9, 10, 11 and 12. Average initial weight per lot on December 14 ranged from 771 to 783 pounds. All cattle except those in Lot 10 were fed a finishing ration for the entire test. The ration consisted of 70% high-moisture corn, 27% corn silage and 3% protein supplement (diethylstilbestrol included as 10 mg/lb) on an "as fed" basis. Cattle in Lot 10 were fed a growing ration of corn silage plus a protein supplement (97% and 3%, respectively) for the first 84 days of the test. After that, they were changed to the high-moisture corn ration.

Samples of the high-moisture corn and corn silage were analyzed monthly at the University of Missouri Experiment Station Chemical Laboratory to determine percent moisture and protein. The pelleted protein supplement was analyzed per batch delivered from the UMC Feedmill rather than on a

Table 7. Cattle Performance, Winter Test 1971-72

Item	2A	4	8	9	Lot 10a	11	12	All Lots
Number of head	40	78.4[b]	15	15	16	16	15	195.4
Ending weight (4-18-72), lb	1112	1095	1060	1077	1103	1047	1035	1087
Initial weight (12-14-71), lb	773	776	781	773	778	783	784	777
Total gain, lb/hd	339	320	279	304	325	264	251	310
A.D.G., lb/hd	2.69[c]	2.54[c,d]	2.21[e,f]	2.41[d,e]	2.58[c,d]	2.09[e,f]	1.99[f]	2.46
Dry matter fed, lb/hd/day	18.6	19.4	16.5	17.3	18.8	17.3	17.4	18.5
Dry matter fed, % of body weight	2.0	2.1	1.8	1.9	2.0	1.9	1.9	2.0
Feed fed, lb/hd/day[a]								
High-moisture corn	19.5	20.2	17.2	18.0	6.7	17.9	18.2	18.1
Corn silage	7.5	7.8	6.7	6.9	35.5	6.9	7.0	10.0
Protein supplement	.8	.9	.7	.8	1.3	.8	.8	.9
Feed fed, lb/cwt/gain[b]	690	762	744	719	729	824	873	750
Total feed fed/hd								
High-moisture corn, (bu. No. 2 corn)	39.2	40.8	34.7	36.6	10.9	36.5	36.7	36.6
Corn silage, lb	943	982	835	878	4868	876	882	1257
Protein supplement, lb	105	109	93	98	172	97	98	109
Carcass grade[i]	5.00[c]	5.04[c]	5.20[c]	4.73[e]	4.88[c]	5.25[c]	4.60[c]	4.99

[a]All cattle except those in Lot 10 were fed a finishing ration for the entire period (70% H.M.C., 27% corn silage and 3% protein supplement). Lot 10 cattle received a growing ration the first 84 days (97% corn silage and 3% protein supplement).
[b]One steer died in Lot 4 on March 5. The data are representative of 79 hd. for the first 56 days and 78 hd. for the next 70 days. Ending weight is a 78 hd. average; total gain represents 79 hd.
[cdef]Those lots with a common superscript are not significantly different (P<.05).
[a]"As fed" basis.
[b]"Dry matter" basis.
[i]U.S.D.A. carcass grades: 1 = G-, 2 = G°, 3 = G+, 4 = Ch-, 5 = Ch° and 6 = Ch+.

monthly basis. Average moisture and crude protein (dry basis) for the high-moisture corn, corn silage and protein supplement were: 21.9 and 10.2%; 64.7 and 7.9%; and 9.6 and 46.3%, respectively. The cattle were fed once daily according to appetite. The intent was to keep some feed before the cattle at all times.

After 84 days, cattle in Lot 11 were given free access to an adjoining outside alley. This change was made in an attempt to determine if the poor performance of steers in Lots 11 and 12 was due to detrimental environmental conditions in the totally-enclosed lots.

Cattle Performance

During the first 28 days on test, many cattle scoured and the amount of feed they consumed fluctuated greatly. Results of a fecal sample study conducted by the UMC Veterinary Clinic indicated that the cattle were "wormy". All of the cattle were treated for internal parasites on February 11 (32nd day) with Thiabenzole pellets at the rate of .1 lb per 100 lb of body weight.

On March 5 (83rd day of test) a steer in Lot 4 died from bloat. Four steers originally assigned to the test were removed from Lots 4, 8, 9 and 12 due to extreme weight losses. Their performance prior to removal from test was excluded from the test. During the 1971-72 winter test the weather was relatively mild and did not greatly affect cattle performance in the outside lots.

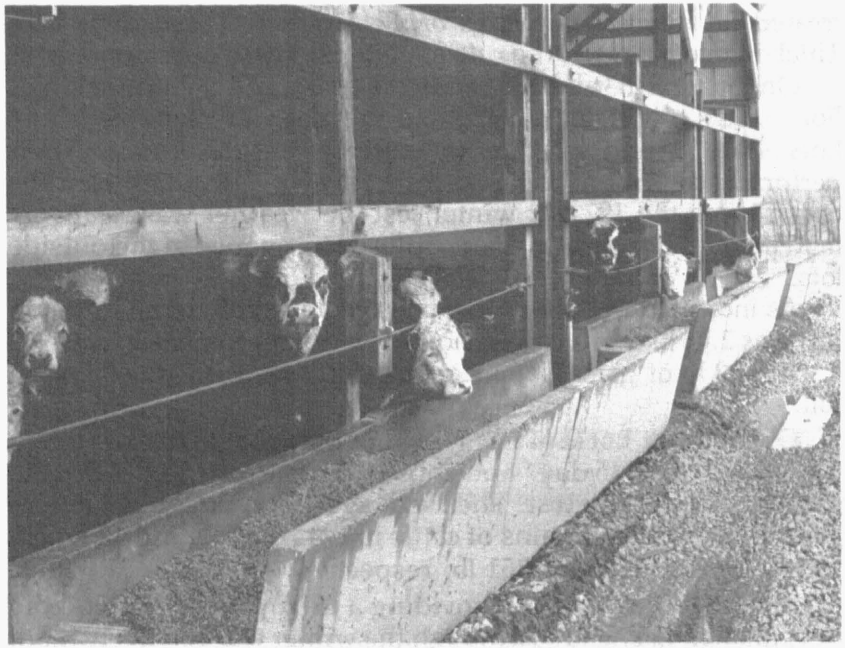
As indicated in Table 7 the average daily gain of all cattle on test was 2.46 lb. Feed conversion, on a dry matter basis, was 750 lb per 100 lb of gain. The steers graded average Choice on the rail.

