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ROUNDUP

DICKINSON EXPERIMENT STATION

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Section I

Reports of
Cattle Research in Progress
at the
Dickinson Experiment Station

Presented by the

Station Staff

at the

27th Annual Livestock Research Roundup

Dickinson Experiment Station
Dickinson, North Dakota

December 1, 1976

USING STRAW IN COW WINTERING RATIONS

Straw feeding at various levels to replace part of the hay in wintering rations for pregnant beef cows has been recommended by this station and others in the U.S. and Canada. Past research at this station indicates that two-thirds of the hay in wintering rations can be replaced with straw, provided sufficient protein is available. Wintering rations of half hay and half oat straw and no supplemental protein have reduced wintering costs without affecting calving performance.

More efficient hay making equipment and portable tub grinders make possible the production of palatable, high quality rations containing various levels of hay and straw that can be blended and fed with little waste.

This cow wintering trial, started during the 1975-76 wintering season, is designed to evaluate the nutritional as well as the economic aspects of processing hay and straw, as compared to feeding these roughages in their long form.

Only mature cows that were at least four years old or older were used in this trial, which started on December 19th, and continued until February 27th, a period of seventy days. Two experimental groups were selected randomly according to age and fed a wintering ration of four parts mixed hay (crested wheatgrass and bromegrass + alfalfa) and three parts oat straw. Daily consumption of approximately twenty-three pounds of forage as fed was desired. Utilizing a fenceline feeder, group I received this ration after it had been processed in a tub grinder through a two inch screen. Group 2, which was fed in a conventional manner on the ground, received the same ratio of hay and straw in the long form on alternate days; hay being fed on Tuesday, Thursday, Saturday and Sunday, and oat straw fed on Monday, Wednesday and Friday of each week. Both lots received minerals free choice. On February 1st, approximately thirty days before calving, each cow received an enterotoxemia booster shot and one-million units of vitamin A, intramuscularly.

Results of the trial are summarized in tables 1 through 4.

Summary:

Chopping a ration of four parts mixed hay and three parts oat straw through a tub grinder produced an economical, highly palatable wintering ration for mature cows that was readily consumed, regardless of weather conditions, up to the start of calving. Costs for chopping amounted to $2.10/ton.

Cows receiving the unprocessed hay and straw consumed 4.0 pounds less total feed per day, and wasted more straw, especially on mild winter days, as compared to a very minimal amount of waste, and continued voluntary intake among the cows fed chopped forage. Body weight changes were not seriously affected by either feeding regime. The group that received unprocessed hay and straw maintained their starting weight, while those cows fed chopped hay and straw had an average increase in body weight of sixty-one pounds per head.

Calving results, as shown in table 3, indicate that feeding chopped or unprocessed hay and straw had no effect on calf birth weight or livability.

Table 1. Feed consumption, chopping costs and wintering economics – winter, 1975-76.

	Group I	**Group 2**
	chopped hay and straw	**long form hay and straw**
Days fed	70	70
No. of head	32	42
Mixed hay, lbs.	32919	40595
Oat straw, lbs.	24690	23300
Feed/hd./day, lbs.	25.7	21.7
Total feed cost, $	853.51	1022.48
Daily feed cost/hd., $	.381	.348
Chopping data:		
Chopping cost/cow, $	1.89	---
Total feed cost/hd., $	28.56	24.34

1 / Mixed hay @ $40/ton, oat straw @ $10/ton, minerals @ $104/ton, fed free choice.
2 / Mineral used is 17% phosphorous, 25% calcium, mixed at the rate of one part mineral mix to two parts
white salt.
3 / Chopping costs, $2.10/ton.

Table 2. Body weight changes

	Group 1			**Group 2**		
	chopped hay and straw			**long form hay and straw**		
Age of cow	4	5,6,7	8,9,10	4	5,6,7	8,9,10
Initial wt., lbs. – (Dec. 16, 1975)	983	1086	1168	945	1078	1142
Final wt., lbs. (Feb. 27, 1976)	1050	1142	1230	935	1083	1143
Gain or loss, lbs.	+67	+56	+62	-10	+5	+1

Table 3. Calf birth weights and livability

	Group 1 chopped hay and straw			Group 2 long form hay and straw		
Age of cow	4	5,6,7	8,9,10	4	5,6,7	8,9,10
No. heifer calves	3	5	4	5 1/	8	4
Avg. birth wt., lbs.	76	70	69	67	70	74
No. steer calves	2	10 1/	6	2	9	11
Avg. birth wt., lbs.	73	74	72	76	69	77

1 / One calf born dead

Table 4. Calculated wintering cost when 23 pounds of "as fed" forage are fed under three feeding regimes to 250 cows for 70 days

	All mixed hay	Chopped 4 parts hay- 3 parts straw	Long form 4 parts hay- 3 parts straw
Cost/lb. feed, $ 1 /	.02	.0146	.0136
Lbs. feed/cow/day	23	23	23
Cost/hd./day, $	.492	.368	.345
Cost 250 cows, - 70 days, $	8,610	6,440	6,038
Difference, $	2170	402	

1 / See table 1 for feed costs, chopping costs and minerals used.

HEIFER MANAGEMENT STUDY

North Dakota stockmen can't afford the luxury of keeping a heifer until she is three years old before she has her first calf. However, heifers bred to calve at two years must be properly managed if the calving season is to be successful. They should be fed so they will be well grown but not fat at calving. They should be bred to calve about three weeks earlier than the cow herd; and, they should be bred to bulls known to sire small framed calves having low birth weights.

Identification of "easy-calving" bulls under natural breeding conditions presents a real problem. One breed of cattle, the Texas Longhorn, is reported to minimize calving difficulties when crossed with Hereford or Angus heifers. However, very little research data is available to confirm or disprove these claims. Several area ranchers have used Longhorn bulls on first calf heifers with apparent success. However, these crossbred calves are often discounted at market time, due to their type, although little or no performance or carcass data are available to justify these discounts. Other area producers report good success by using small framed Angus bulls on Hereford heifers to reduce calving difficulties.

With these ideas in mind, a trial was designed to compare calving difficulty with first calf Hereford heifers bred to either Angus or Longhorn bulls.

In May, 1975, forty straightbred Hereford heifers weighing approximately 680 pounds were assigned at random to one of two breeding groups. One group of 20 heifers was exposed to a two year old Longhorn bull while the other group was exposed to a two year old registered Angus bull. Both bulls remained with the heifers from May 7th to July 8th, a period of 62 days. During this period the heifers grazed on fertilized tame grass pasture. Upon removal of the Longhorn and Angus bulls, Polled Hereford bulls were run with the heifers. The heifers grazed on native range until October 16th when they were pregnancy checked. This check revealed one heifer not bred because of an infantile reproductive tract, and two suspected late calves.

The heifers were wintered as a mixed group on a full feed of hay until February 5th, 1976. At this time, the heifers were moved into calving lots and self-fed a chopped mixed hay ration plus minerals. After calving, each heifer received approximately two pounds of ground oats in addition to the chopped hay.

A close watch and record was kept of each birth including birth date, weight, sex and ease of delivery. Type of delivery was scored from 1 to 5 as follows: 1--no help, 2--slight pull, 3--hard pull, 4--Caesarian, 5--born dead.

Weaning weights were recorded at approximately 205 days of age.

Table 5. Calving data – Heifer Management Study, 1975-76.

	Angus x Hereford	Longhorn x Hereford
No. heifers exposed	20	20
No. heifers calving	18 [1/] [2/]	19 [2/]
Avg. birth wt.	17 hd avg. = 69# [3/]	19 hd avg. = 63#
Steers	7 hd = 70#	13 hd = 66#
Heifers	10 hd = 68#	6 hd = 58#
Avg. age at weaning	203 days	197 days
Weaning wt.	Actual Adjusted	Actual Adjusted
Steers	5 hd 454 462	13 hd 407 426
Heifers	10 hd 400 401	5 hd 369 369
Estimated calf value [5/]		
Steers	5 hd @ $177.06	13 hd @ $146.68
Heifers	10 hd @ $131.93	5 hd @ $110.70
Avg.	$146.97	$136.69
Return/cow exposed [4/]	$122.48	$129.49
Calving score-		
No difficulty	16 [3/]	19
Hard pull	1	0

1/ One cow removed because of abnormal reproductive tract.
2/ One cow removed, late calving straight Hereford calf.
3/ One BWF calf born deformed, dead at birth, not included.
4/ Return based on cows capable of breeding in both herds. Value of cows producing straightbred Hereford calves not included.
5/ BWF steers @ 39¢, heifers @ 33¢, LxH steers @ 36¢, heifers @ 30¢.

Summary:

In this first years' trial no serious calving problems were experienced with either bull, although all of the calves sired by the Longhorn bull were born unassisted. The Angus X Hereford bull calves were four pounds heavier, and the heifer calves ten pounds heavier at birth than the Longhorn X Hereford calves. At weaning on Sept 28, the Angus X Hereford steer calves averaged 47 pounds heavier, and the heifers 31 pounds heavier than the Longhorn X Hereford calves. Using current market values, the Angus X Hereford steer calves would return $30.38 and the heifer calves $21.23 more than the Longhorn X

Hereford calves. However, on a per cow exposed basis, the Longhorn X Hereford calves actually returned about $7.00 more per cow because more calves were alive at weaning. Because of the limited numbers of animals involved, this report is not intended to be conclusive. This year's trial did show Longhorn X Hereford calves to be easy to deliver, but that they weighed less at birth and weaning, and would sell for less than the Angus X Hereford calves.

WINTERING REPLACEMENT HEIFER CALVES

Heifer replacement calves can be wintered to gain from 1.25 to 1.50 pounds per head per day without becoming over-conditioned according to research conducted at the U.S. Range Livestock Station, Miles City, Montana; South Dakota State University's Antelope Range Field Station, and the Dickinson Experiment Station. Heifer calves fed to gain at this rate will produce good economical gains and will be cycling early in the breeding season.

Straightbred Hereford heifer calves were wintered a total of 141 days, December 1 to April 20, in this trial under two feeding regimes. Two lots of 10 head each, received a self-fed mixed growing ration and one lot of 20 head was hand fed. All three lots were provided with pole barn shelters and automatic waterers. Straw bedding was used on a routine basis.

Self-fed rations, balanced according to the NRC requirements, were prepared through a portable mixer grinder and fed in self-feeders of Dickinson Experiment Station design. Weights and gains of the heifers in drylot are shown in table 6; rations as they were fed are shown in table 7; and, wintering data for the four year period 1973-76 have been summarized in table 8.

Table 6. Weights and gains in drylot under two feeding systems

	Self-fed	Self-fed	Hand-fed
No. head	10	10	20
Days fed	141	141	141
Initial wt., lbs.	425	427	429
Final wt., lbs.	624	632	589
Gain, lbs.	199	205	160
Avg. daily gain, lbs.	1.41	1.45	1.13

Self feeding a high roughage growing ration of chopped hay and oats to replacement heifer calves has produced good, steady winter gains without evidence of overconsumption or bloating problems. Since there was very little waste when the ration was self-fed, the cost of winter gain for self-fed heifers amounted to $28.50 per hundredweight, as compared to $34.00 per hundredweight for the hand fed heifers. The self-fed heifers are also able to consume more total roughage in the self-fed rations, and consequently require less grain to make gains equal to heifers being hand fed. Although the hand fed heifers made compensatory gain during the summer grazing period, the self-fed heifers apparently were able to cycle and conceive earlier in the breeding season, as indicated by the fall pregnancy test. It is important for the replacement heifer to conceive early and calve early in order to maintain an early calving cow herd.

Table 7. Average feed consumed daily and cost of gain, 1976

	Self-fed	Self-fed	Hand-fed
No. head	10	10	20
Oats, lbs.	2.48	2.51	3.49
Tame hay, lbs.	12.90	12.90	10.10
Alfalfa hay, lbs.	.68	.69	.07
Minerals, lbs.	.34	.40	.35
Total consumed, lbs.	16.40	16.50	14.64
Feed cost/hd, $	57.71	53.20	54.40
Feed cost/hd/day, $	.40	.41	.39
Feed cost/cwt gain, $	29.00	28.00	34.00

Table 8. Feed consumption, gain and cost of wintering heifers, self-fed and hand-fed, 1973-76

	Hand-fed				Self-fed			
	1973	1974	1975	1976	1973	1974	1975	1976
No. head	12	12	8	20	12	12	23	20
Days fed	168	181	155	141	168	181	155	141
Initial wt., lbs.	410	417	459	429	408	417	455	426
Spring wt., lbs.	588	660	656	589	650	700	716	628
Winter gain, lbs.	178	243	196	160	241	284	262	202
Avg. daily gain, lbs.	1.06	1.34	1.26	1.13	1.44	1.57	1.55	1.43
Lbs. feed/hd/day	13.1	17.2	13.8	14.64	14.8	14.0	17.8	16.44
Feed cost/hd/$	33.02	79.47	64.57	54.40	34.29	67.46	83.11	56.40
Feed cost/hd/day, ¢	19.6	43.9	38.4	39.0	20.4	37.3	49.5	40.0
Feed cost/cwt gain, $	18.50	28.01	32.94	34.00	14.20	23.78	31.76	28.00

Following the drylot wintering phase, all heifers were separated into sire groups and turned into Russian wildrye pasture on April 20th. On May 25th, they were moved to crested wheatgrass pasture where they remained until they were moved to native grass pasture on July 1. Weights and gains for the pasturing phase are summarized in table 9.

On September 14 all heifers were pregnancy tested. Results of the test are shown in table 10.

Table 9. Weight gain on grass April 20 to September 14th (147 days)

	Hand-fed	Self-fed
Russian wildrye (April 20 – May 25, 35 days)		
No. head	20	20
Initial wt., lbs.	589	628
Final wt., lbs.	653	663
Gain, lbs.	64	35
Avg. daily gain, lbs.	1.82	1.00
Crested wheatgrass (May 25 – July 1, 37 days)		
No. head	20	20
Initial wt., lbs.	653	663
Final wt., lbs.	733	744
Gain, lbs.	80	81
Avg. daily gain, lbs.	2.14	2.19
Native range (July 1 – Sept. 14, 75 days)		
No. head	20	20
Initial wt., lbs.	733	744
Final wt., lbs.	806	806
Gain, lbs.	73	58
Avg. daily gain, lbs.	.97	.83
Total summer gain on grass, lbs.	217	174
Avg. daily gain- (147 days), lbs.	1.48	1.18

Table 10. Pregnancy test results on September 14th. Exposed to fertile bulls from May 3rd to August 1st.

	Self-fed	Hand-fed
No. head		
Estimated age of fetus:		
100-120 days	12-60%	6-30%
80-99 days	4-20%	8-40%
60-79 days	3-15%	5-25%
40-59 days	1- 5%	1- 5%

EFFECTS OF BRUCELLOSIS VACCINATION ON WINTER GAIN

Heifers in this trial were vaccinated for brucellosis with strain 19 organisms on two dates, December 4 and January 27. Winter gains were not significantly affected when brucellosis vaccinations were administered either early or late, as shown in table 11.

Table 11. Effects of brucellosis vaccination on winter gain – 1973-76

	Date vaccinated					
	Nov. 11-73	**Jan. 14-74**	**Nov. 29-74**	**Jan. 28-75**	**Dec. 4-75**	**Jan. 27-76**
No. head	16	16	16	15	20	20
Avg. wt. gain/hd, lbs.-						
(Nov 1 – Dec 18)	68	76				
(Nov 19 – Dec 26)			35	36		
(Dec 1 – Dec 29)					33	35
Avg. wt. gain/hd, lbs.-						
(Nov 1 – Feb 14)	136	151[1/]				
(Nov 19 – Feb 24)			127	121		
(Dec 1 – Feb 24)					122	114
Total wt. gain/hd, lbs.-						
(Nov – May 1)	221	283				
(Nov 19 – May 17)			247	239		
(Dec 1 – Apr 20)					187	175

1 / Significant at the 5% level.