Outside Flat Lot (Lot 2A). Cattle in the outside flat lot gained the fastest (2.69 lb/day) and most efficient (690 lb/D.M./100lb gain) of all cattle on test. Their average total gain of 339 lb was greater (P<.05) than gains of cattle in Lots 8, 9, 11 and 12 which were 279, 304, 264 and 251 lb, respectively.

Mounded Lot (Lot 4). Providing a mound for the cattle did not enhance daily gain. Although the winter was relatively mild, at times the lots became quite sloppy. Cattle in the mounded lot were slower gaining (2.54 vs. 2.69 lb/day) and less efficient (762 vs. 690 lb D.M./100 lb gain) than those in the flat lot (Lot 2A) even though they were fed 8 lb more dry matter per day (19.4 vs. 18.6 lb).

Outside Lots (Lots 2A & 4). Statistical comparison revealed that cattle in the outside lots gained faster (P<.05) than those in the confinement barns (2.59 lb. vs. 2.31 and 2.04 lb for Lots 2A and 4, 8 and 9, and 11 and 12, respectively). However, there was essentially no difference in feed conversion between cattle in the outside lots and those in the open-front confinement barn (737 vs. 731 lbs/D.M./100 lb gain for Lots 2A and 4, and 8 and 9, respectively).

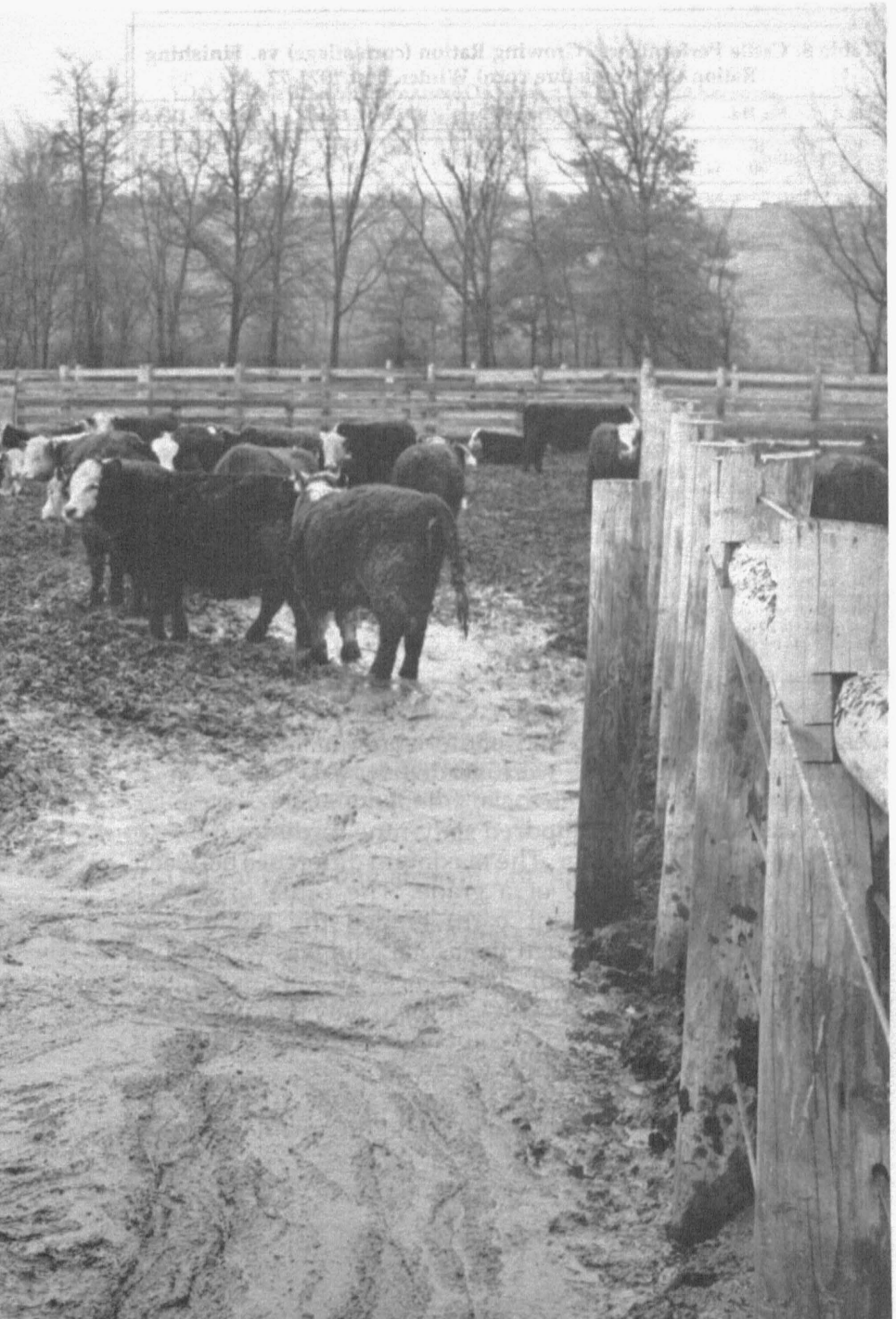
Open-Front Confinement Barn. (Lots 8 & 9). Cattle in the open-front confinement barn (Lots 8 and 9) gained faster (P<.05) than those in totally-enclosed confinement (Lots 11 and 12); however, average daily gains were relatively low (2.31 vs. 2.04 lb, respectively). Dry matter consumption by cattle in the

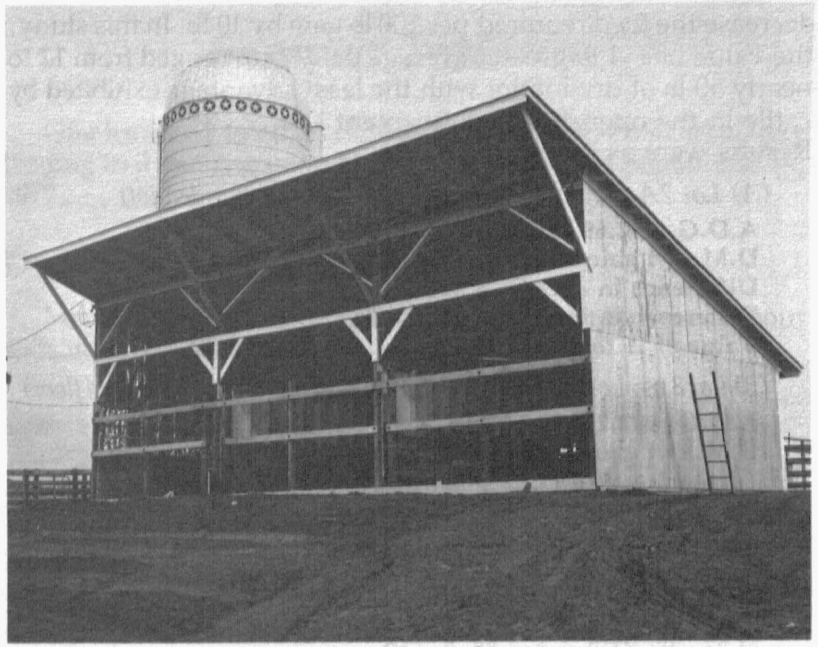


Cattle performance in the open front barn was acceptable. RIGHT: An unusually wet fall and spring caused poor performance in outside lots during the 1972-73 winter test.

open-front confinement barn was low compared to those in the outside lots (16.9 vs. 19.1 lb D.M./hd/day for Lots 8 and 9 vs. 2A and 4, respectively), which may partially explain the below-average gains. The degree of slotted floor in the confinement barn (one-third in Lot 8 and two-thirds in Lot 9) did not affect cattle performance.

Totally-Enclosed Confinement Barn (Lots 11 & 12). As in previous tests, cattle in Lots 11 and 12 did not perform satisfactorily. Gains were significantly less ($P<.05$) than for most of the other lots of cattle as indicated in Table 7. Feed consumption, although lower than desired, was equal to that of the cattle in the open-front barn (17.4 vs. 16.9 lb D.M./hd/day for Lots 11 and 12 vs. Lots 8 and 9, respectively).





Roof design of the open-front barn provided maximum shade during summer and maximum sun during winter. Pen floors were one-third, two-thirds, and totally slotted.

Growing Versus Finishing Ration. Cattle fed the corn silage ration the first 84 days (Lot 10) and then the finishing ration gained .27 lb more per day than cattle fed the finishing ration for the entire test period (Lots 8 and 9). It should be noted, however, that these were thin, large framed cattle at the beginning of the test and consequently capable of consuming large amounts of roughage. Decreased performance during the last 42 days suggests that rumen fill may account for some of the superior gains made by the cattle in Lot 10 during the first 84 days on feed (Table 8).

Feed Efficiency. Generally, as the rate of gain increases, the efficiency of converting feed to gain increases. Some cattlemen use the rule-of-thumb that a .1 lb increase in A.D.G. will

decrease the feed required per 100 lb gain by 10 lb. In this study, the value of a .1 lb greater average daily gain ranged from 12 to nearly 50 lb of dry matter with the least advantage exhibited by cattle in the open-front confinement lots.
Results were as follows:

(A) Lot 2A vs. Lot 4 (Outside flat lot vs. mounded lot)

A.D.G. = 2.69 vs. 2.54 lb
D.M./cwt gain = 690 vs. 762 lb
Difference in A.D.G. = .15 lb
Difference in D.M./cwt gain = 72 lb
Value of .1 lb greater A.D.G. = 48 lb less D.M./cwt gain

(B) Lot 8 vs. Lot 9 (Open-front confinement—⅓ vs. ⅔ slotted floor)

A.D.G. = 2.21 vs. 2.41 lb
D.M./cwt gain = 744 vs. 719 lb
Difference in A.D.G. = .2 lb
Difference in D.M./cwt gain = 25 lb
Value of .1 lb greater A.D.G. = 12.5 lb

(C) Lot 11 vs. Lot 12 (Totally-enclosed confinement)

A.D.G. = 2.09 vs. 1.99 lb
D.M./cwt gain = 824 vs. 873 lb
Difference in A.D.G. = .1 lb
Difference in D.M./cwt gain = 49 lb
Value of .1 lb greater A.D.G. = 49 lb

Table 8. Cattle Performance, Growing Ration (corn silage) vs. Finishing Ration (high-moisture corn) Winter Test 1971-72

Lot	No. Hd.	Ration	First 84 Days	Last 42 Days	Total 126 Days
10	16	Growing[a]	2.95	1.84	2.58
8 & 9	30	Finishing	2.52	1.90	2.31

[a]After 84 days these cattle were changed from the corn silage growing ration to the high-moisture corn finishing ration.

Table 9. Carcass Data, Winter Test 1971-72

	Lot							
	2A	4	8	9	10[a]	11	12	All Lots
No. head	40	78	15	15	16	16	15	195
Days on feed	174	174	167	167	167	167	167	
Date of slaughter	May 4	May 4	Apr. 27	Apr. 27	Apr. 27	Apr. 27	Apr. 27	
Live weight, lb	1133	1125	1079	1086	1120	1076	1012	1107
Chilled carcass wt, lb[b]	702	702	669	683	691	665	653	690
Dressing percent	62	62.4	62	62.9	61.7	61.8	64.5	62.3
No. abscessed livers	1	5	0	0	0	0	1	7
No. carcasses bruised[c]	3	6	3	3	1	6	5	27

[a]These cattle were fed a corn silage ration for 84 days.
[b]Estimated via a 2% pencil shrink of the hot carcass weight.
[c]According to the U.S.D.A. grader. Many, however, may be due to grub damage.