PROSTOGLANDINS FOR SYNCHRONIZATION OF ESTRUS IN BEEF COWS

A cooperative trial to evaluate Prostin F2 Alpha for the control of estrus in beef cows, to permit synchronized artificial insemination, was started in June, 1976.

Prostin F2 Alpha is a prostoglandin analog, produced by the Upjohn Company, Kalamazoo, Michigan. At present it is available for experimental use only.

Basically, the drug acts to interrupt the cycle of a normally cycling cow, and start the cycle over in a normal manner. Thus, cows treated as a group will re-cycle as a group and can be artificially inseminated as a group.

The trial involved 72 commercial Hereford and Angus X Hereford cows three years old and older, belonging to the Osteroos Ranch of Des Lacs, North Dakota.

The Upjohn Company provided the Prostin F2 Alpha used in the trial. Dr. Ed Moody, with Upjohn, palpated all cows for evidence of pregnancy, and estimated age of each fetus.

Dickinson station personnel assisted in allotting the cattle into treatment groups, made the injections of Prostin F2 Alpha, and analyzed the results of the trial.

All care and handling, all artificial insemination and all record keeping of the cows in this trial was done by Loren Osteroos.

The trial involved 72 cows, 3 years old and older, randomly divided by age and calving date into three treatment groups.

Group one, designated as the control group, was handled in a normal A.I. breeding program. They were observed for estrus and artificially inseminated 12 to 14 hours following visual detection. Observation began on July 10, with first insemination made on July 12. To equalize the amount of handling in all groups, this group was run through the chutes along with the groups being treated.

Each cow in group two was treated with a 5 ml injection of Prostin F2 Alpha (5mg/ml) on June 29 and again on July 10th, starting at 8:00 A.M. They were artificially inseminated 12 to 14 hours after detection of standing heat, following the second injection of the drug.

Group three received the same Prostin F2 Alpha injections outlined for group two. Cows in group three were then artificially inseminated 80 hours after the final injection of the drug, regardless of the appearance of estrus.

Fertile clean up bulls with marking halters were turned with the cows on July 28.

On September 25 all cows were palpated for evidence of pregnancy, and the age of each fetus was estimated.

Results of the trial to date are summarized in table 12. It should be noted that in the control herd one cow was bred early and one cow died during the breeding season. These cows are not included in the analysis.

Summary:

While actual calving results will not be available until the spring of 1977, on the basis of pregnancy tests it appears that treatment with Prostin F2 Alpha will permit the breeding of normal, cycling cows at a specific time, with no reduction in conception rates. In a normal 25 day breeding period, 10 percent more cows had apparently settled in the treated herd than in the control herd.

Prostin F2 Alpha appears effective in synchronizing estrus in beef cows. By eliminating the need for heat detection and reducing labor requirements necessary in a normal A.I. breeding program, it may offer a potential for more widespread use of artificial insemination in commercial beef herds.

Table 12. Results of estrus synchronization using Prostin F2 Alpha

	Group 1 normal AI	**Group 2 AI at estrus**	**Group 3 AI at 80 hrs.**
No. of cows allotted	21[1/]	26	25
No. of cows bred -			
First 21 days	16	23	25
Not detected	3	3	--
Percent cows bred first 21 days	84%	88%	100%
Results of pregnancy test on September 25, 1976:			
Cows diagnosed pregnant the first 21 days	12 of 19 63%	17 of 26 65%	16 of 25 64%
Cows diagnosed pregnant after 25 days	14 of 19 74%	21 of 26 81%	21 of 25 84%
Cows diagnosed pregnant	19 of 19 100%	26 of 26 100%	25 of 25 100%

1 / One cow died, one cow bred early. Not included in calculations.

COMPARISON OF HEREFORD AND ANGUS-HEREFORD CROSSBRED STEER CALVES UNDER GROWING CONDITIONS

This trial is the first phase of a comparison of straightbred Hereford and crossbred Angus-Hereford steer calves under both pasture and feedlot conditions.

The trial is designed to measure differences in rate of gain and feed efficiency when steers are "roughed" through the winter at a daily rate of gain of between 1.25 and 1.50 pounds, with the intention of turning them out to pasture the following summer.

In 1973-74 two lots of 13 steers of each type were wintered for 152 days, from November 30 to May 1; in 1974-75 the wintering period of 175 days was from November 19 to May 13, and in 1975-76 the wintering period of 157 days extended from December 1 to May 6.

Table 13. Ration fed, feed consumption and cost per hundred-weight gain

	BWF Lbs./hd. per day			**Hereford Lbs./hd. per day**		
Ration as fed:	**1974**	**1975**	**1976**	**1974**	**1975**	**1976**
Oats	3.0	2.9	2.4	3.0	2.7	2.4
Alfalfa hay	2.0	0.7	0.7	2.0	0.6	0.7
Tame hay	9.8	10.7	14.0	9.8	9.9	14.3
Mineral mix	0.2	0.4	0.4	0.2	0.3	0.4
Total feed consumed	15.0	14.7	18.2	15.0	13.5	17.8
Lbs. feed/lb. gain	12.6	10.1	12.5	10.8	10.1	11.7
Ration cost:						
Per head $	51.20	68.48	68.99	49.89	63.79	67.40
Per 100 lbs. gain $	28.39	26.96	30.09	23.70	27.26	28.24
3-Yr. avg. cost/100# gain	$28.48			$26.40		

In this ration feed costs were figured at: $4.38/cwt for oats; $40/ton for alfalfa; $30/ton for tame hay; and, $9.55/cwt for mineral mix in 1974. In 1975 alfalfa increased to $50/ton, tame hay increased to $40/ton, and there were no changes in the costs for mineral mix and oats. In 1976 the only cost that differed from 1975 was oats at $4.22/cwt.

Table 14. Weight and gain, winter growing period, 1974-75-76

	BWF				Hereford			
	1974	1975	1976	3-yr. Avg.	1974	1975	1976	3-yr. Avg.
No. head	13	13	13		12[1/]	13	13	
Initial wt., lbs.	366	367	475	402	375	373	469	406
Final wt., lbs.	547	621	707	625	583	607	709	633
Avg. steer gain, lbs.	180	254	232	222	208	234	240	227
Difference, lbs.		+20			+28		+8	
Days fed	152	175	157	161	152	175	157	161
ADG, lbs.	1.18	1.45	1.47	1.38	1.37	1.34	1.52	1.41

1 / One steer removed because of lameness.

Summary:

During the 1974 and 1976 feeding periods the Hereford steers gained more and were slightly more efficient than the BWF steers. The BWF steers gained more and were more efficient than the Hereford steers during the 1975 wintering period. The 3-year average favors the Hereford steers which averaged 5 pounds heavier, and were more efficient than the BWF steers resulting in an average of $2.08 less feed per hundred pounds gain. Indications are that healthy individuals of either type will perform equally well under this type of winter feeding regime.

GRASS FED BEEF

Current and future differences between feed grain prices and cattle prices seem to indicate that we may be forced into a beef production system utilizing all or nearly all-roughage rations. With todays fast, efficient hay handling equipment, producing and feeding high quality hay may make it possible to produce "grass" fat beef using only limited amounts of concentrates in the ration.

This trial is designed in three phases, the calf wintering phase, the summer grazing phase and the feedlot finishing phase, to take steer calves from weaning to slaughter.

In the wintering phase, Hereford and Angus-Hereford crossbred calves were self-fed a limited grain-high roughage growing ration to produce gains of 1.25 to 1.50 pounds per day. Actual average daily gain for the 1974-75 winter period was 1.40 pounds per head per day for 175 days. The wintering ration was composed of 20% oats and 80% chopped hay self-fed, with minerals added at the rate of 10 pounds of dicalcium phosphate and 40 pounds of salt added per ton of feed. Average feed cost per steer for the winter period was $66.13.

Gains for the first two years of the wintering phase are shown in table 15.

Table 15. Gains – calf wintering phase, 1973-74 and 1974-75

	BWF		**Hereford**	
	1973-74	**1974-75**	**1973-74**	**1974-75**
Initial weight, Nov.	367	367	374	374
Spring weight, May	552	621	583	607
Days fed	152	175	152	175
Average daily gain	1.21	1.45	1.37	1.33
Two-year ADG	1.33		1.35	

The pasture phase utilizes a three-pasture grazing system using crested wheatgrass for spring and early summer, native range in mid and late summer and Russian wildrye for fall grazing. Beginning on May 13, 1975 the steers grazed until November 25, 1975, a period of 196 days. Average daily gain for the entire grazing period was 1.13 pounds per head per day. Details of performance for the different pasture periods are show in table 16.

Table 16. Gains, pasture phase, 1974-1975

	BWF 1974	BWF 1975	Hereford 1974	Hereford 1975
Crested wheatgrass				
Early May	552	621	583	606
Late June	636	689	673	675
Avg. daily gain	1.53	1.22	1.64	1.21
	1.37		1.42	
Native range				
Early September	766	818	781	808
Avg. daily gain	1.83	2.26	1.51	2.34
	2.04		1.92	
Russian wildrye				
Late November	803	852	817	823
Avg. daily gain	0.52	0.40	0.52	0.18
	.46		.35	
Total gain on grass	251	230	234	217
Grazing period	196	196	196	196
Avg. daily gain	1.28	1.17	1.19	1.10
Two-year avg.	241		226	
Days grazed	196		196	
Avg. daily gain	1.22		1.14	

At the end of the grazing period in November, the steers were allotted at random for the finishing phase into two lots, each lot made up of 6 crossbred and 6 straightbred steers. In this phase, both lots were self-fed chopped hay and minerals. In addition to the hay, one lot was fed ground oats at the rate of one percent of their liveweight until the steers averaged about 900 pounds. From 900 pounds to slaughter, ground barley was fed at the one percent rate.

These steers were scheduled to be marketed at two slaughter weights, a light weight of about 975 pounds and a normal market weight of about 1070 pounds. This was done to provide a comparison of both lots sold under weight constant and time constant conditions. Steers were selected at random for each marketing period, when the finishing phase was begun. Details of performance for the first two years are shown in tables 17 and 18.

Table 17. Two year gain, carcass, and feed data – short fed drylot phase

	1% Grain ration		Chopped hay ration	
	BWF	**Hereford**	**BWF**	**Hereford**
Initial wt.				
1974-75	799	813	781	833
1975-76	897	853	877	855
Final wt.				
1974-75	990	1013	968	1035
1975-76	970	933	982	960
Days fed				
1974-75	110	110	152	152
1975-76	50	50	115	115
Avg. daily gain				
1974-75	1.73	1.81	1.23	1.33
1975-76	1.46	1.60	0.91	0.91
Hot carcass wt.				
1974-75	550	555	511	536
1975-76	520	489	533	507
Dressing %				
1974-75	56	55	53	52
1975-76	53	52	54	53
USDA grade				
1974-75	1 ch 2 gd	3 gd	1 ch 2 gd	3 gd
1975-76	3 gd	3 gd	3 ch	3 ch
Selling Price:				
	March 4, 1975		April 16, 1975	
1974-75	Ch=$54.40 Gd=$50.50		Ch=$66.00 Gd=$62.00	
	Jan. 20, 1976		March 25, 1976	
1975-76	Gd=$59		Ch=$55 Gd=$53	
Avg. carcass value $				
1974-75	284.90	280.44	323.42	332.73
1975-76	307.00	288.31	293.33	275.97
Avg. feed cost $				
1974-75	89.03	89.03	94.73	94.73
1975-76	42.77	42.77	74.00	74.00
Return over feed $				
1974-75	195.87	191.41	228.69	238.00
1975-76	264.23	245.54	219.33	201.97

Table 18. Two year gain, carcass and feed data – long fed drylot phase

	1% Grain ration		Chopped hay ration	
	BWF	Hereford	BWF	Hereford
Initial wt.				
1974-75	818	811	813	810
1975-76	893	847	843	857
Final wt.				
1974-75	1073	1048	1035	1060
1975-76	1087	1070	1012	1008
Days fed				
1974-75	152	152	208	208
1975-76	115	115	162	162
Avg. daily gain				
1974-75	1.68	1.56	1.07	1.20
1975-76	1.68	1.94	1.04	0.93
Hot carcass wt.				
1974-75	607	591	564	563
1975-76	606	594	564	560
Dressing %				
1974-75	57	56	55	53
1975-76	55	55	56	56
USDA grade				
1974-75	2 ch 1 gd	3 gd	3 ch	3 gd
1975-76	1 pr 1 ch 1 st	1 ch 2 gd	3 ch	3 gd
Selling Price:				
	April 16, 1975		June 11, 1975	
1974-75	Ch=$66 Gd=$62		Ch=$81 Gd=$73	
	March 25, 1976		May 12, 1976	
1975-76	Pr=$56 Ch=$55 St=$51		Ch=$61.50 Gd=$59.50	
Avg. carcass value $				
1974-75	391.51	366.21	457.11	411.23
1975-76	326.61	316.75	346.70	333.00
Avg. feed cost $				
1974-75	134.72	134.72	129.82	129.82
1975-76	98.37	98.37	106.83	106.83
Return over feed $				
1974-75	256.79	231.49	327.29	281.41
1975-76	228.24	218.38	239.87	226.17

Summary:

Results from this trial show that steers can be fed to acceptable carcass weights and grades on all roughage ration.

Feeding the two lots of steers to equal weights of about 1000 pounds required sixty five more days in 1976, and feed costs were $31.23 higher for the hay fed steers. However, the hay fed steers graded higher, averaging choice while the hay and 1% grain fed steers graded good. The hay fed steers also had slightly heavier carcasses and dressed about 1% higher.

On an equal weight basis of about 1050 pounds, the long grain fed steers reached market weights 47 days earlier and yielded about forty more pounds of carcass. There was no appreciable difference between feeding treatments on grade. In this comparison feed costs were about $8.50 more per steer for the hay fed groups, when hay was prices at $40.00 per ton, oats at $1.35 per bushel, barley at $2.30 per bushel and $10.00 per ton for grinding the hay and grain.

FEEDLOT COMPARISON OF HEREFORD, ANGUS X HEREFORD, AND LONGHORN X HEREFORD STEERS

This trial was designed to study the performance of Longhorn X Hereford crossbred calves in comparison to either straight Hereford or Angus X Hereford crossbred calves.

Producers using Longhorn bulls on straight bred beef heifers are discounted when these calves are placed on the feeder market. Feeders are reluctant to buy these calves, since very little documented information is available as to how these crossbred calves perform in the feedlot. Again, there is almost no carcass information available on these cattle, especially when graded under the current grading standards.

In this first year of the trial, two sets of LH X H steer calves were purchased from the Harold Hanson Ranch of Reeder and the Bloom Ranch of Taylor, North Dakota. Hereford and BWF calves for comparison were either raised at the Dickinson Experiment Station or were purchased through the local auction market. At the time these calves were purchased, there was approximately a $5/hundredweight discount on the LH X Hereford steers. Calves were worked through our chutes for the usual branding, dehorning and vaccination. All the LH X H calves were dehorned which was not so with the BWF or the Hereford calves since they were naturally polled.

The calves were all self-fed a complete mixed ration composed of 50% chopped hay and 50% oats at the start of the trial on December 1, 1975. On April 1, the oats was increased to 75% and the hay decreased to 25% of the ration. On June 15th, 15% of the oats was replaced by barley. Barley was again increased by 15% on June 28 and July 13th. Twenty pounds of salt and 5 pounds of di-calcium phosphate were added per 1000 pounds of ration.

The steers were fed from December 1, 1975 until October 12, 1976 at which time they were shipped by truck to Flavorland Dressed Beef in West Fargo, North Dakota, a distance of 300 miles. The steers were sold on a grade and weight basis, with additional carcass information gathered with the cooperation of the meats department of the Department of Animal Science, NDSU.

The results of the trial are show in tables 19 and 20.