Marketing

The 126-day test ended on April 18. The confinement cattle were marketed on April 27, those from the outside lots on May 4. Although slaughter of all cattle on April 18 was desired, it is highly unlikely that the difference of seven days between slaughter groups had any significant effect on carcass grade. During the post-test period the ration was unchanged except for the withdrawal of diethylstilbestrol seven days prior to slaughter. The total number of days on feed (Pretest, Test and Post-test periods) was 167 and 174 days for the confinement barn and outside cattle, respectively.

Live weights by lot were obtained upon arrival at the slaughter plant. A record was made of individual hot carcass weights, bruised carcasses and of any abnormalities of lungs, heart and liver. Carcasses were graded by a U.S.D.A. meat grader the day after slaughter.

Carcass Grades. One hundred sixty-nine carcasses (86.7%) graded low Choice or higher. The maximum difference between lots was approximately .2 of a grade. The cattle in Lot 11 (totally-enclosed confinement barn) graded the highest, as shown in Table 8, even though their total gain was well below the average (264 vs. 310 lb). Differences in carcass grades between lots were not significant. Cattle fed only the corn silage ration for the first 84 days were competitive with those receiving high-moisture corn with respect to carcass grade.

Slaughter Weights and Visual Observations. The average live weight of all cattle on arrival at the slaughter plant was 1,107

Table 10. Performance Of Steers With Liver Abscesses, Winter Test 1971-72

Lot	Steer No.	A.D.G., lb	Ending Wt., lb[a] 4-18-72
2A	12	2.65	1046
2A Avg. (40 hd.)		2.69	1112
4	68	2.25	1055
4	83	1.78	982
4	160	2.17	1018
4	183	4.01[b]	1293
4	197	3.54	1156
4 Avg. (5 hd.)		2.75	1101
4 Avg. (79 hd.)		2.54	1095
12	180	2.21	990
12 Avg. (15 hd.)		1.99	1035
Avg. Abscessed Liver Steers (7 hd.)		2.66	1077
Avg. All Test Cattle (196 hd.)		2.46	1087

[a]Overnight shrunk weight
[b]Highest gaining steer on test

lb. Hot carcasses averaged 704 lb and the average dressing percent was 62.3 based on a 2% pencil shrink of the hot carcass weight. The dressing percentages were about the same for all lots of cattle, except those in Lot 12 (Table 9). There seems to be no logical explanation for the relatively high dressing percentage of cattle in Lot 12.

The lungs of one steer in Lot 10 were condemned due to pneumonia. The incidence of abcessed livers was a very low 3.6% (7 abcessed) with only one abcessed liver occurring among the confinement barn cattle (Lots 8, 9, 10, 11 and 12). Table 10 shows the daily gains made by those steers with condemned livers. The average daily gain was 2.66 lb or .2 lb more than the average of all cattle; however, four of the seven steers with abcessed livers gained slower than the average. The incidence of liver abcesses did not correlate with cattle performance in this study.

Summer Test 1972

One hundred twelve yealing steers were used in a 112-day feeding trial that began on May 30 and ended on September 19, 1972.

Description of the Cattle

Most of the cattle were Hereford or Angus; however, about 15% were crossbreds.

Pre-Test Treatment

One hundred thirty-six yearling steers were delivered to the feedlot from Sedalia, Missouri on May 13. The cattle had been fed a rather high-energy ration. Upon arrival, they were given access to grass hay and water. Corn silage and a protein supplement were fed on the second day and hay was discontinued.

All of the cattle were vaccinated and indentified on May 22. Vaccines included IBR, BVD and Clostridial infections including Blackleg and Malignant Edema. Identification included a tattoo and a plastic ear tag. A check weight was obtained on May 26.

Pre-Test Performance

The average shrink from pay weight at Sedalia to the feedlot (175 miles) was 46 lb (5.5%). On May 30, the cattle weight 845 lb which represented an average daily gain of 2.82 lb or essentially a return to pay weight after 17 days.

Design of the Test

On May 30, 188 steers were allocated at random within weight groups to Lots 1B, 5B, 9, 10 and 11 based on their May 26 weights which ranged from 638 to 1034 lb. Cattle with extremes in weight were not used. The maximum spread in average initial

weight by lot was 7 lb. Both the initial and ending weights of the cattle were obtained from an average of two weights taken 48 hours apart.

All of the cattle were fed alike. Corn silage was fed *ad libitum* for the first 62 days of the test. This ration included 3% of a 40% protein supplement (UMC No. 2) on an "as fed" basis. Beginning on July 31, the cattle were switched (over a 15 day period) to a high energy ration of high-moisture corn plus a roughage-bearing protein supplement (90% high-moisture corn and 10% protein supplement on an "as fed" basis). The cattle received the high energy ration for 35 days (August 15 to September 19).

Corn silage and high-moisture corn samples were analyzed monthly to determine the percent moisture and crude protein. The protein supplements were analyzed per batch delivered to the feedlot rather than on a monthly basis. Average moisture and crude protein (dry basis) of the corn silage, high-moisture corn, UMC No. 2 protein supplement, and the roughage-bearing protein supplement were: 64.8 and 6.9%; 23.1 and 11.0%; 8.2 and 44.9%; and 9.0 and 35.0%, respectively.

Cattle Performance

The health of the cattle was excellent; no deaths occurred. Several of the cattle (10 to 20%) developed pinkeye during July and August. Those cattle were treated and most individuals cleared up within a few days. All of the cattle were wormed with Thiabendazole on June 6.

The cattle gained 1.95 lb per day for the 112-day test. Dry matter required per 100 lb of live weight gain averaged 942 lb (Table 11). The exact cause(s) of the relatively poor cattle performance was uncertain. The cattle in the summer, 1972 test were "warmed up" before purchase, a highly influential factor on test results. Dry matter intake was less than anticipated, averaging 1.9% of body weight. Other factors responsible for the poor cattle performance included: (1) a high heat increment due to the corn silage consumption and (2) poor quality high-moisture corn (lacked palatability).