Table 19. Feedlot data and carcass information

	BWF	Hereford	Bloom LH	Hanson LH
No. Head	7	7	7	7
Period on test	All lots on trial December 1-October 12			
Days fed	316	316	316	316
Final weight	1093	1063	999	980
Starting weight	411	396	401	405
Feedlot gain	682	667	598	575
Avg. daily gain	2.15	2.11	1.89	1.81
Pounds feed/lb gain, lbs.	9.6	9.2	9.9	10.1
Cost of feed/steer, $	269.13	251.82	243.45	237.53
Slaughter information:				
Hot carcass wt., lbs.	640	628	584	580
Dressing %	58.5	59.1	58.4	59.1
USDA grade	7 choice	7 choice	6 choice 1 good	7 choice
Selling price, $	7 hd@57.50	7 hd@57.50	6 hd@57.50 1 hd@54.50	7 hd@57.50
Carcass value, $	367.92	361.35	333.63	333.50
Feed consumed – lbs/steer:				
Oats, lbs.	3156	2999	2873	2864
Barley, lbs.	1048	937	943	847
Tame hay, lbs.	1871	1760	1674	1672
Alfalfa, lbs.	314	292	282	276
Di-cal, lbs.	32	30	29	28
Salt, lbs.	129	120	115	113
Total, lbs.	6550	6138	5917	5801

Table 20. Analysis of costs and returns

	BWF	Hereford	Bloom LH	Hanson LH
Cost of calf, $ [1/]	164.40	158.40	140.35	141.75
Cost of feed, $	269.13	251.82	243.45	237.53
Total cost, $	433.53	410.22	383.80	379.28
Carcass value, $	367.92	361.35	333.63	333.50
Loss, $	-65.61	-48.87	-50.17	-45.78

1 / Hereford and BWF @ $40/cwt.
Longhorn X Hereford @ $35/cwt.

Discussion:

Early in the feeding period, an outbreak of shipping fever broke out in lots at the station. Although numerous Hereford and BWF calves were treated and cured, no problems were observed in either pen of LH X H steers. Although our sample numbers were small, it does appear that this LH X H cross is hardy and at least in this instance showed some resistance to disease.

Summary:

The LH X H steers gained about 0.2 of a pound slower than either the Hereford or BWF steers. Feed efficiency was lower with the LH X H steers, although total feed costs per head were about $25 cheaper than with either the Hereford or BWF.

A look at the carcass information shows that the LH X H steers graded essentially the same as the Hereford or BWF and had identical dressing percentages.

The total economic picture shows the LH X H steers equal to Herefords and slightly better than the BWF used in this trial based on the prices used.

Additional work will be carried out to see if these results will continue to hold true.

FEEDLOT PERFORMANCE COMPARISON OF BULLS & STEERS

This trial was designed
to compare feedlot performance and market potential of bulls and steers under similar feeding and marketing conditions.

The feeding of bull calves to produce "bullock" beef at approximately 1050 lbs., or 16-18 months of age, has been demonstrated to be a very efficient method of producing good quality beef. However, to date, the meat trade has discounted "bullock" meat due to lack of consumer acceptance. Thus, the economics of producing "bullock" beef has suffered.

In this first year of the trial, weanling bull and steer calves of either Hereford or Angus X Hereford breeding were allotted and started on trial on December 1, 1975. The bull calves were all purchased, and we found it difficult to find as uniform a group as we would have liked, because of lack of numbers on the market. The steers were mostly from the Station herd, with a few purchased animals added. All groups, steers and bulls, were treated as uniformly as possible with regard to vaccinations, feeding, weighing and handling. The animals were shipped for slaughter when they reached average lot weights of 1050-1100 pounds. The calves were all self-fed a mixed hay and grain ration including minerals according to the schedule shown in table 21.

The cattle were shipped by truck to Flavorland Dressed Beef in West Fargo, North Dakota for slaughter. They sold on an individual grade and weight basis. Additional carcass information was gathered with the assistance of the meats department, Department of Animal Science, North Dakota State University.

<u>Discussion:</u>

The bulls were heavier at the beginning of the trial because of difficulty in obtaining them. They gained at a faster and more efficient rate than did the steers, and were ready for market 85 days earlier than the steers. Both bulls and steers handled equally well.

The bulls graded USDA stag, since there was no established market for "bullock" grade. However, since these "bullock" carcasses did not show the coarseness usually associated with bull beef, they should have been very acceptable from the consumer viewpoint, according to meats department personnel of the Department of Animal Science, North Dakota State University.

<u>Summary:</u>

The Hereford bulls gained .29 pound/day faster, and the BWF bulls .35 pound/day faster than their steer counterparts. Feed efficiency also favored the bulls.

The bull carcasses had less waste fat in the kidney area, approximately 0.5 inches less back fat, and about 3 square inch larger loin eye.

Although the bull carcasses sold for $5.50/cwt less than the steer beef, on the basis of carcass value less feed cost the bulls returned almost $35.00 more per head than the steers.

Results of this trial indicate that “bullock” beef production is a method that can very well increase feedlot efficiency.
The trial will be continued in the 1976-77 feeding period with calves of more uniform starting weights and breeding.

Table 21. Rations as fed to bulls and steers

Ration	**#1**	**#2**	**#3**	**#4**	**#5**
Date started	Dec. 1	March 4	June 15	June 28	July 13-Finish
Ingredients – lbs.					
Oats	500	750	600	450	300
Alfalfa	50	50	50	50	50
Tame hay	450	250	200	200	200
Barley	--	--	150	300	450
Di-calcium	5	5	5	5	5
Salt	20	20	20	20	20
Total	1025	1025	1025	1025	1025

Table 22. Average feed consumption per head per day

	Pounds feed consumed per head per day			
Ingredients:	**BWF bulls**	**Hereford bulls**	**BWF steers**	**Hereford steers**
Oats	11.9	12.8	9.98	9.49
Alfalfa	0.89	1.0	0.99	0.92
Tame hay	6.18	6.13	5.92	5.56
Barley	0.71	0.87	3.31	2.96
Di-calcium	0.09	0.10	0.10	0.09
Salt	0.39	0.41	0.40	0.37
Total	20.16	21.31	20.70	19.39

Table 23. Feedlot performance comparison of bulls and steers

	BWF bulls	Hereford bulls	BWF steers	Hereford steers
No. of head	5[1/]	6	7	7
Period on test	Dec 1-July 19	Dec 1-July 19	Dec 1-Oct 12	Dec 1-Oct 12
Days fed	231	231	316	316
Slaughter wt., - (live), lbs.	1056	1098	1093	1063
Starting wt., lbs.	477	542	411	396
Gain in feedlot, - lbs.	579	556	682	667
ADG, lbs.	2.50	2.40	2.15	2.11
Feed/100# gain	805	884	960	920
Cost of feed/hd, $	186.29	198.46	269.13	251.82
Cost/100# gain, $	32.17	35.69	39.46	37.75

1 / One animal removed.

Table 24. Slaughter data comparison of bulls and steers

	BWF bulls	Hereford bulls	BWF steers	Hereford steers
Hot carcass wt., lbs.	611	658	640	628
USDA grade	5 stags	6 stags	7 choice	7 choice
Carcass value/cwt., $	52.00	52.00	57.50	57.50
Total carcass value, $	317.93	341.99	367.92	361.35
Dressing %	57.9	59.9	58.5	59.1
Kidney knob, lbs. est.	12.6	17.0	23.2	19.7
Loin eye, sq. inch	13.84	13.88	10.77	10.68
External fat thickness	0.27	0.27	0.94	0.74
Carcass value, less Feed cost, $	131.64	143.53	98.79	109.53

COMPARISON OF BEEF AND DAIRY STEERS ON SELF FED HIGH ENERGY FATTENING RATIONS

This trial was started in 1974 at the request of the North Dakota Milk Producers Association to study the management steps and feed requirements necessary to produce acceptable dairy beef, and to compare the economics of feeding dairy steers and beef steers.

Hereford and Holstein steers weighing about 420 pounds were started on a self-fed ration of oats, tame hay, alfalfa and minerals. After the steers reached an average of 650 pounds, barley was gradually substituted for oats until barley made up 60% of the total grain in the ration.

The Hereford steers and half of the Holstein steers were slaughtered at an average weight of about 1050 pounds. The remaining Holsteins were slaughtered when they weighed between 1175 and 1200 pounds.

Average feed consumption for the 1975-76 feeding period is shown in table 25. Average results for three feeding periods, from 1974 thru 1976 are summarized in table 26.

Summary:

Feeding either beef or dairy steers on a high energy fattening ration has not been a paying practice over the three year period of this trial.

Dairy steer calves were bought for $12.50 to $19.00 per hundredweight less than beef steer calves, and with this kind of market spread in purchase price dairy steers can compete favorably with beef steers when both are fed to finish weights of 1050-1100 pounds.

After dairy steers reached weights of 1050-1100 pounds, both rate of gain and feed efficiency declined.

With the revised grading system placing less emphasis on conformation and more emphasis on rib eye marbling, well fed dairy steers are able to grade very well.

Both beef and dairy steers performed well in the feedlot in all three years of this trial, with no noticeable difference in sickness or other feedlot problems between breeds.

Table 25. Average feed consumption for steers fed from December 1, 1975 to August 24 or October 12, 1976

	Hereford steers sold Oct 12, 1976	Holstein steers sold Aug 24, 1976	Holstein steers sold Oct 12, 1976
	Average pounds feed per day		
Oats	10.8	12.7	11.8
Barley	3.0	2.0	3.3
Alfalfa	0.9	1.0	1.0
Tame hay	4.4	4.8	4.8
Di-cal	0.1	0.1	0.1
Salt	0.4	0.4	0.4
Total	19.6	21.0	21.4

Table 26. Weights, gains and return for beef bred and dairy bred steers- 3 year average

	Beef steers	Dairy steers	Dairy steers heavy
Initial wt., lbs.	428	448	437
Final wt., lbs.	1076	1088	1165
Gain, lbs.	647	640	728
Days fed	311	295	367
ADG, lbs.	2.09	2.18	2.0
Hot carcass wt., lbs.	637	634	676
Dressing %	59.0	57.3	57.9
USDA grade	76% choice 23% good	50% choice 40% good 10% standard	57% choice 38% good 5% standard
Avg. carcass value, $	393.25	374.77	379.02
Initial cost, $	181.91	125.90	123.58
Feed cost/hd., $	242.87	246.64	319.88
Total cost, $	424.78	372.54	443.46
Return, $	-31.53	+2.23	-64.44

RUMENSIN IN HIGH ROUGHAGE FATTENING RATIONS

Rumensin is a new feed additive for beef cattle that is reported to improve feed efficiency by increasing the energy available from a given amount of ration. This is accomplished by altering rumen fermentation to increase the proportionate amounts of useable volatile fatty acids, with less loss of carbon dioxide and methane gas.

In this trial, two pens of straightbred Hereford steer calves of similar background were randomly allotted on February 10, 1976. Both pens were hand fed 4 pounds ground oats per head per day, and were self-fed chopped mixed hay consisting of approximately 20% alfalfa and 80% tame grass. Both lots were also self-fed a mineral mixture free choice.

In addition, one lot received 150 mg per head per day of Rumensin (monensin sodium) in the ground oats until May 22nd, at which time the level of Rumensin was increased to 200 mg per head per day. The Rumensin fed steers averaged about 610 pounds at this time. On October 13th, ground barley was added to the ration at the level of 3 pounds per steer per day.

The results of this trial after 274 days on feed are shown in table 27. The steers will continue on feed until they reach live weights of 1050-1100 pounds, at which time they will be slaughtered and carcass information gathered.

Summary:

Although no serious problems have been encountered with the use of this additive, the calves were somewhat reluctant to accept the ration for the first three or four days.

To date, the steers receiving Rumensin apparently have outgained the control steers. They have also required less feed per pound of gain, resulting in lower cost.

A complete report on this trial will be available on request after February 1, 1977 and will be published in the 1977 Livestock Research Roundup handbook.

We would like to thank Elanco Company for the Rumensin used in this trial and Dr. William Dinusson for assistance in designing the trial.

Table 27. Weights, gains and feed cost to date. Rumensin feeding trial

	Rumensin	Check
No. head	7	7
Days fed (Feb 10-Nov 10)	274	274
Initial wt., lbs.	411	406
November wt., lbs.	911	861
Feedlot gain, lbs.	500	455
ADG, lbs.	1.82	1.66
Feed/pound gain, lbs.	9.41	10.00
Feed cost/cwt gain, $	28.83	30.82
Feed/head/day, lbs.	17.13	16.62
Feed cost/head/day, $ [1/]	0.526	0.513

1/ Feed costs do not include cost of Rumensin or minerals. At this writing, cost of Rumensin at 150-200 mg per head per day should not exceed 2¢ per head per day.

BACKGROUNDING OR FINISHING AS FEEDING ALTERNATIVES

There is a difference of opinion among North Dakota stockmen with regard to the net income that can be derived when calves are handled in a backgrounding program and marketed as feeders, weighing 700 to 800 pounds, compared to calves finished for slaughter. Some stockmen, because of the circumstances under which they operate, may not be able to hold their calves any longer than late winter or early spring, at which time they want to market at the top price for feeders. For those who could feed a greater length of time and utilize more cheap feed the question arises as to whether or not marketing as feeders will bring a greater income than those finished. There also is the question as to whether or not top market price is received for feeders when fed a good gaining ration up to 750 pounds. Some livestock men believe that calves fed a good gaining ration will carry too much condition to bring top market price as a 750 pound feeder, and that those sold as feeders cannot be fed a ration for good gains.

Little work has been done on this method of handling calves when fed for good gains either to be marketed as feeders or when finished for slaughter. Some reports indicate that the income for feeders up to 700-800 pounds will not be less if a ration is fed that gives a good gain resulting in growth along with additional condition. Others report that the increased weight which is cheaper because of faster gains will off-set the higher price that may be received for an animal which has made slower gains and has more frame and less condition.

This trial was designed to compare the economics of backgrounding program with a finishing program for the North Dakota calf producer. Calves averaging 400-425 pounds were randomly assigned to be backgrounded at either a moderate or high level of energy, and when the calves averaged 700-750 pounds half of them were randomly selected to be sold while the remaining steers were finished at a high level of energy to slaughter weights.

The results of this year's trial and the three year averages have been summarized in tables 28 through 31.

<u>Summary:</u>

In 1974 expenses were much too high in relationship to selling price which resulted in a net loss for both backgrounding and finishing. In 1975 a more favorable balance resulted in a net above feed and calf costs for all feeding and marketing alternatives. This year calves backgrounded at a moderate level of gain produced less expensive gains resulting in an average of $6.67 higher return. Finishing, during 1976 resulted in a net loss regardless of the backgrounding type, however, those calves backgrounded at a moderate level of gain and then finished at maximum level of gain yielded a net loss that was $11.00 less than the loss sustained under the heavy feeding regime.

Backgrounding at a moderate level of gain, when compared over the last three years, has resulted in an average net profit of $16.96 as compared to $2.28 when fed for maximum gains, and in addition, the moderate level of feeding has produced calves that are well framed, and carry only a moderate amount of condition.

Finishing at a high level of energy following backgrounding at a moderate level of energy resulted in a three year average net loss of $23.05 per head as compared to a net loss of $37.68 when a high level of energy was fed during both backgrounding and finishing.