Table 11. Cattle Performance, Summer Test 1972

	Lot					
	1B	5B	9	10	11	All Lots
No. of head	40	40	8	16	8	112
Ending weight (9-19-72), lb	1080	1061	1077	1062	1021	1066
Initial weight (5-30-72), lb	847	845	866	848	851	848
Total gain, lb/hd	233	216	211	214	170	218
A.D.G., lb/hd	2.08[a]	1.93[b]	1.88[a,b]	1.91[a,b]	1.52[c]	1.95
Dry matter fed, lb/hd/day	18.8	18.5	17.6	18.1	16.5	18.3
Dry matter fed, % of body weight	2.0	1.9	1.8	1.9	1.8	1.9
Feed fed, lb/hd/day[d]						
High-moisture corn	9.5	9.2	8.5	8.7	8.0	9.1
Corn silage	28.3	27.9	27.1	28.0	25.2	27.8
Protein supplement	1.7	1.7	1.7	1.7	1.6	1.7
Feed fed, lb/cwt/gain[e]	903	960	939	950	1091	942
Total feed fed, /hd						
High-moisture corn, bu No. 2 corn	16.7	16.3	15.1	15.4	14.2	16.1
Corn silage, lb	3174	3119	3039	3133	2818	3114
Protein supplement, lb	195	191	187	193	183	192
Carcass grade[f]	5.03[a]	4.43[a]	4.75[a]	4.94[a]	5.00[a]	4.78

[abc]Those lots with a common superscript are not significantly different (P<.05).
[d]"As fed" basis
[e]"Dry matter" basis
[f]U.S.D.A. carcass grades: 1 = G-, 2 = G°, 3 = G+, 4 = Ch-, 5 = Ch°, 6 = Ch+

Outside, Flat Lot (Lots 1B & 5B). Cattle in the outside lots gained .11 lb more per day and were slightly more efficient than cattle in the open-front-and-rear confinement barn (Lots 9 and 10). The outside cattle gained significantly faster (P<.05) than those in totally-enclosed confinement (2.01 vs. 1.52 lb, for Lots 1B and 5B vs. Lot 11, respectively). A difference in average daily gain of .15 lb between Lots 1B and 5B significantly favored the cattle in 1B (P<.05). Daily gains were 2.08 and 1.93 lb, respectively.

Open-Front-and-Rear Confinement Barn (Lots 9 & 10). The cattle in Lots 9 and 10 gained .38 lb per day faster (P<.05) than those cattle in the totally-enclosed barn (evaporative cooled Lot 11). Average daily gains were 1.88 and 1.91 lb for cattle in Lots 9 and 10, respectively, vs. 1.52 for cattle in the evaporative-cooled lot.

Totally-Enclosed Confinement Barn With An Evaporative Cooler (Lot 11). Cattle performance in Lot 11 was extremely poor

Table 12. Cattle Performance, Open-Front Barn vs. Totally-Enclosed Barn, Summer Test 1972

PERIOD	Lot	9		11	
	Group[1]	A	B	C	D
1st 28 days		2.44	2.39	1.44	1.38
2nd 28 days	A.D.G. lb	1.50	1.11	1.28	1.28
1st 56 days		1.97	1.75	1.36	1.33
	Group	A	D	C	B
3rd 28 days		1.82	2.25	1.30	1.29
4th 28 days	A.D.G. lb	1.75	2.36	2.04	2.00
2nd 56 days		1.79	2.30	1.67	1.64
Total Test Period	Lot	9		11	
	A.D.G. lb	2.29		1.50	
	Group	A	B	C	D
	A.D.G. lb	1.88	1.70	1.51	1.82

[1]Each group consisted of eight head. At end of 56 days, half of the cattle in lot 9 were transferred to lot 11 and half of those in lot 11 to lot 9.

Table 13. Carcass Data, Summer Test 1972

	Lot					
	1B	5B	9	10	11	All Lots
No. head	40	40	8	16	8	112
Days on feed	139	138	137	137	137	
Date of slaughter	Sept. 29	Sept. 28	Sept. 27	Sept. 27	Sept. 27	
Live weight, lb	1070	1047	1050	1054	1012	1051
Chilled carcass weight, lb[a]	664	657	678	669	647	662
Dressing percent	62.1	62.8	64.6	63.5	63.9	63.0
No. abscessed livers	1	0	0	1	0	2
No. carcasses bruised	2	1	0	1	0	4

[a]Calculated via a 2% pencil shrink of the hot carcass weight.

and significantly less (P<.05) than in all other lots as shown in Table 11.

Plastic ductwork was installed in Lot 11 in an effort to improve air distribution. The ceiling was much dryer than in previous tests but feed intake was not increased and cattle performance was not improved. At the end of 56 days half of the cattle in Lot 9 were transferred to Lot 11 and half of those in Lot 11 to Lot 9. This switch was made in an attempt to increase the power of the test (probability that Lots 9 and 10 are found to be different, if in fact they were different); however, a statistical analysis was not possible on the animals switched. Average daily gains for the original cattle (groups A and C) and the transferred cattle (Groups B and D) are shown in Table 12. As expected, those cattle moved to Lot 9 made compensatory gains. Performance of those cattle transferred to the less desirable environment (Lot 11) dropped to the level of those that remained in Lot 11 for the entire test.

Marketing

The test ended on September 19, The barn cattle (Lots 9, 10 and 11) were slaughtered on September 27; Lot 5B cattle on September 28; and Lot 1B cattle on September 29, by Royal Packing Company, East St. Louis, Illinois. During the post-test period the cattle remained in their respective test lots and the ration was unchanged except for the withdrawal of diethylstilbestrol at least seven days prior to slaughter.

The cattle were weighed by lot on arrival at the slaughter plant. Individual hot carcass weights were obtained as well as visual observation of vital organs (lungs, heart and liver) for abnormalities. U.S.D.A. carcass grades were obtained the day following slaughter. The grader also indicated those carcasses with bruise damage.

Carcass Grades. There were no statistical differences (P<.05) in average carcass grade by lot. As indicated in Table 11, the average carcass grade for all cattle was near average Choice. Approximately 93% of the cattle graded low Choice or better.

Slaughter Weights And Visual Observations. The cattle averaged 1051 lbs on arrival at the slaughter plant. The average hot carcass weight was 675 lb. Average dressing percent, based on a 2% pencil shrink of the hot weight, was 63%. Table 13 shows the very low incidence of abcessed livers (two) and bruised carcasses (four).

Winter Test 1972-73

Yearling steers were fed during a winter trial that began November 14, 1972 and ended May 1, 1973. The primary test objectives were (1) to compare cattle performance in an open-front confinement barn with cattle performance in outside lots (no shelter) and (2) to evaluate various growing and finishing rations and combinations thereof for beef cattle.

Description of the Cattle

Two hundred thirty-six steers of Angus, Hereford and mixed dairy-beef breeding were delivered to the feedlot on October 24. Size and quality were quite variable.

Pre-Test Treatment

The cattle were given access to grass hay and medicated water upon arrival. Tetracycline Hydrochloride (Polyotic) was added to the drinking water at the rate of 500 mg per head per day. This medication was continued for nine days. One week after arrival (October 30 and 31) the cattle were tagged, tattooed, implanted, vaccinated and weighed. Each steer was implanted with 30 mg of diethylstilbestrol (Dibestrol-C) at the cost of $.16 for the implant. Vaccines included IBR, BVD, Blackleg, Malignant Edema and Enterotoxemia. Cattle weights ranged from 446 to 866 lb with an average of 673 lbs. The cattle were fed corn silage *ad libitum* for the entire 21-day pre-test period (October 24 to November 14).

Design of the Test

Two hundred twenty-eight steers were assigned to lots at random, within weight groups, on November 10. The average of two individual weights (November 13 and 15) was used as the initial weight of November 14. The mean starting weight for all cattle was 684 lb, and ranged from 667 to 693 lb.

Facilities. Five outside lots (2A, 2B, 3A, 3B and 5A) and the three lots in the open-front confinement barn (8, 9 and 10) were used during this trial. The only variable between the outside lots was a difference in width of the concrete pad behind the feedbunk (12′ or 27′). It was assumed that this difference would not affect the outcome of the study.

Table 14. Treatment (Rations Fed)[a] Winter Test 1972-73

Lot (Location)	Ration - Growing Phase (56 days)		Ration - Finishing Phase	
5A (Outside)	G-1	Corn silage *ad libitum*	F-1	HMC[b] and corn silage
8 (Confinement barn)	G-1	Corn silage *ad libitum*	F-1	HMC and corn silage
2A (Outside)	G-2[c]	Corn silage plus 1 lb dry corn/cwt	F-2	Dry corn and corn silage
2B (Outside)	G-3[c]	Corn silage plus 1 lb HMC/cwt	F-1	HMC and corn silage
3A (Outside)	F-1	HMC and corn silage	F-1	HMC and corn silage
9 (Confinement barn)	F-1	HMC and corn silage	F-1	HMC and corn silage
3B (Outside)	F-2	Dry corn and corn silage	F-2	Dry corn and corn silage
10 (Confinement barn)	F-2	Dry corn and corn silage	F-2	Dry corn and corn silage

[a]All rations included a protein supplement of which not more than 50% of the protein equivalent was from urea.
[b]HMC = high-moisture corn treated with propionic acid.
[c]The amount of corn gain was increased once every week based upon an estimated weekly gain.

Rations. Five different isonitrogenous rations were fed which include three growing rations and two finishing rations. Ration ingredients were: corn silage, high-moisture corn treated with propionic acid (HMC-AT), dry corn, and a protein supplement. Propionic acid was sprayed on the high-moisture crimped corn at the rate of six to eight oz per bushel (.7 to .9%) just prior to blowing it into a 60′ upright, concrete-stave silo.

During the growing phase (first 56 days) the cattle were fed one of the following rations:

G-1: Corn silage *ad libitum* (protein supplement included)

G-2: Corn silage *ad libitum* (protein supplement included) Dry corn fed at the rate of 1% of body weight

G-3: Corn silage *ad libitum* (protein supplement included) High-moisture corn-acid treated fed to provide the dry matter equivalent of the dry corn in ration G-2.

Table 15. Climatological Data[a], National Weather Service - Columbia Regional Airport, Winter Test 1972-73

Item	1972		1973			
	November	December	January	February	March	April
Days of precipitation ≥ .01 inch	11(7)	12(8)	9(8)	7(8)	17(11)	11(8)
Percent of possible sunshine	29(56)	43(50)	53(52)	50(55)	39(56)	45(62)
No. of cloudy days	26(13)	20(16)	17(17)	14(14)	22(16)	19(15)
No. of clear days	3(11)	4(8)	7(8)	8(8)	5(6)	5(8)
No. of days ≤ 32°F	15(14)	29(24)	21(27)	22(23)	3(17)	4(3)
No. of days ≤ 0.0°F	0	0	3	0	0	0

[a]( ) standard normals for the period of 1931-1960.

Two rations were fed during the finishing phase (105 days for the confinement barn cattle; 112 days for the outside cattle). These were:

F-2: Corn silage 34% (as fed)
Dry corn 62% (as fed)
Protein supplement 4% (as fed)

F-1: Corn silage
High-moisture corn-acid treated
Protein supplement
This ration was mixed according to ration F-2 with one exception; the high-moisture acid-treated corn was added in the amount to provide the dry matter equivalent of the corn in ration F-2.

The various feeding regimes by lot are shown in Table 14. Average moisture and crude protein (dry basis) of the corn silage, high-moisture corn-acid treated, dry corn, and the protein supplement[1] were: 65.9 and 8.4%; 21.5 and 11.0%; 15.3 and 10.4%; and 9.0 and 43.5%, respectively.

[1]Not more than 50% protein equivalent from urea.