Table 28. Backgrounding feed consumption and costs when fed at two levels of gain – December 1 – April 29, 1976

Ingredients	Moderate	Heavy
Days fed	149	149
ADG, lbs.	1.83	2.15
Oats, lbs.	4.8	11.5
Alfalfa, lbs.	0.8	0.8
Mixed hay, lbs.	11.1	4.0
Di-cal phosphate, lbs.	0.08	0.08
Salt, lbs.	0.32	0.32
Total/hd/day, lbs.	17.10	16.70
Feed cost/lb., $	.03241	.04241
Feed/lb. gain, lbs.	9.34	7.77
Feed cost/cwt gain, $	30.27	32.95
Total feed cost/hd, $	82.33	102.80

Table 29. Backgrounding at two levels of gain – weight gains, returns and expenses – 1976 and 3 year average

	Dec. 1-April 29, 1976		3 Year average	
	Moderate	Heavy	Moderate	Heavy
No. head	10	10	10	10
Days on feed	149	149		
Initial wt., lbs.	418	425	430	430
Final wt., lbs.	690	737	675	715
Gain, lbs.	272	312	245	285
ADG, lbs.	1.83	2.15		
Returns/hd @$41.40/cwt @$41.00/cwt	285.66	 302.17	264.88	271.21
Expenses:				
Calf cost/hd, $	160.93	163.63	181.90	182.80
Feed cost/hd, $	82.37	102.85	66.02	86.13
Total expenses, $	243.30	266.48	247.92	268.93
Net gain/loss, $	+42.36	+35.69	+16.96	+2.28

Table 30. Finishing feed consumption and costs following back-grounding at two levels of gain, April 29-October 12 1976

	Moderate	Heavy
Days fed	166	166
ADG, lbs.	2.34	1.93
Oats, lbs.	10.5	10.2
Alfalfa, lbs.	1.2	1.1
Mixed hay, lbs.	5.8	4.3
Barley, lbs.	6.4	5.9
Di-cal phosphate, lbs.	0.12	0.11
Salt, lbs.	0.48	0.42
Total daily consumption, lbs.	24.50	22.03
Feed cost/lb., $	.04254	.04365
Feed/lb. gain, lbs.	10.47	11.41
Feed cost/cwt gain, $	44.54	49.80
Total feed cost/hd, $	173.26	159.36

Table 31. Finishing weight gains, returns and expenses – 1976 and 3 year average

	April 29 – Oct 12, 1976		3 Year average	
	Moderate	**Heavy**	**Moderate**	**Heavy**
No. head	10	10	10	10
Days on feed	166	166	176	176
Initial wt., lbs.	683	728	673	706
Final wt., lbs.	1072	1048	1045	1076
Gain, lbs.	389	320	372	370
ADG, lbs.	2.34	1.93	2.11	2.10
Returns:				
Avg. carcass wt., lbs.	635	630	618	639
Carcass grade	10 choice	10 choice	73% choice	77% choice
Dressing %	59.2	60.1	59.1	59.5
Avg. carcass value, $	365.13	362.25	379.98	394.36
Expenses:				
Calf cost/hd, $	159.39	160.93	181.39	181.91
Feed cost/hd, $	255.66	262.25	221.64	250.13
Total expenses, $	415.05	423.18	403.03	432.04
Net gain/loss, $	-49.92	-60.93	-23.05	-37.68

CALF SHELTERS

Calf shelters of one kind or another have been used by cattlemen for a long time, and many plans and designs are available from various sources.

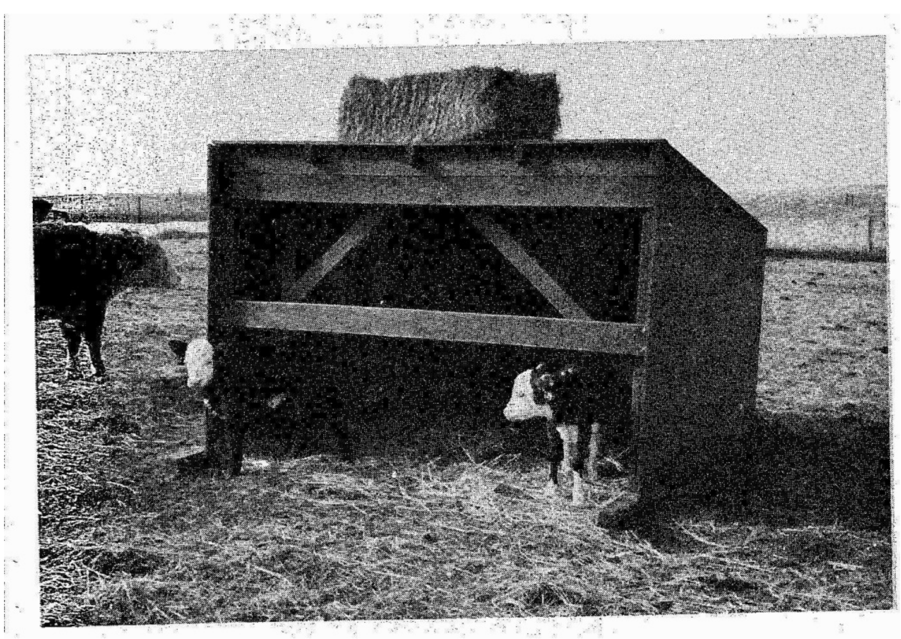
Shelters used at the Dickinson Experiment Station are effective, simple and easy as well as economical to build. This shelter, shown in figure 1, is a balloon frame shed designed to utilize full 4'x8' plywood sheets wherever possible, reducing cutting and fitting to a minimum.

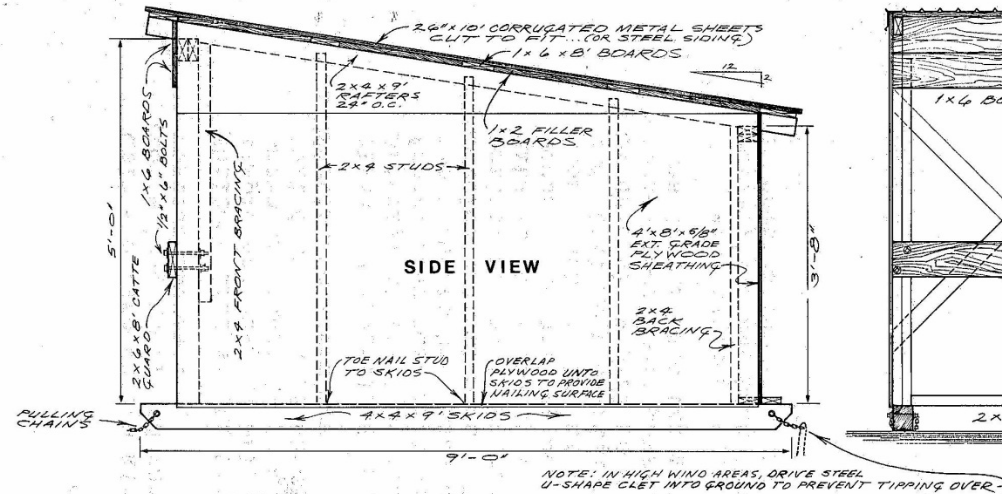
Plans and specifications for this shelter are shown in figure 2. Briefly, it is eight feet square, five feet high at the open front, four feet high at the back, has a 2x6 positioned across the front to keep cows out, the entire unit riding on 4x4 skids beveled on both ends. Design considerations included maneuverability and sunlight penetration. Its relatively small size permits it to be easily moved by one man when wind direction changes occur. The shallow depth of eight feet permits sunlight penetration nearly to the back wall, enabling calves to lay in the sun and still be protected from the cold wind. No shelters have been blown over by wind in two years use. However, any operator concerned about this possibility could anchor the shelter with steel pins driven into the ground, and attached to the skid drag chains.

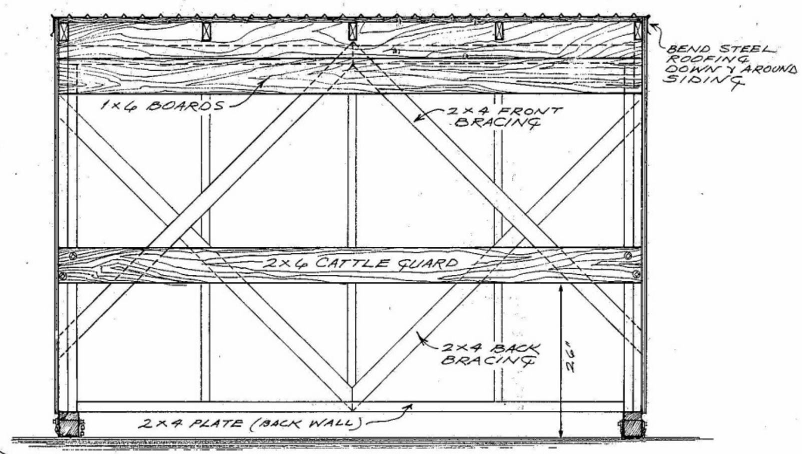
This size shelter will comfortably accommodate twelve to fifteen calves, and has been found very satisfactory, especially when used in combination with the slotted board fence shelter for the cow herd.

Calf shelters must be properly managed to avoid problems with scours. A shelter should never be bedded a second time in the same location. One of the advantages for smaller shelters is the ease with which they can be moved to new ground, making it easy to keep them clean and sanitary.

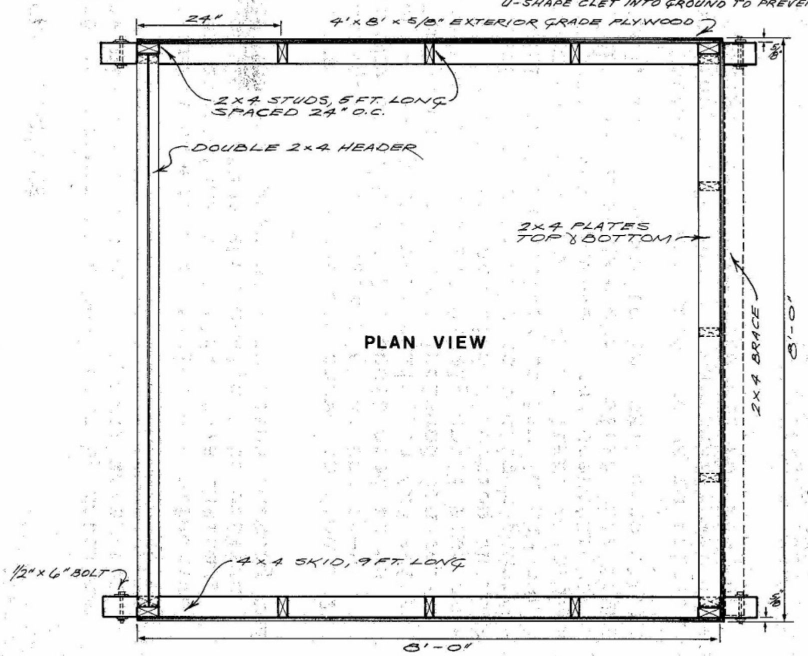
Fig. 1 Calf shelter used at the Dickinson Station

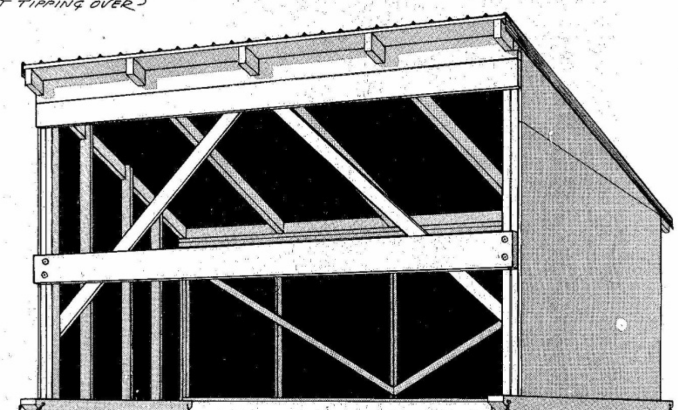






FRONT VIEW





PERSPECTIVE VIEW

Materials List

2 . . . 4 x 4 x 9' SKIDS
17 . . . 2 x 4 x 5' STUDS
5 . . . 2 x 4 x 9' RAFTERS
5 . . . 2 x 4 x 8' PLATES
4 . . . 2 x 4 x 6' BRACES
5 . . . 1 x 6 x 8' BOARDS
8 . . . 1 x 2 x 18" FILLER BOARDS
1 . . . 2 x 6 x 8' GUARD RAIL
4 . . . 4 x 8 x 5/8" EXTERIOR PLYWOOD
4 . . . 26" x 10' METAL ROOFING
8 . . . 1/2" x 6" BOLTS
4 . . . 16" PULL CHAINS

NAILS . . .
16 LBS. FRAMING NAILS (20d)
6 LBS. GALV. NAILS (6d)
2 LBS. GALV. ROOFING NAILS/LEAD WASHER
PAINT OR STAIN

Section I - A

Special Reports
Straw for Wintering Beef Cows

By

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Dickinson Experiment Station
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STRAW FOR WINTERING BEEF COWS
W. E. Dinusson

By-products from the production of agricultural crops are now, and have been for centuries, used as feeds for livestock. Straw and chaff from the cereal grains are no exception. In an old edition (1936) of Feeds and Feeding, Morrison stated, "Straw from the small grains is satisfactory as the chief feed or even as the only roughage for wintering beef breeding cows or young cattle over a year of age, if it is properly supplemented." In this statement what constitutes a "supplement?" Thus, misinterpretations of this statement were frequent.

Was the "straw" prior to 1936 the same as the straw of today? What changes have taken place in the last 40 to 50 years which may have affected the feeding value of straw? Probably the biggest change was a change in harvesting methods. The straws of today picked up by a baler usually do not have the weed seeds, broken kernals, etc., so common in the straw stacks nor is the straw broken up as much by the combine as was the case with the old threshing machines. Even the chaff from chaff savers is different from the chaff found at two sides of the straw stack. The grains were usually cut on the "greener" side and let mature in shocks which preserved more of the leaves and weeds which accumulated in the straw pile.

A second major difference is the use of herbicides to control weeds. Many of the weeds common in cereal grains did not have considerable nutrient value which tended to "supplement" the missing nutrients in the straw. Other differences are varieties. Cereal plant breeders are looking for and incorporating characteristics into the grains which tend to increase yields and ease of harvesting. What effect does the shorter, stiffer straw have? If increased straw strength is obtained, it is likely that there would be an increase in lignin which is not only indigestible but also reduces the digestibility of the cellulose part of the straw. Further, increased straw strength and reduced shattering permits the crop to stand until more mature before swathing or even straight combining and this would result in lower digestibility and lower nutritional value. Does increased resistance to disease in these crops result in an affect on nutritive value? Probably, because if the plant is more resistant to bacterial or fungal invasion, it is likely to also resist the ruminal bacterial action.

The trend towards rough-awned or bearded cereal grains to permit the swaths to stay on top of limited stubble may also cause problems when chaff savers are used. The rough beards have been known to cause sores and abscesses in the mouth and throat region when bearded cereal grains were cut for hay when overly mature. How much of a problem this would be when chaff savers are used remains to be seen.

Should plant breeders pay attention to possible feeding value of these by-products. Probably not at this time, because of economic considerations. In some countries of the world where the straws are a major feed for livestock this is considered, but the production from the cattle fed these by-products as the major feeds is much below that demanded from livestock here.

What are the merits as well as weaknesses of straw as feeds for cattle and sheep. Table 1 presents some data found in textbooks and tables of feed composition. Many of these values were obtained 40 to 50 years ago and may not be a true estimate of the straws and chaffs of today. A couple of hays are included for comparisons. The NRC requirements for wintering pregnant beef cows are also listed. These percentage requirements are based on intakes of 1.8 to 2 pounds of ration per 100 pounds live weight.

TABLE 1. STRAW AND CHAFFS
(as fed basis)

	TDN	PROTEIN	DIG. PROT.	CRUDE FIBER	PHOS.
	%	%	%	%	%
Alfalfa hay (Med bloom)	51	16.5	11.4	26.8	.20
Prairie hay (Cut early)	47	7.8	2.2	28.5	.17
Crested Wheat (Cut early)	52	9.7	5.7	29.3	.13
Wheat Straw	43	3.2	0.4	37.1	.07
Wheat Chaff	37	5.1	0.8	29.8	.14
Oat Straw	46	3.8	1.1	36.3	.09
Oat Chaff	34	5.0	1.0	26.0	.30
Barley Straw	38	3.6	0.7	36.2	.09
Rye Straw	28	3.0	0.0	42.4	.09
Wintering Cow Requirements	47	5.4	2.5	----	.16

A quick look at this table shows that as the only feed, only the hays have enough usable energy and because of the poor apparent digestibility of the protein, only two of the hays would meet the needs for digestible protein. One other fact is evident – either alfalfa or crested wheat hay cut early as 1/3 to ½ of the ration with most of the straws making up the rest of the ration would meet the requirements for wintering cows – at least up to the last month to 6 weeks of pregnancy.

It can be seen from these values that it's a toss-up which is more limiting – usable energy (TDN) or digestible protein. Unless minimum maintenance requirements are met, than any protein supplement, such as soybean oil meal, would be used for energy purposes. On the other hand if protein (nitrogen) is seriously lacking the energy would be poorly digested and utilized. This will be mentioned later in relation to the effect on voluntary intake. Straws can never be depended upon to supply vitamin A. Certainly following a dry year where cattle have grazed dry, dead grass for most of the fall, with no green regrowth, this could bring on a vitamin A deficiency and vitamin A should be included in the supplement unless the hay portion is exceptionally green and leafy. Neither can rations based on straw be depended on to supply phosphorus or trace minerals. Therefore a good salt-mineral mix should be available to provide phosphorous and trace minerals.

With all of its nutritional short coming, why is straw included in wintering rations? The reason is that straw, as a part of the ration, can be utilized to provide the heat necessary to maintain body temperature. It is well known that the poorer the roughage the greater is the heat increment. Heat increment is the amount of heat given off during the eating, digestion and metabolism of feedstuffs. Thus if some feed is given to provide additional energy and protein the straw can be used as the rumen "filler" and provide the heat which is so necessary.

In addition to the reasons just mentioned, there is another factor to be considered when trying to winter cows on straw alone. The cows can't eat enough to meet their requirements: Research has shown that when cows are fed average to good grass hay they can eat about 2 to 2.2 pounds per 100 pounds of body weight. When fed straw alone, they can eat only 1 to 1.5 pounds per 100 pounds body weight daily (with excellent quality chopped straw intake might be slightly greater). Feeding some protein (nitrogen) may increase intake a bit, but some additional source of energy is also needed. Why is this? With low energy feeds, intake is limited by capacity of the rumen and digestive tract. In the case of straw the rate of digestion is much slower than for a better quality roughage. For example, had the cows been fed all the crested wheat hay referred to in Table 1 that they could eat, they would have consumed over 2 pounds per 100 pounds body weight. It would have taken 55 to 70 hours for any given feeding to be digested and the orts excreted. In the case of wheat straw alone, intake would have been about 1.3 pounds per 100 pounds of body weight and the transit time through the digestive system would have been 90 to 110 hours. In the case of the rye straw, had it been fed as the only feed, intake would have been less than one pound per hundred pounds, and impaction would have resulted. In fact, when roughages contain less than 35% TDN, cattle will hardly consume them unless forced by starvation or extremely cold weather. This brings up another factor. Cold weather stimulates a cow's appetite and will temporarily increase feed intake. Cold will also cause a reduction in digestibility. Although cows can adapt, that is, cold weather will have less effect in March than it did have in November, it still has to be considered. Reports from the field have shown that cows have been wintered on poor quality roughages during mild weather only to have impactions following a real drop in temperature.

Can straw be used to advantage in rations for wintering cows? Some recent research sheds some light on how to use straw to the best advantage. In 1965 the Dickinson Station initiated some research on the use of straw. The rations used were 20 pounds of crested-bromegrass hay plus minerals compared with 7 pounds crested-bromegrass, one pound soybean oilmeal, and wheat straw free-choice, plus the same mineral mix. After the first year, because of waste, the straw was chopped and self fed. Chopping the straw also resulted in increased intake. About February 1 each year, both lots received two pounds of barley plus 10,000 I.U. of vitamin A per head per day. About March 15, the straw and soybean oilmeal were removed and hay increased to 20 pounds. Calving started the last week of March. Grain was also fed during lactation until cows went on pasture. Table 2 summarizes the average of 4 years data. The straw consumed averaged 10.5 pounds per day.

TABLE 2. STRAW VS. HAY FOR COWS
(Four Year Summary)

	Hay Lot	**Hay & Straw Lot**
Cows No. (avg/year)	46.5	46.5
Initial wt. (Dec) lb.	1065.1	1060.3
Wt. (May) lb.	998.5	968.3
Difference lb.	-66.7	-92.0
Fall Wt. (Oct) lb.	1117.9	1100.5
Summer gain, lb.	119.5	132.2
Wt. Change (Dec-Oct) lb.	52.8	40.2
Calf birth wt., lb.	72.3	71.3
Calf weaning wt., lb.	378.1	376.7
Conception rate (3 yrs) (Cows and Heifers		
First Cycle	27	27
Second Cycle	12	10
Third Cycle	5	5

In these trials the beef cows wintered on the hay rations lost weight in two of the four years, while those receiving one-third hay and two-thirds straw lost weight every winter. Average calf birth weights and weaning weights were essentially the same. Conception rates were about the same for both groups.

In another series of trials, straw was used in rations for wintering beef cows where two types of protein supplementation was tested, biuret vs. soybean oil meal. In the first years of work the rations were about 7 pounds crested brome hay, 12 pounds of chopped wheat straw (fed free choice) and one pound of barley for the first 68 days, increased to 3 pounds per head for the last 45 days. The cows gained an average of one-third pound per day for this period with no observable difference in calf birth weights. In the second trial, crested brome hay was fed at a level of 5 pounds per head daily and chopped out straw fed free choice, plus one pound of barley per head daily and protein source plus minerals. The straw consumption for this trial was 15.4 and 16.8 pounds for the soybean oil meal and Kedlor lots respectively. The gains were about half a pound and a quarter pound daily for the cows, with no appreciable difference in calf birth weights. In the third trial similar rations were fed to the two groups except the out straw was fed in the long form and barley was not fed until the last 17 days at the rate of 2 pounds per head daily. The straw consumption amounted to about 14 pounds daily for each lot. In this experiment, they lost over a pound a day in the Kedlor treatment and 0.84 pounds in the soybean oil meal group. There was little difference in calf birth weights. Apparently there was lack of energy intake and the cows could not consume enough straw when it was fed in the long form.

In the third series of experiments at the Dickinson Experiment Station on the use of straw in rations for wintering beef cows mixed brome-crested hay was compared to a 50:50 mixture of brome-crested hay and oat straw. Both rations were fed in the long form with no supplemental protein. The hay appeared to have a high enough crude protein to provide the minimum protein needed. The rations were fed for about 60 days, starting about December 1, after which the straw was replaced with hay and supplemental grain feeding (one pound rolled barley per head per day) was fed to both groups. This was fed for 30 days until calving at which time the cows calving were moved to another lot and fed two pounds of oats, plus all the hay they would consume. A salt-mineral mixture was available at all times.

The roughage intake was about 21.5 pounds per head daily, with the hay-straw lot eating a little less. A 3-year average shows that the hay fed lots gained about half a pound per day for the 60 day period on roughage alone, whereas the hay-straw fed lots maintained their weights. Birth weight of calves were similar between lots.

Another interesting observation in these trials, was the production on native dead grass or stubble aftermath when grazed from about November 1 to December 1. In all three years the cows lost weight during this period, even though supplemental protein blocks were provided. In fact, the average loss over the 3 years was over a pound a day per cow. Thus the average total loss of weight during the grazing period of 30 days was greater than the 60 day loss, even for those cows receiving half their ration as oat straw.

In the experiments just reviewed, although not designed to effectively measure the effect, the data suggests that first and second calf heifers should be in good body condition in the fall if they are to be wintered on even 50 percent straw in their rations.

In the last couple of Feeder's Day Reports from the University of Alberta, research on the feeding of straws is reported. In a trial to measure the voluntary intake of oat straw by beef cows as affected by amount of supplemental feed, intake of oat straw was over 18 pounds per head daily and was not affected significantly by the various supplements fed or small changes in the fineness of chopping. Three, five or seven pounds of a grain and/or protein supplement results in gains of 0.8 to 1.18 pounds for the first 68 days of the wintering period. In the last month of the trial, gains of the cows were less and mixing a pound of molasses with the days feeding did not improve intake of straw appreciably nor did the addition of a liquid sugar-urea mixture.

In continuing studies the following year, cows were wintered for 98 days on rations containing from 78 to 94% barley straw. Three physical forms of ration were used, pelleted, chopped or ground. In addition, three levels of protein were used and different amounts of barley grain was fed. All rations were adequately supplemented with minerals and vitamins. The cows fed the pelleted rations ate more (over 23 pounds per head per day) and gained more (0.9 lbs per day) than those receiving the ground rations (21 pounds and gain of 0.55 pounds per day). There was little difference in feed intake with the different protein levels but the gains increased with each increase in protein level. The voluntary feed intake of the pelleted diets increased from 21.3 to 28 pounds per day as the percentage of straw was decreased from 94 to 78% of the pellets. However, the intake of straw remained relatively constant.

The researchers at Alberta started another experiment to further evaluate high levels of straw in beef cow rations. In the previous experiment two cows had died. They had also been individually fed to measure feed wastage as well as intakes. To further check on group feeding of high straw rations, in this experiment, seven different rations containing different levels of protein and 85 to 100 percent straw were used. The cows fed the 100 percent straw diet were given 2 pounds of rapeseed meal per head daily for the first 10 days of straw feeding. The Bonanza barley straw used in this experiment was either fed from the bale or, in some lots, chopped. Minerals and vitamins were provided in all treatments.

After about 50 days on test, one of the sheds burned down and 4 of the 7 treatments had to be discontinued. However, some very interesting observations were made. Daily feed consumption for the 100% straw ration (supplemented with mineral and vitamins) was less than 15 pounds per head per day and the loss in weight was one-third pound per day. In addition, four cows on rations containing less than 15% concentrate (grain plus protein supplement) died of abomasal impaction. Three other cows showed problems and were removed from their pens and given limited hay for one to 3 days and recovered. In this experiment, chopping the straw did not increase intake but there was about 15% less waste of straw over that fed in long form.

From reviewing these and other experimental results some preliminary conclusions can be drawn:

1) Straw, even when supplemented with minerals and vitamins, should not be the only feed for wintering cows.

2) Straw can replace up to two-thirds of the hay, if supplemented with minerals and vitamins.

3) If the hay is of good quality (above 10.5 percent crude protein) additional protein supplementation should not be necessary for wintering beef cows.

4) If the one-third hay is only fair to poor quality and less than 9% crude protein, additional supplementation with protein source is recommended.

5) Chopping of the straw will usually increase intake and reduce waste. Grinding straw (less than three-fourths inch lengths) is of questionable value.

6) With rations of straw and grain, or grain-protein-mineral-vitamin mixes, a minimum of three pounds of the concentrate needs to be fed to minimize difficulties from impaction and other health related problems.

7) Two and three year old heifers and cows do not appear to get adequate nutrition on rations containing one-half to two-thirds straw when fed in competition with older cows.

8) Additional research is needed to find ways to more effectively use straw in beef cow rations.

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Section II

Reports of

Swine Research in Progress

at the

Dickinson Experiment Station

Presented by the

Station Staff

at the

27th Annual Livestock Research Roundup

Dickinson Experiment Station
Dickinson, North Dakota

December 1, 1976

HOG MARKETING ECONOMICS
SELLING PACKER GRADE AND YIELD VS. SELLING LOCALLY

A study designed to evaluate the economics of selling market hogs on a grade and yield basis as compared to selling at a local buying station was initiated at the Dickinson Experiment Station in the 1975-76 winter season.

In this economic study, market barrows from the station were randomly assigned to be marketed at either the Hormel and Company plant, Mitchell, South Dakota or Western Livestock Company, Dickinson, North Dakota. The project called for one group to be sold on March 4th, and a second group on October 1st. Inclement weather during the first week of March, caused the scheduled March 4 selling to be delayed until March 12th.

On March 12th, thirty six market pigs were weighed, and shipped to the Hormel and Company plant at Mitchell, South Dakota, a distance of 450 miles. The average weight of the 36 pigs at Dickinson was 242.5 pounds. Upon arrival at Mitchell, the 36 pigs averaged 237.6 pounds. The average shrink of 4.9 pounds per head amounted to 2.02 percent. At Mitchell, the pigs were provided with shelter, feed, and water until being slaughtered, approximately sixty hours after leaving Dickinson.

Pigs marketed on October 1st averaged 223.1 pounds per head at Dickinson and on arrival at Mitchell their average weight was 215.2 pounds per head. Loss in transit of 7.9 pounds per head amounted to an average shrinkage of 3.5 percent. On arrival in Mitchell, after eight hours hauling time, the pigs stood an additional five hours before starting to the kill floor.

Dickinson weights, destination weights and percent shrinkage for liveweight marketing methods are shown in table 1.

Table 1. Weight summary – pigs sold grade and yield vs. local marketing

Method of Marketing	**Grade & yield**		**Local market**	
Date marketed	**March 12**	**Oct. 1**	**March 12**	**Oct. 1**
No. of head	36	28	19	7
Total Dickinson wt., lbs.	8729	6247	4459	1653
Avg. wt./pig, lbs.	242.5	223.1	234.7	236.1
Total wt. at destination, lbs.	8555	6025	4459	1620
Total shrink, lbs.	174	222	--	33
Shrink/pig, lbs.	4.9	7.9	--	4.7
Percent shrink	2.02	3.5	--	2.0

Those pigs selected for local marketing on March 12th were weighed and hauled directly to the local buying station at Western Livestock Company. Since the Experiment Station is located two miles from the local buying station no measurable shrinkage was experienced. Therefore, pigs marketed locally on October 1st were weighed, hauled thirty miles, and then sold to duplicate a typical trip to market. The pigs lost 4.7 pounds per head which amounted to an average shrink of 2.0 percent as shown in table 1.

Grade and yield market information, meat price computation, premium payments for grade, and live market values have been summarized in tables 2 through 4.

Table 2. Grade & yield data, Hormel & Company, Mitchell, South Dakota – hogs marketed March 12, 1976

March 12 hog market (total liveweight marketed 8,555 lbs.)			
Live wt.	**Price/cwt**	**Live wt.**	**Price/cwt**
180-190	44.50	250-260	43.75
200-230	45.00	260-270	43.25
230-240	44.75	270-280	42.25
240-250	44.25	280-290	41.25

Meat price computation and extended value:							
Live wt.	**Hot carcass**	**Mkt. price**	**÷**	**Yield conv. factor**	**=**	**Meat price/ cwt**	**Extended value, $**
200-230	2059	(45.00	÷	.72)	=	$62.50	1,286.88
230-240	688	(44.75	÷	.725)	=	$61.75	424.63
240-250	543	(44.25	÷	.727)	=	$60.86	330.47
250-260	1513	(43.75	÷	.729)	=	$60.01	907.95
260-270	588	(43.25	÷	.730)	=	$59.24	348.33
270-280	605	(42.25	÷	.732)	=	$57.71	349.15
280-290	421	(41.25	÷	.733)	=	$56.27	236.89
	6417						3,884.30

Carcass grade and premium payment for grade:				
Grade	**No. head**	**Hot carcass wt.**	**Grade differential/cwt**	**Amount**
1	10	1589	+$1.75	$27.80
1a	6	1131	+$1.25	$14.13
2	6	1004	+$1.00	$10.04
2a	5	950	+$0.75	$ 7.12
2b	4	818	+$0.50	$ 4.09
3	5	925	--	--
Totals	36	6417		$63.18
Total grade and yield value		$63.18		
		$3,884.30	$3,947.48	
		$3,947.48	85.55	= $46.14/cwt

Table 2. Grade & yield data – hogs marketed March 12th continued

Actual yield 6417 ÷ 8555 =	75.0%
Hormel's average standard yield @ 235 =	72.5%
Yield difference	+2.5%
Market value excluding grade	$45.00/cwt
Market value increase for yield	+$0.41/cwt
Market value increase for grade	+$0.73/cwt
	$46.14/cwt

Table 3. Grade & yield data, Hormel & Company, Mitchell, South Dakota – hogs marketed October 1, 1976

October 1, hog market (total liveweight marketed 6,025 lbs.)