Cattle Performance

Overall cattle performance was very poor, attributed to an unusually wet fall, winter and spring. Lot conditions were the worst they had been since the feedlot was constructed in 1965. Weather data for the test period is shown in Table 15. Average daily gain and feed conversion for all cattle was 1.88 lb, 985 lb D.M. per 100 lb gain (Table 16).

After 56 days, three steers were removed from test due to their extremely poor performance and health; these steers were from Lots 2A and 3B. Four steers died during the test; two were from Lot 5A and one each from Lots 2A and 3B. The two steers from Lot 5A died during December and January and postmortem inspection attributed the causes to a side injury and pneumonia, respectively. The steer from Lot 2A was removed from test after 56 days and died after several weeks of illness. The Lot 3B steer died after 163 days on test due to a lung disorder. This steer's performance was extrapolated to the end of the test (168 days) and hence, included in the test analysis.

Facility Differences. Cattle in the confinement barn gained significantly faster (.64 lb/day) and were more efficient (328 lb less D.M./100 lb gain) than those fed outside. The difference in performance was essentially the same irregardless of the rations fed as determined by the following comparisons: Lot 8 vs. Lot 5A; Lot 9 vs. Lot 3A; and Lot 10 vs. Lot 3B.

Feeding Systems (Ration Fed). Cattle fed a finishing ration for the entire test period (Lots 3A, 3B, 9 and 10) gained over .2 lb per day faster ($P<.05$) and required approximately 135 lb less dry matter per 100 lb of gain than those fed corn silage *ad libitum* the first 56 days (Lots 9 and 10 vs. 8; Lots 3A and 3B vs. 5A). The cattle on the high energy ration were also higher grading than those fed corn silage, although not significantly different. Adding corn to the ration at the rate of 1 lb per 100 lb of body weight did not increase gain or carcass grade (Lots 2A and 2B vs. 5A); however, feed conversion was improved by 65 pounds. The steers fed outside a finishing ration for the entire test period (Lots 3A and 3B) gained .21 lb per day faster ($P<.05$) on 100 lb less dry matter per 100 lb of gain than those fed 1 lb of corn per

Table 16. Cattle Performance, Winter Test 1972-73

Lot	2A	2B	3A	3B	5A	8	9	10	All Lots
Ration(s) Fed	*G2→F2*	*G3→F1*	*F1*	*F2*	*G1→F1*	*G1→F1*	*F1*	*F2*	
Item									
Number of head	34	36	36	35[a]	34	16	16	16	223
Ending weight, lb[b]	957	978	996	1002	961	1044	1069	1077	997
Initial weight (11-14-72), lb	696	685	688	684	687	678	675	667	685
Total gain, lb/hd	261	293	308	318	274	366	394	410	312
A.D.G., lb/hd	1.55[h]	1.74[f,g]	1.83[e,f]	1.89[e]	1.63[g,h]	2.27[d]	2.45[c,d]	2.55[c]	1.88
Dry matter fed, lb/hd/day	17.6	19.1	18.9	18.7	19.1	18.4	18.3	16.6	18.5
Dry matter fed, % of body weight	2.1	2.3	2.2	2.2	2.3	2.1	2.1	1.9	2.2
Feed fed, lb/hd/day[i]									
Corn silage	17.8	18.8	10.1	10.6	23.7	22.9	9.9	9.6	
High-moisture corn-AT		14.6	18.4		12.5	12.0	17.7		
Dry corn	12.3			16.6				14.7	
Protein supplement	1.3	1.4	1.1	1.1	1.5	1.4	1.1	.9	
Feed fed, lb/cwt/gain[j]	1129	1095	1032	988	1174	808	748	652	985
Total feed fed/hd									
Corn silage, lb	2996	3163	1692	1787	3975	3679	1591	1538	
High-moisture corn-AT, bu of No. 2 corn		39.6	49.7		33.9	31.1	46.1		
Dry corn, bu of No. 2 corn	35.8			48.6				41.0	
Protein supplement, lb	214	228	188	191	244	225	175	163	
Carcass grade[k]	4.35[d,e]	4.08[e]	4.81[c,d]	4.57[c,d,e]	4.41[c,d,e]	4.25[d,e]	4.88[c,d]	5.00[c]	4.51

[a]One steer died after 163 days on test. This steer's performance was extrapolated to the end of the test (an additional 5 days). Hence all of the following data includes this steer.
[b]Final weight for Lots 2A, 2B, 3A, 3B and 5A = May 1 (168 days). Final weight for Lots 8, 9 and 10 = April 24 (161 days).
[c,d,e,f,g,h]Those lots with a common superscript are not significantly different ($P<.05$).
[i]"As fed" basis
[j]"Dry matter" basis
[k]U.S.D.A. carcass grades: 1 = G-, 2 = G°, 3 = G+, 4 = Ch-, and 5 = Ch°.

Table 17. Carcass Data, Winter Test 1972-73

	Lot								
	2A	2B	3A	3B	5A	8	9	10	All Lots
No. head	34	36	36	34	34	16	16	16	222
Days on feed	168	168	168	168	168	161	161	161	
Live weight, lb[a]	943	970	987	1000	960	1033	1062	1068	990
Chilled carcass weight, lb[b]	584	603	616	615	590	644	661	672	614
Dressing percent	61.9	62.2	62.4	61.5	61.5	62.3	62.2	62.9	62.0
No. abscessed livers	0	1	5	2	1	1	0	1	11

[a]Weight off the truck at the slaughter plant. Lots 8, 9 and 10 were slaughtered April 26 and the outside cattle (Lots 2A, 2B, 3A, 3B, and 5A) on May 3, 4, 10 and 11.
[b]Calculated via a 2% shrink of the hot carcass weight.

100 lb of body weight (Lots 2A and 2B).

Propionic Acid Treated High-Moisture Corn Versus Dry Corn. Throughout most of the feeding period the acid treated high-moisture corn could not be distinguished from normal high-moisture corn. Many of the kernels were carmelized rather than normal (yellow) as expected. Analyses on two samples taken in April 1973 revealed that the corn contained approximately four ounces per bushel (.40 to .45%) rather than the six to eight ounces applied. Near the end of the feeding trial (lower half of the silo) most of the corn was yellow (normal) as expected. It is hypothesized that some of the acid was lost during application and secondly that some seepage occurred. The corn seemed palatable and was readily consumed.