Live wt.	Price/cwt	Live wt.	Price/cwt
180-190	32.50	240-250	33.00
190-200	33.00	250-260	32.50
200-230	33.50	260-270	32.00
230-240	33.25		

Meat price computation and extended value:

Live wt.	Hot carcass	Mkt. price	÷	Yield conv. factor	=	Meat price/ cwt	Extended value, $
180-190	267	(32.00	÷	.709)	=	45.13	120.49
190-200	280	(33.00	÷	.713)	=	46.28	129.58
200-230	2502	(33.50	÷	.720)	=	46.52	1,163.93
230-240	518	(33.25	÷	.725)	=	45.86	237.55
240-250	889	(33.00	÷	.727)	=	45.39	403.51
	4456						2,055.06

Carcass grades and grade differential:

Grade	No. head	Hot carcass wt.	Grade differential/cwt	Amount
1	17	2629	+$1.75	$46.00
1a	1	180	+$1.25	$ 2.25
2	6	938	+$1.00	$ 9.38
2a	2	355	+$0.75	$ 2.66
3	2	354	--	--
		4456		$60.29

Total grade and yield value		$60.29	
		$2,055.06	$2,115.35
		$2,115.35	60.25 = $35.11/cwt

Table 3. Grade & yield data, Hormel & Company, Mitchell, South Dakota – hogs marketed October 1, 1976 continued

Actual yield 4456 ÷ 6025 =	73.96%
Hormel's average standard yield =	72.08%
Yield difference	+1.88%
Market value excluding grade	$33.50/cwt
Market value increase for yield	.60/cwt
Market value increase for grade	1.01/cwt
Total grade and yield value	$35.11/cwt

A comparison of these two marketing methods based on an equal weight of 220 pounds is shown in table 4.

Table 4. Comparison of grade and yield marketing vs. local marketing based on equal weight

Method of Marketing	**Grade & yield**		**Local market**	
Date marketed	**March 12**	**Oct. 1**	**March 12**	**Oct. 1**
Live wt. value/cwt	46.14	35.11	43.75	33.75
Gross return, 220 lb. market hog, $	101.51	77.24	96.25	74.25
Expenses: trucking, $	-2.77	-3.03	-0.50	-0.50[1/]
shrinkage, $	-2.14	-2.66	--	-1.59
Net return, $	96.60	71.55	95.75	72.16
Difference, $	+0.85			+0.61

1 / Trucking is a variable cost, substitute your own value when evaluating your market situation.

Summary:

The results, after two marketings, indicate that there is no advantage for selling market hogs on a grade and yield basis from the Dickinson area. Trucking expense and an average liveweight shrinkage of 2.75% resulted in an average net cost of $3.21, which in the second marketing was not offset by grade and yield premiums.

Data summarized in table two and three illustrates that the highest grade and yield premiums were paid for number one and two grade hogs that weighed from 200- 230 pounds on arrival at Mitchell, South Dakota, and that prices paid for hogs lighter or heavier than the optimum 200-230 pound weight class were discounted heavily. Hogs can easily become heavier than the optimum weight when unexpected winter storms interfere with normal transportation movement.

Trucking arrangements, in addition to the problems already stated, can be difficult to arrange when small or part loads are involved.

Therefore, due to the high cost of shipping, shrinkage, and the potential for death loss, only the producer situated within 130-175 miles of a grade and yield packer that is able to sell a minimum of 30-40 butcher hogs at a time, ranging from 200-230 pounds could profit from grade and yield marketing.

SWINE ARTIFICIAL INSEMINATION PILOT TRIAL

Artificial insemination of swine is not new. Until boar semen could be successfully frozen and stored, and the optimum time of insemination became better understood, AI was not very practical for the commercial pork producer and was used only to a limited extent by purebred breeders. Recently, USDA-ARS scientists at Beltsville, Maryland, perfected the technique that is not being used to freeze and thaw boar semen. These freezing and thawing techniques, and improved semen extenders in which fresh collected semen can be successfully held for as long as 72 hours, have made AI for swine a practical possibility, creating considerable interest among commercial pork producers as well as purebred breeders. In response to this new interest, a pilot breeding trial was conducted at the Dickinson Experiment Station to lay the ground work for future trials.

Twenty-two second and third litter sows were selected for the study. Twelve were inseminated with one ampule of reconstituted frozen boar semen of either Hampshire or Yorkshire origin. The remaining ten sows were exposed to fertile Hampshire or Yorkshire boars.

To reduce the labor involved in heat detection, the sows were synchronized using the hormones pregnant mare serum (PMS), and human chorionic gonadotrophin (HCG) following lactation. PMS was administered the first morning after weaning, and HCG was given 56 hours following the PMS injection. Insemination was done twenty-four hours after the HCG injections without regard to standing heat.

In table 5, the percent conception rate, litter size, and number of pigs weaned per sow have been summarized. Table 6, shows each boar’s performance.

The semen used in this breeding trial was purchased at a cost of $4.00 per ampule from United Suppliers, Inc., Box 538, Eldora, Iowa; the only commercial supplier of frozen boar semen in the United States at this time. Shipping and handling charges amounted to approximately $2.00 per ampule.

Summary:

Conception rate and litter size were considerably lower in those sows bred artificially, as compared to the naturally serviced group. As shown in table 5, seven of the twelve sows inseminated conceived, which resulted in a 58% conception rate versus an 80% conception rate for the sows serviced naturally. In addition to the higher conception rate, natural service also yielded significantly more pigs per sow than the AI group.

Boar performance, as shown in table 6, contributed heavily to the lowered conception rate of those sows bred artificially. The semen of Yorkshire origin settled only 20% of the five sows exposed, whereas 86% of those sows exposed to Hampshire semen were settled. In addition to the boar effect, time of insemination and number of inseminations can directly effect conception rate. The results of a breeding trial comparing one insemination with two inseminations separated by 8 hours is shown in table 7. Two inseminations did not affect the number of pigs born per sow, however, the conception rate was insignificantly increased.

Although the sows bred artificially farrowed smaller litter, the pigs farrowed were of superior quality and expressed above average muscling, length and balance. This pilot breeding trial indicates that when using superior sires, such as those available through AI, excellent quality offspring can be produced without the expense of owning and keeping the sire. With this is mind, the commercial pork producer may want to consider swine artificial insemination as a breeding management method.

Table 5. Sow performance, AI pilot breeding trial, winter 1975-76

	Artificially inseminated	Naturally serviced
No. sows exposed	12	10
No. sows settled	7	8
Conception, %	58	80
Avg. pigs born/sow	6.0	9.8
Avg. pigs weaned/sow	5.7	9.3
Baby pig ADG, lbs.	.68	.63

Table 6. Boar performance, AI pilot breeding trial, winter 1975-76

	Hamp (AI)	York (AI)	Hamp (n.s.)	York (n.s.)
No. sows exposed	7	5	5	5
No. sows settled	6	1	3	5
Conception, %	86	20	60	100

Table 7. Sow performance, AI pilot breeding trial, one insemination vs. two inseminations, spring, 1976

	One insemination	Two inseminations separated by 8 hours
No. sows exposed	7	8
No. sows settled	5	7
Conception, %	71.9	87.5
Avg. no. pigs born alive	6.8	6.8
Avg. no. pigs weaned	6.0	4.9
Avg. weaning wt., lbs.	56	51

SWINE FEEDING TRIALS – WINTER, 1975-76

Hulless barley is reported to be superior to hulled barley and equal to corn, in feeding value for growing-finishing pigs. According to research conducted in Montana and Oregon, the hull and fiber in barley contributes to lower gains of feeder pigs fed barley rations as compared to pigs fed grains with lower fiber content.

This trial, in its second year, was designed to compare rations of hulled barley, oats, and soybean oilmeal; hulless barley, oats and lysine; and hulless barley, oats and soybean oilmeal. The rations as shown in table 8, balanced according to the National Research Council's requirements, were processed in a portable mixer grinder and self-fed.

Crossbred barrows (Yorkshire X Hampshire) were compared with purebred Yorkshire barrows in this feeding trial. Pigs with an average starting weight of 46 pounds were used. All were wormed with dichlorvos swine wormer at the start of the trial. Weights, gains and feed costs have been summarized for all pigs in table 9. Table 10 summarizes the crossbred vs. straight comparison.

Summary:

Pigs that were fed hulless barley, supplemented with either soybean meal, or lysine, were slightly less efficient than those pigs fed hulled barley supplemented with soybean meal. However, the cost per hundred pounds gain was the least for pigs fed the hulless barley rations, since the cost per hundred pounds of feed was $.33 cheaper for the hulless barley supplemented with lysine, and $.41 cheaper for hulless barley supplemented with soybean meal.

Crossbred barrows fed hulless barley gained significantly better and were more efficient, which resulted in an average lower cost per hundred pounds gain of $1.64 for the hulless-lysine supplemented pigs and $1.97 for the hulless-SBOM-supplemented pigs. The crossbred barrows that were fed hulled barley-SBOM did not out perform their straightbred counterparts.

Hulless barley varieties have not produced as much grain per acre as hulled varieties, in field trials in western North Dakota. Any advantage they might have in feed value would have to be enough to more than compensate for their lower yielding capability to make them useful to North Dakota producers.

Table 8. Rations as fed – swine feeding trial – winter, 1975-76

Ingredients	Ration 1 Hulled bly 50% oats + SBOM	Ration 2 Hulless bly 50% oats + lysine	Ration 3 Hulless bly 50% oats + SBOM
Hulled barley, lbs.	447.5	--	--
Hulless barley, lbs.	--	487.0	440.5
Oats, lbs.	447.0	480.0	448.0
SBOM, lbs.	80.0	--	80.0
Lysine, 98%, lbs.	--	6.0	--
dical, lbs.	8.0	7.5	6.0
Limestone, lbs.	11.0	13.0	11.0
Minerals & vitamins, [1/]	6.5	6.5	6.5
Crude protein, %	15.5	15.2	17.5
Cost/100# feed, $ [2/]	5.61	5.28	5.20

1 / Includes: 5 lbs. trace mineral salt, 1 lb. fortafeed, 45 gms. vitamin B_{12}, 30 gms. vitamin A, 6 gms vitamin D_3 and 180 gms. zinc sulfate per 1000 lbs. complete feed.

2 / Costs used for computing: hulless barley and hulled barley, $3.00/bu; oats, $1.35/bu.; SBOM, $182/ton

Table 9. Weights, gains and costs – swine feeding trial – winter, 1975-76

	Hulled bly Oats+SBOM	Hulless bly oats+lysine	Hulless bly oats+SBOM
Initial wt., lbs.	46	46	46
Final wt., lbs.	234	232	237
Gain, lbs.	187	186	191
Days fed	118	118	118
Avg. daily gain, lbs.	1.58	1.58	1.62
Feed/hd./day, lbs.	5.83	5.99	6.28
Feed/lb. gain, lbs.	3.70	3.79	3.87
Cost/100# gain, $	20.74	20.00	20.12

Table 10. Weights, gains and costs – crossbred vs. purebred barrows

	Hulled bly oats+SBOM str.	X	Hulless bly oats+lysine str.	X	Hulless bly oats+SBOM str.	X
Initial wt., lbs.	47	46	46	46	46	46
Final wt., lbs.	229	238	227	236	225	248
Gain, lbs.	182	192	181	190	179	202
Days fed	118	118	118	118	118	118
Avg. daily gain, lbs.	1.54	1.63	1.53	1.61	1.52	1.71
Feed/hd./day, lbs.	5.72	5.95	6.04	5.93	6.22	6.35
Feed/lb. gain, lbs.	3.71	3.65	3.95	3.64	4.09	3.71
Cost/100# gain, $	20.80	20.46	20.85	19.21	21.27	19.30
	.34		1.64		1.97	

Gains and feed efficiency of crossbred and straightbred gilts were compared when a basal ration supplemented with soybean oilmeal was fed. As indicated in table 11, the crossbred gilts gained significantly better and were more efficient which resulted in a savings of $2.58 per hundred pounds of gain.

Table 11. Comparison of crossbred vs. purebred gilts fed 14.7 percent barley + SBOM ration

	Yorkshire	Yorkshire + Hampshire
Initial wt., lbs.	59	73
Final wt., lbs.	195	228
Gain, lbs.	136	155
Days fed	102	102
Avg. daily gain, lbs.	1.33	1.52
Feed/hd./day, lbs.	5.92	6.07
Feed/lb. gain, lbs.	4.45	3.99
Cost/100# gain, $	24.95	22.37
Difference, $	2.58	

FEEDING LIQUID WHEY IN SWINE RATIONS

The disposal of liquid whey, a by-product of cheese manufacture at North Dakota cheese plants, has been a problem. Its resistance to decomposition in sewage systems has made it necessary to find other means of disposal. Its use as a fertilizer is of limited value. However, it can be used in swine feeding to provide necessary protein.

Drying whey produces the most useful product. However, drying is a costly process and disposal in the liquid form is the most economical method.

Feeding trials conducted at the Dickinson Experiment Station over the past three years were designed to determine the feeding value of whey compared with the synthetic amino acid, lysine; and soybean oilmeal, used as protein supplements. Pigs were fed in partial confinement and on spring seeded winter wheat pasture. Each supplement as it was fed with a basic barley and oats growing-finishing ration is shown in table 12.

Liquid whey supplied by the Dickinson Cheese Company was hauled daily and stored in an elevated fiberglass holding tank. The whey was furnished at no cost but a charge of ½ cent per gallon was made to cover costs for hauling.

The whey was self-fed through a gravity flow system using PVC rigid plastic pipe and lixit nipple waterers. Due to the manner in which the liquid whey was fed it was impossible to measure consumption accurately because of waste in feeding. Approximately 2 ½ to 3 gallons were utilized per head daily.

Results and Discussion:

Three years data, which has been summarized in table 13, indicate that pigs can be raised to slaughter weights very efficiently and economically, using liquid whey as a protein supplement. Feed savings for the three year period amounted to 107 pounds less feed per 100 pounds gain, which resulted in a saving of approximately $5.60 per 100 pounds gain over the soybean meal fed pigs and $5.80 per 100 pounds gain over the lysine supplemented pigs.

Pigs will adjust to liquid whey very easily, and without scouring problems, if both liquid whey and water are available free choice for approximately two weeks before water feeding is discontinued. The nipple waterers, which are used to regulate the flow of whey, are located at a height of 15” while the pigs are becoming adjusted to liquid whey and learning to drink from the nipple waterers. Wastage rapidly becomes a problem, therefore, once the pigs have become accustomed to drinking whey from the nipple waterers it is necessary to raise the valves to a height of approximately 28”. To help the pigs reach the 28” nipple, a step was positioned 18” below the nipple valve. When using the step just described the nipple valve is just within reach of the pig and waste is reduced considerably.

When feeding liquid why it is extremely important that the whey be salt free. Always insure that the whey has been removed from the cheese process before salting has taken place.

Other Considerations:

Liquid whey feeding will be most successful when the following conditions exist; salt free whey is available on a regular basis; the pigs weigh at least 35 pounds; PVC plastic or stainless steel feeding equipment is used to reduce corrosion, contamination and fly and odor problem; and adequate protection from the weather is provided.

Table 12. Rations fed and three year average cost/ton, 1973-75

	Ration supplement		
Ingredient	**SBOM**	**Lysine**	**Whey**
Oats, lbs.	200	234	236
Barley, lbs.	676	739	740
Soybean oilmeal, lbs.	100	--	--
Lyamine, lbs.	--	3	--
Minerals, vitamins 1/	24	24	24
Price/ton, $ 1973	70	60	49
1974	111	109	102
1975	132	129	126
3-year average	104	99	92

1 / Includes: Limestone 9 lbs., di-cal 9 lbs., trace mineral salt 5 lbs., vitamin B complex 1 lb., 30 gms. Vitamin A, 14 gms. vitamin D_3 and 180 gms. zinc sulphate per 1000 pounds feed.