The acid treated high-moisture corn fed in a limited quantity with corn silage (Lot 2B; ration G-3) resulted in significantly greater and more efficient gains than the addition of dry corn (Lot 2A; ration G-2). Dry corn on the other hand, held the advantage when fed as the main ingredient in the finishing ration. Gains were not significantly different; however, cattle fed the dry corn (Lots 3B and 10) required approximately 70 lb less dry matter per 100 lb of gain than the wet corn steers (Lots 3A and 9).

Marketing

The test ended on two separate dates; April 24 for cattle in the confinement barn (Lots 8, 9 and10) and May 1 for those in the outside lots (Lots 2A, 2B, 3A, 3B and 5A). Hence, the feeding trial was 161 and 168 days in length for the inside and outside cattle, respectively. During the post-test period the cattle remained in their respective lots and their ration was unchanged.

The cattle were slaughtered on April 26 and May 3, 4, 10 and 11. Off-the-truck weights were obtained by lot on arrival at Royal Packing Co., East St. Louis, Illinois. Individual hot carcass weights were obtained as well as visual observation of vital organs (lungs, heart and liver) for abnormalities. U.S.D.A. carcass grades were obtained the day after slaughter.

Carcass Grades. Three-fourths of the carcasses graded low Choice or higher. As shown in Table 16, average carcass grades by lot were significantly different in several instances. Those cattle fed a finishing ration during the entire trial (Lots 9, 10, 3A and 3B) graded higher than those fed a growing ration the first 56 days.

Slaughter Weights and Visual Observations. The cattle averaged 990 lb on arrival at the slaughter plant. Dressing percent, based on a 2% pencil shrink of the hot carcass weight, averaged 62% with less than a 1.5% spread between lots (Table 17). The total number of abcessed livers was very low except in Lot 3A. Cattle with abcessed livers gained as well as any of the cattle; their slaughter weights ranged from 778 to 1131 lb (972 lb average) and average daily gains from 1.15 to 2.70 lb (1.77 lb average).

Summary

Cattle in the open-front confinement barn gained approximately .1 lb more per day and were more efficient converters than those in the outside lots during the summer tests of 1970 and 1971. The confinement cattle also graded significantly higher than the outside cattle in both tests. The 1972 summer test results revealed a slight advantage in gain and feed efficiency for the outside lots, however, overall cattle performance was poor.

During the winter tests of 1970-71 and 1971-72, cattle in the open-front confinement barn did not perform as well as those outside. Daily gain for both winter tests was approximately .25 lb greater for the outside lots. There was essentially no difference noted in carcass grade. Both the 1970 and the 1971 winters were considered mild which may account for the lack of an advantage for the barn as compared to a .67 lb advantage noted during the extremely wet winter and spring of 1969 (see Special Report 122 of the University of Missouri-Columbia College of Agriculture). Results of the 1972-73 winter test were quite similar to the 1969 test. Cattle in the barn gained .64 lb more per day and required 328 lb less dry matter per 100 lb of gain.

There was no significant difference in the performance of the three lots in the open-front confinement barn (Barn No. 1). However, cattle appearance (cleaner hair coats) favored the totally slotted floor. Less labor was also required to clean the totally slotted lot as compared to the one-third and two-thirds slotted lots.

Cattle provided a shade during the summer consistently gained .1 to .15 lb per day faster than the outside cattle without shade.

During two winter tests (1970-71 and 1971-72) cattle in the mounded lot failed to gain as fast as those in the flat lot. Cattle used the mound during both tests, however, the winter weather was not very severe.

The totally enclosed confinement barn (Barn No. 2) consistently exhibited the lowest average daily gain during both the summer and winter tests. In summer the evaporative-cooled lot (Lot 11) produced better cattle performance than Lot 12, cooled with an exhaust fan, however, cattle performance was unsatisfactory. During the summer test in very hot humid weather, the cattle were under constant stress, i.e., temperature was always above 70° Fahrenheit and humidity was high. The evaporative cooler lowered the temperature of Lot 11 by 10 degrees, however, cattle performance was not increased to any great extent.

Feeding a high energy finishing ration for the entire test period during the winter 1972-73 proved to be the most economical for both inside and outside lots. Extremely wet weather resulted in performance that significantly favored the confinement barn regardless of ration fed.

Cattle tended to work manure away from the feed bunk. The late A. J. Dyer measured this distance.

Conclusions

1. Cattle provided shade in the summer (either in outside lots or via an open-front-and-rear confinement barn) generally gain at least .1 lb per day faster than those without shade. They also gain more efficiently.
2. The Weldon Spring open-front confinement cattle significantly out-performed those cattle fed in the outside lots during two of the six winter trials (1969 and 1973) conducted from 1968 through 1973. During both 1969 and 1973 the weather was extremely wet and the lots were in bad condition for several weeks. Cattle gains during the other four, more typical mid-Missouri winters were not different among the facilities. Perhaps a cattle feeder's justification for a confinement facility should be partially based on the predicted number of poor cattle feeding winters for a given period of time.
3. Cattle in the open-front barn consistently were more efficient converters of feed to gain than the outside cattle.
4. During mild winters the mound did not result in any significant increase in cattle performance. It appeared that given ample time, cattle are able to compensate for short periods of poor performance due to poor lot conditions caused by inclement weather, etc.
5. No differences in cattle performance could be attributed to the degree of slotted floor in confinement; however, those in the totally slotted lot were always cleaner and more presentable to the packer buyer.
6. Cattle gains in the totally-enclosed barn were consistently poor. The cause(s) for this poor performance was never identified.
7. The evaporative cooler increased cattle performance in summer but not to an acceptable level.

Field Days at the Weldon Springs Experimental Feedlots allowed researchers to share results with beef producers.

an equal opportunity institution

SR222 9/79/1M