Table 13. Three year average for weight, gain and feed cost, 1973-75

	Ration supplement					
	Whey		**SBOM**		**Lysine**	
Initial wt., lbs.	35	51	34	51	35	51
Final wt., lbs.	190	205	200	211	192	217
Gain, lbs.	156	154	165	160	158	166
Days fed	127	117	127	117	127	117
Avg. daily gain, lbs.	1.22	1.31	1.30	1.36	1.24	1.42
Feed/cwt gain, lbs.	285	297	410	397	395	386
Feed cost/cwt gain, $	14.49	14.89	20.78	19.85	20.74	20.41

**DRIED SWEET WHEY IN
GROWING-FINISHING RATIONS FOR SWINE**

This feeding trial is designed to determine the substitution value of dried sweet whey compared with barley in swine growing-finishing rations; and, to determine the optimum amount of whey that can be fed without causing undesirable side effects such as scours and blindness.

Whey, a by product of North Dakota cheese plants, can be used successfully as livestock feed. Feeding trials at the Dickinson Experiment Station summarized in the preceeding report, show liquid whey to be a practical and economical feed in rations for growing-finishing pigs. Dried sweet whey has a protein and energy analysis similar to barley, possesses a well balanced amino acid and vitamin B complex level, and is superior to barley in lysine. Drying liquid whey eliminates problems associated with handling bulky liquid, and results in a products that can be stored, handled and mixed as a dry feed.

Research conducted at the Illinois Agricultural Experiment Station indicates that when rations containing sixty percent dried whey were fed to growing-finishing pigs a depression in rate of gain and daily feed intake was experienced as well as a tendency toward sours. In addition to the sixty percent level, rations containing 0, 5, 10, 20 and 40 percent dried whey were fed and performed satisfactorily.

Crossbred and straightbred pigs produced at this station, averaging 37 pounds, were randomly allotted into eight groups. To provide for pen replication two feeding units of four pens each were used. The rations fed, as shown in tables 14 and 15, consisted of a basic barley and oat control ration and three experimental rations in which barley was replaced with either 15, 30, or 45 percent dried sweet whey. The crude protein level was maintained at 15.5 percent until the pen averaged 120 pounds, at which time the protein was lowered to 12 percent. A portable mixer-grinder was used to process the rations which were self fed in meal form.

Housing consisted of exposed solid concrete floored pens equipped with open front type shelters and automatic waterers. The pigs were weighed at two week intervals, with records maintained on condition of health, with particular attention to incidence of scours and blindness.

The results of this feeding trial indicate that dried sweet whey can successfully replace as much as forty-five percent of the barley in swine growing-finishing rations, and that the best performance and most economical gains were produced among pigs fed a ration containing fifteen percent dried sweet whey.

Rations containing dried sweet whey, when compared with the basic barley and oats control ration, had a lower fiber content that resulted in an increase in palatability, feed consumption, and average daily gain. Compared to the control ration, increased feed efficiency resulted among pigs receiving fifteen and forty-five percent dried sweet whey, and although no difference in feed efficiency occurred between the two rations, the cost per hundredweight gain was $1.47 more for those pigs receiving forty-five percent dried whey.

Pigs fed thirty percent dried whey consumed the largest amount of feed per head per day and gained at the fastest rate. However, they were equal in efficiency to the control pigs and less efficient than those pigs consuming either the fifteen or forty-five percent dried whey rations. The loss in efficiency which was experienced, is probably due to a mild outbreak of scours that set back the 30 percent pigs and resulted in an added cost of $2.36 per hundredweight gain when compared to the better performing and most economical fifteen percent dried whey ration.

Based on the results of this first feeding trial it appears that only slightly more per pound can be paid for dried whey than for barley when fed at the forty-five percent level.

Table 14. Rations as fed to 120 pounds, 1976

Ingredients in pounds	**#1 0% Whey**	**#2 15% Whey**	**#3 30% Whey**	**#4 45% Whey**
Dried sweet whey	--	150	300	450
Oats	285	285	285	285
Barley	572	425	278	131
SBOM	120	120	120	120
Dical	6	5	4	3
Limestone	11	9	7	5
Vitamins & minerals [1/]	6	6	6	6
Total	1,000	1,000	1,000	1,000
Cost/lb. of feed, -Whey: 6.5¢		.0604	.0626	.0648
5.75¢		.0593	.0604	.0614
Gross energy (Kcal/lbs.)	1,832	1,791	1,755	1,716
% protein	15.5	15.6	15.7	15.8
% calcium	0.617	0.621	0.602	0.628
% phosphorus	0.528	0.537	0.549	0.559

1 / Includes trace mineral salt, 5 lbs; vitamin B complex, 1 lb.; vitamin A, 30 grams; vitamin D, 14 grams and zinc sulfate, 180 grams.

Table 15. Rations as fed from 120 pounds to market, 1976

Ingredients in pounds	#1 0% Whey	#2 15% Whey	#3 30% Whey	#4 45% Whey
Dried sweet whey	--	150	300	450
Oats	285	285	285	285
Barley	673	525	378	231
SBOM	20	20	20	20
Dical	6	5	4	3
Limestone	10	9	7	5
Vitamins & minerals 1/	6	6	6	6
Total	1,000	1,000	1,000	1,000
Cost/lb. of feed, -Whey: 6.5¢	.0533	.0554	.0576	.0598
5.75¢		.0593	.0604	.0614
Gross energy (Kcal/lbs.)	1,832	1,791	1,755	1,716
% protein	15.5	15.6	15.7	15.8
% calcium	0.560	0.597	0.600	0.570
% phosphorus	0.503	0.513	0.524	0.534

1 / Includes trace mineral salt, 5 lbs; vitamin B complex, 1 lb.; vitamin A, 30 grams; vitamin D, 14 grams; and zinc sulfate, 180 grams.

Table 16. Weights, gains and feeding economics – summer, 1976

	No whey	15%	30%	45%
No. head	13	14	14	14
No days on feed	118	118	118	118
Initial wt., lbs.	37	37	37	36
Final wt., lbs.	197	217	229	223
Total gain, lbs.	160	180	192	187
Average daily gain, lbs.	1.36	1.53	1.63	1.58
Feed/hd/day, lbs.	5.00	5.32	5.96	5.48
Feed/lbs. gain, lbs.	3.68	3.48	3.66	3.47
Feeding economics:				
Computed when whey costs- 6.5¢/lb.				
Cost/lb. feed, $	.0555	.0576	.0612	.062
Cost/cwt gain, $	20.42	20.04	22.40	21.51
Computed when whey costs- 5.75¢/lb.				
Cost/lb. feed, $	.0555	.0565	.0589	.0587
Cost/cwt gain, $	20.42	19.66	21.56	20.37

USING ALFALFA IN RATIONS FOR GESTATING GILTS AND SOWS

How much alfalfa can be used in self-fed gestation rations for gilts and sows?

This study, started at the request of North Dakota pork producers, was designed to evaluate moderate and high levels of alfalfa in self-fed gilt and sow gestation rations under North Dakota winter conditions.

Research conducted in Nebraska indicates that lower cost gestation rations can be formulated using high levels of alfalfa, without affecting gilt development, litter size, birth weights, number of pigs weaned or weaning weights.

Twenty four purebred Yorkshire gilts were randomly allotted into two groups. Each group was fed a 15% protein gestation ration containing either 40% or 70% alfalfa, and balanced according to NRC requirements.

Both groups were sheltered in portable houses under drylot conditions, and had free access to automatic waterers and self-feeders equipped with openings large enough to handle the bulky rations satisfactorily.

The two rations as fed are shown in table 17. During the feeding period the gilts were weighed bi-monthly. Their weights, gain and feed costs are summarized in table 18. Litter production data are shown in table 19.

Table 17. Gestation ration composition – winter, 1975-76

	40% alfalfa	**70% alfalfa**
Alfalfa, lbs.	400.0	700.0
Oats, lbs.	526.5	179.0
Soybean oilmeal, lbs.	63.0	107.5
Tripoly phosphate, lbs.	4.0	7.0
Vitamins and minerals, lbs. [1/]	6.5	6.5
Total, lbs.	1000.0	1000.0
Protein, %	15.0	15.0
Cal.dig.energy, Kcal/lb.	988	826
Cost/lb., $	.04132	.03814

1 / Includes trace mineral salt, 5 lbs.; B-complex vitamins, 1 lb.; vitamin A, 75 gms.; vitamin D, 5 gms.; zinc sulfate, 180 gms.

Table 18. Gestation weights, gains and feed costs – winter, 1975-76

	40% Alfalfa		70% Alfalfa	
		2nd litter		2nd litter
Ration	**gilts**	**sows**	**gilts**	**sows**
Weights & gains:				
No. Head	12	10	11	10
Avg. initial wt., lbs	364	469	350	441
Avg. final wt., lbs.	465	584	396	536
Avg. gain, lbs.	101	115	46	95
Days on test	69	58	69	58
Avg. daily gain, lbs.	1.47	1.97	0.66	1.51
Feed & costs:				
Total feed consumed, lbs.	708	900	651	800
Feed/hd./day, lbs.	10.3	15.5	9.4	13.8
Ration cost/day, $	.42	.64	.36	.53
Feeding period cost, $	28.98	37.18	24.84	30.51
Savings, $			4.14	6.67

Table 19. Litter production data

	40% Alfalfa		70% Alfalfa	
		2nd litter		2nd litter
Ration	**gilts**	**sows**	**gilts**	**sows**
Birth:				
No. of litters	12	10	11	9
Litter size	10.1	7.5	8.9	9.6
Litter wt., lbs.	32.9	28.1	25.1	27.7
Avg. individual pig wt., lbs.	3.3	3.7	2.8	2.9
Weaning:		**To date**		**To date**
No. of litters	12	10	11	9
Litter size	8.8	7.2	7.9	8.1
Litter wt., lbs.	253	1 /	208	1 /
Avg. individual pig wt., lbs.	29.0		26.3	
Percent survival	87.0	96.0	88.7	84.0

1 / Baby pigs not weaned at time of publication.

Summary:

Gestation diets containing either 40% or 70% alfalfa were fed to first litter gilts for the last sixty-nine days of gestation. All of the pigs were handled alike and were housed in drylot under North Dakota winter conditions. Those gilts fed the 70% alfalfa ration consumed approximately one pound less feed per head per day than those fed the 40% ration, which amounted to a saving of $4.14 per gilt for the feeding period. The savings in feed, however, did not nearly offset the loss in litter production. (See table 19) Those gilts fed the 40% gestation ration farrowed one more live pig per litter; had pigs weighing a half pound more at birth; and, weaned more and heavier pigs per litter which resulted in an average of 45 more pounds of feeder pig produced per gilt.

The results of this first farrowing indicate that the higher energy ration containing 40% alfalfa is more suitable for gilt development and litter production.

Second litter sows in phase II of this trial, which is designed to evaluate the long term effect of feeding moderate versus high levels of alfalfa in gestation rations, performed satisfactorily under both levels of alfalfa. Although no problems were experienced, daily feed consumption was high for both levels of alfalfa and resulted in an average daily feed cost of $.64 among those pigs fed 40% alfalfa and $.53 among the pigs receiving 70% alfalfa, which resulted in a savings of $6.67.

Litter production data is incomplete, since the pigs had not been weaned at the time this progress report was written. Although weaning data is not available, results indicate that sows fed 40% alfalfa farrowed 2.1 fewer pigs per litter that were an average .8 pound heavier at birth, and experienced a 12% better survival rate. Even though litter performance, especially survival rate, was better among sows fed at the 40% level, sows fed at the 70% level had .9 more pigs alive when this report was published. Based on the limited results of this first trial it appears that pigs born to sows fed 40% alfalfa are stronger and more vigorous. Future trials are planned to further investigate the level of alfalfa and its effect on baby pig survival.

Section III

Reports of

Range and Pasture Management Research

at the

Dickinson Experiment Station

Presented by

Dr. Warren C. Whitman, Botanist

Mr. Paul Nyren, Botanist

at the

27th Annual Livestock Research Roundup

Dickinson Experiment Station
Dickinson, North Dakota

December 1, 1976

THREE-PASTURE SYSTEM GRAZING TRIAL

The grazing trial utilizing crested wheatgrass for spring and early summer grazing, native grass in mid and late summer, and Russian wildrye for fall grazing was concluded in 1976 after five years of study. The study compares fertilized and unfertilized crested wheatgrass and native pastures. The Russian wildrye pastures used in the study have all been fertilized each year. The fertilized crested wheatgrass and native pastures received 50 lbs. of N per acre annually. The Russian wildrye pastures received 75 lbs. N in 1972, 150 lbs. N in 1973, and 50 lbs. N-30 lbs. P_2O_5 in 1974, 1975 and 1976.

The grazing plan for the 1976 season is shown in table 1. This year 13 steers were grazed on each crested wheatgrass pasture. One steer was removed from each group when the animals were moved to the native grass pastures. For the remainder of the season 12 yearling steers were grazed in each pasture. They were moved to drylot on October 21 for a total grazing period of 168 days.

Forage production and grazing utilization for the 1976 season is shown in table 2.

Forage production on all pastures was down considerably from the 1975 levels with the exception of the unfertilized crested wheatgrass which was 16% higher than the 1975 yield. Production from the fertilized crested pasture was 2847 lbs. per acre, 21% below the 1975 level. Production from the fertilized crested pasture was 2847 lbs. per acre, 21% below the 1975 level. Utilization again this year was lighter than desirable with slightly less utilization on the unfertilized than fertilized pasture. The grazing period on these pastures extended from May 6th to June 28, a total of 53 days.

The production of the native grass pastures was less than in 1975. While the unfertilized pasture declined at least with a 6% drop in production the fertilized pasture produced 21% less than the 1975 crop. While production decreased, utilization increased substantially.

Forage utilization was 54% on the unfertilized, and 58% on the fertilized pastures. Because of decreased production the grazing period on native pastures was reduced to 45 days, from June 28 to August 13.

Forage production on the Russian wildrye pastures was down from 1975. This year the steers were placed on pastures 1 and 3 at the beginning of the grazing period. Average production for the two pastures was 1703 lbs. per acre compared to 2182 lbs. per acre for the first two pastures grazed in 1975. The animals were moved to pastures 2 and 4 on September 17. The average production for these pastures was 1192 and 1288 lbs. per acre for pastures 2 and 4 respectively. The steers remained on these pastures until October 15 at which time they were allowed to graze the regrowth of pastures 1 and 3. The steers grazed pastures 1 and 3 for an additional 16 days at which time they were moved to drylot. Utilization of the Russian wildrye was heavy averaging 82% on pastures 1 and 3 and 76% for pastures 2 and 4. Sixty two percent of the 693 lbs. per acre regrowth from pastures 1 and 3 was utilized.

The performance of the steers on the three-pasture trial for the 1976 season is summarized in table 3. As in previous years 6 of the steers in each lot were black whiteface and 6 were Herefords. Average daily gains were much lower on the fertilized crested wheatgrass than in 1975. Gains on the unfertilized crested were similar to those of previous years. Gains on the fertilized crested pasture were 0.80 lbs. per head per day compared to 1.53 lbs. per head per day for the preceeding 4 years. Average daily gains on the unfertilized pasture were 1.42 lbs. per head per day for the 1976 season as compared to the 4 year average of 1.70 lbs. per head per day.

Both average daily gains and gains per acre on the native pastures were below the 1975 levels. As in 1975 the average daily gains on the unfertilized native were above those on the fertilized. However, because of the size difference in the two pastures, gains per acre were again higher on the pastures receiving fertilizer.

The steers were moved to the Russian wildrye pastures on August 13th. The grass in the pastures was estimated at this time to contain 30% green material. The animals were weighed off pastures 1 and 3 on September 17th and at that time had consumed 82% of the forage. On September 17th it was estimated that of the forage remaining 15-20% was still green. While production was lower and there was less green material than in 1975 the forage available was palatable to the animals and apparently nutritious.

Again in 1976 the performance of the Herefords and black whitefaces was compared and the data summarized in table 4. While the Herefords seemed to do better on the crested and the black whitefaces better on the Russian the results over the 5 years of the study are inconsistent.

In 1976 the portion of the study involving Kedlor (biuret) was discontinued because Kedlor is no longer available commercially.

A summary of the 1976 results with the 3-pasture grazing system shows that the yearling steers on the fertilized pastures each gained an average of 166 lbs. during the 168 day period from May 6 to October 21. During this period each steer consumed an average of 70% of the forage on 2.6 acres. This represents an overall beef production of 56.5 lbs. per acre. The steers grazing the unfertilized crested, unfertilized native and fertilized Russian wildrye gain an average of 175 lbs. during the same period, utilizing about 67% of the forage produced on 4.0 acres. The overall production of beef on these pastures was thus 43.5 lbs. per acre.

Table 5 summarizes the 5-year results of the trial. The 3-pasture system with fertilizer on all pastures produced an average of about 75 lbs. of beef per acre, while the system where only the Russian wildrye pastures received fertilizer has produced approximately 56 lbs. of beef per acre over the 5 years. At the present time the state of the economy is such that any system which adds cost to the production of beef is unfavorable despite the substantial increase in beef production per acre.

Table 1. Projected grazing plan for the three-pasture trial for the 1976 season

Pasture	Grazing period	Pasture size-acres	No. of steers	Stocking rate-acres/steer per month
Crested wheatgrass	May-June	16	13	0.6
Crested wheatgrass + 50 lbs. N	May-June	8	13	0.3
Native grass	July-Aug.	18	12	0.7
Native grass + 50 lbs. N	July-Aug.	12	12	0.5
Russian wildrye (fertilized)	Aug.-Oct.	8	12	0.3
Russian wildrye (fertilized)	Aug.-Oct.	8	12	0.3

Table 2. Forage production and utilization during grazing periods on crested wheatgrass, native grass, and Russian wildrye pastures – 1976 season

Pastures	Pasture size acres	Period grazed	Days in period	Forage produced-lbs/acre	Forage utilized-lbs/acre	Forage left on ground-lbs/acre	Percent utilization
Crested wheatgrass	16	5/ 6- 6/28	53	2564	1726	1146	60
Crested + 50 lbs. N	8	5/ 6- 6/28	53	2847	1779	1068	62
Native grass	18	6/28- 8/13	46	2315	1052	1263	54
Native + 50 lbs. N	12	6/28- 8/13	46	2842	1207	1635	58
Russian wildrye 1 & 2[1/]	8	8/13-10/21	69	3339	2679	660	82
Russian wildrye 3 & 4	8	8/13-10/21	69	3240	2434	806	75

1 / The steers from the fertilized crested and native pastures were placed on Russian wildrye pastures 1 and 2 while those from the unfertilized treatment were placed on pastures 3 and 4

Table 3. Pasture systems grazing trial. Weights and gains of yearling steers on crested wheatgrass, native grass, and Russian wildrye pastures – 1976 season

Pastures	Period grazed	Days in period	No. of steers	Avg. initial wt/steer lbs.	Avg. final wt/steer lbs.	Avg. gain per head-lbs.	Avg. daily gain per head lbs.	Avg. gain per acre-lbs.
Crested wheatgrass	5/ 6- 6/28	53	13	710.4	786.2	75.8	1.42	61.6
Crested fertilized	5/ 6- 6/28	53	13	719.6	762.1	42.5	0.80	69.1
Native grass	6/28- 8/13	46	12 1/	786.2	828.4	42.2	1.42	28.1
Native fertilized	6/28- 8/13	46	12 1/	762.1	818.4	56.2	1.22	56.2
Russian wildrye 1 & 2	8/13- 9/17	35	12 3/	818.4	867.0	48.6	1.39	73.0
	9/17-10/15	28	12	867.0	907.0	40.0	1.45	60.1
	10/15-10/21	6	12	907.0	885.4	-21.6	-3.60	-32.4
Russian wildrye 3 & 4	8/13- 9/17	35	12	828.4	871.6	43.2	1.23	64.7
	9/17-10/15	28	12	871.6	902.5	30.9	1.10	46.4
	10/15-10/21	6	12	902.5	885.4	-17.1	-2.85	-25.6

1 / One steer cut from each group when animals moved from crested wheatgrass to native grass pastures.

2 / The steers from the fertilized crested and native pastures were placed on Russian wildrye pastures 1 and 2 while those from the unfertilized treatment were placed on pastures 3 and 4.

3 / All steers from the fertilized native were placed in pasture 1 and 2 and those from the unfertilized treatment on pastures 3 and 4

Table 4. Average daily gains (lbs.) of Herefords and Black-Whiteface steers[1/] on unfertilized and fertilized pastures during the 168 day grazing period in 1976 season

Pasture treatment	**Steers**	**Crested wheatgrass 5/6-6/28 53 days**	**Native grass 6/28-8/13 46 days**	**Russian wildrye[2/] 8/13-10/21 69 days**	**Avg. for 168 days**
Unfertilized	Herefords	1.51	0.79	0.95	1.08
	Black WF	1.34	1.02	1.01	1.12
	Average	1.43	0.91	0.98	1.10
Fertilized	Herefords	0.86	1.21	0.72	0.90
	Black WF	0.74	1.02	0.94	0.90
	Average	0.80	1.12	0.83	0.90

1 / Each lot of 12 steers consisted of 6 Herefords and 6 Angus X Hereford steers.

2 / Effects of Kedlor treatment removed by averaging steers of the same kind from both treatments together.

Table 5. Five-year average weights and gains of yearling steers on crested wheatgrass, native grass, and Russian wildrye pastures, 1972-1976

Pastures	Pasture Size-acres	Avg. no. days grazed	No. of steers	Avg. initial wt/steer lbs.	Avg. final wt/steer lbs.	Avg, gain per head lbs.	Avg. daily gain per head lbs. 1/	Avg. gain per acre-lbs. 1/
Crested wheatgrass	16	53	12	606.9	697.8	90.9	1.64	66.8
Crested + 50 lbs. N	8	53	12	613.4	690.3	76.9	1.38	112.2
Native grass	18	46	12	700.9	786.6	85.7	1.53	56.2
Native + 50 lbs. N	12	46	12	690.9	781.36	90.4	1.51	89.1
Russian wildrye 1 & 2 2/	16	75	12	780.9	849	68.1	0.91	51.1
Russian wildrye 3 & 4	16	75	12	787.1	844	56.9	0.76	42.6

1 / Averaged from annual values as included in reports, not from days – grazed and gains reported above.
2 / Steers on pastures 1 and 2 fed Kedlor in 1973, 1974, and 1975.

INTERSEEDING TO IMPROVE GRAZING VALUE OF NATIVE RANGELAND

A study of the grazing value of interseeding native prairie was begun at the Dickinson Station in the spring of 1976, because interseeding shows promise of being one of the methods that can be used to improve both the quantity and quality of forage produced on rangeland.

Interseeding is not a new idea. Reports of its use date back to 1899, and it has been attempted many different times and places since then. Many of these first attempts at interseeding failed because of lack of knowledge about the importance of seed source, seeding rates, and particularly, competition from the established grassland being interseeded.

Studies conducted in the Northern Great Plains have shown that interseeding can increase productivity of native range. Range interseeded with Travois alfalfa, the best producing species interseeded in trials begun at the Dickinson Station in 1969, has produced an average of 1.75 tons per acre more than untreated native range.

One of the major reasons this practice has not been accepted by ranchers is because of the old style lister interseeders defaced the rangeland so severely. The ripping and plowing action of the lister-seeder rolls the sod back in strips and chunks, producing a destructive effect that is not appealing to conservation minded stockmen. While weathering, and trampling by livestock eventually smooths the surface appreciably, the land is scarred by the lister treatment.

Until recently most of the interseeders used were designed and built by interested ranchers or technicians, for experimental use. Because of increased interest in interseeding several equipment manufacturers are working on various machine design and some are available commercially. One such machine, the John Deere 1500 Powr-till seeders, was used in this study. This machine uses power driven rotating colters to cut through the sod and prepare a seed bed. These colters open a ¾ to 1 inch wide cut, and can be adjusted to penetrate ¾ to 2-1/4 inches deep. Competition from established vegetation is not eliminated, making use of an herbicide necessary to allow establishment of the interseeded species.

Treatments in the 1976 trial include interseeding with Travois alfalfa and Vinall Russian wildrye; fertilizing with 50 pounds nitrogen fertilizer per acre; one check pasture tilled but not seeded and one untreated control. Roundup, sprayed at ¾ pound per acre was ineffective in reducing competition from existing species because of unfavorable weather conditions.

Both the alfalfa and Russian wildrye germinated, but the unfavorable dry weather and competition from the native grassland appeared to prevent their establishment. If necessary, the trial will be reseeded in the spring of 1977.

GRAZING STUDY OF RECLAIMED MINE LAND

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The first mined land "reclaimed" under the 1969 North Dakota reclamation law was returned to the owner in the spring of 1976. As the state's requirements for reclamation are met, more mined lands will be returned to owners. Most will be revegetated with perennial grasses suitable for grazing, however, the effects of grazing these lands are unknown. Will the response be similar to grazing pastures and ranges on unmined land? How stable are these soils when the vegetation is grazed? How much grazing will reclaimed lands safely withstand? How serious would overgrazing be to the reclamation effort?

To better answer some of these questions, a study was initiated in spring 1976, by the Agricultural Research Service, Mandan, ND on a released area near Center, ND. The area had been mined, reshaped and seeded in early 1973 by Baukol-Noonan Coal Company. A good stand of bromegrass, crested wheatgrass, intermediate wheatgrass, and alfalfa was established. It was not harvested or clipped until grazed in this study.

The area was fenced into six pastures providing three grazing treatments, each one duplicated. Two exclosures 50 x 100 ft were fenced out of each pasture as ungrazed controls. Pastures were grazed at 0.6, 1.2, and 1.8 acre/yearling steer to provide heavy, moderate, and light grazing intensities, respectively.

In 1976, three Hereford steers which averaged 525 pounds were allocated to each pasture on May 25. Vegetation was uniform over all treatments. They grazed until July 23, a 55-day season, at which time the moderately grazed pasture had 51% of the vegetation remaining. Twenty percent remained on the heavy grazed and 68% on the lightly grazed. Dry matter production in the ungrazed exclosures averaged 3,330 lb/acre at the close of the grazing season.

Steers performed adequately on the grass, giving average daily gains of 1.6 lb on heavy, 1.8 lb on moderate, and 2.3 lb on light grazing treatments. Pounds of beef produced per acre were 147, 100, and 69 for the heavy, moderate, and light treatments, respectively. These data indicate satisfactory beef production this first year of the study. However, as the study progresses over the next 4 years, effects from previous grazing treatments will become a factor. The limited size of the pastures and small number of animals provide production data for a very limited situation. However, other data obtained on vegetation composition and species change, soil water recharge and use, soil compaction, and methods of measuring these factors on reclaimed land are being obtained, which will provide guidelines for practical use of reclaimed land as well as for future research needs on reclamation.

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Section IV

Range Livestock Nutrition

By

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RANGE LIVESTOCK NUTRITION

Donald C. Clanton

Introduction

A far reaching concept in animal nutrition is the balance between the nutrients of the ration and the realization that relative excesses may be as undesirable as relative deficiencies. We have only begun to understand nutrient interrelationships. It is definite that the efficiency of feed utilization by animals can be greatly influenced by changing nutrient balance, or the relationship of nutrients to energy in the ration.

The nutrient requirements of range cattle are dependent upon their age and the stage of their production. Although, the National Research Council has published requirements for the different classes of cattle there is some doubt as to the application for cattle managed under range conditions. They are, however, the best recommendations available. After the requirement is determined, then it becomes necessary to estimate how nearly the range forage meets the requirement. To do this accurately it is necessary to know how much forage cattle will eat, its nutrient content and its digestibility. Needless to say, much of this information is not available so that any estimate of the nutrient intake and utilization from the forage is truly an estimate.

Many years ago it was determined through chemical analyses that some grass winter ranges and poor quality grass hays were low in protein, phosphorus and carotene. In fact, they may be so low in midwinter that it is not necessary to know the percent of the nutrient utilized or the amount the animal ate to determine that a supplement is necessary. For example, if range forage contains 4% crude protein of which on-half is digestible, the calf would have to eat at least 35 pounds of forage to meet his requirement. This would be impossible, thus, we recommend the feeding of a protein supplement. The same principle will apply for other classes of cattle although mature cows have a lower protein requirement and can eat more than a calf thus probably come closer to getting the required protein from range forage. This may also be true in the case of phosphorus and carotene (vitamin A).

While determining that range grasses in midwinter were low in protein, phosphorus and carotene, researchers also found that they were relatively high in crude fiber and nitrogen free extract (carbohydrates), the primary sources of energy in forage. Because of this, it was assumed that range cattle were receiving enough energy. In more recent years, it has been established that the gross energy content of rations is rather meaningless and it is necessary to know how well the animals utilize the gross energy before deciding if energy is limited. Also, the amount of digestible energy received by an animal is greatly influenced by the amount of forage intake.

Protein and energy relationships

When providing supplemental nutrients to cattle, the first limiting nutrient should be supplemented first, then the second, and so forth. The difficult task is to determine which is the first limiting nutrient. When energy is the first limiting nutrient, supplemental protein will be used for energy until energy needs are met and protein becomes the first limiting then it will be used for protein needs. This is not the case with minerals and vitamins, however their utilization can be influenced by a lack of energy intake. The data shown in table 1, which was taken from research at Nebraska demonstrates the relationship between energy and protein.

Table 1. The effect of replacing bromegrass hay with high protein or energy supplements on utilization of protein and energy.

	Ration		
	1	**2**	**3**
Bromegrass hay, lbs	15.00	14.00	10.00
Ground corn, lbs	00.00	00.00	5.00
Soybean meal, lbs	00.00	1.00	00.00
Energy megcal/lb			
Digestible	0.84	0.86	0.90
Metabolizable	0.62	0.69	0.75
Protein, %			
Crude	8.1	10.5	8.1
Digestible	3.2	5.3	3.0
Nitrogen retention, gm/da	-10.7	0.6	8.2

The distinguishing feature of protein is the fact that it contains on the average 16% nitrogen. When chemically analyzed for protein the percent nitrogen in the feed is determined and multiplied by 6.25 which gives the percent protein. When protein is used for energy, the nitrogen is removed from the protein and eliminated through the urine. The remaining compound then resembles carbohydrate and can be used for energy. Referring to table 1 the cows were in negative nitrogen balance when receiving 15 pounds of bromegrass hay containing 8% crude protein. This means that the cows were excreting through feces and urine more nitrogen than they are taking in. Much of this was from a normal body loss of tissue nitrogen, however some was from ration origin. When replacing one pound of hay with one pound of a high protein supplement, (ration 2), they came to equilibrium and when replacing 5 pounds of hay with 5 pounds of corn (ration 3) they went to positive nitrogen balance. This demonstrates that of the two, energy was the first limiting. Had the protein been first limiting then it would have been the greatest improvement in nitrogen balance with ration 2. It is also important to note from these data that when a low quality forage is supplemented with plant protein (ration 1 versus 2) digestible and metabolism energy values rise. This is because soybean meal contains nearly twice as much digestible energy as the hay it replaced. Actually, there was a reduction in the digestibility of the energy in the hay. This same effect is caused by the supplementation of corn (ration 1 versus 3). If the soybean meal and corn had not reduced the digestible energy of the hay, ration 2 and 3 would have had .89 and 1.10 megcal digestible energy per pound. The reason for the reduction in forage energy digestibility was probably that the microorganisms in the rumen used the readily available carbohydrates in soybean meal and corn in preference to those not so readily available in the low quality forage. The end result was a lower digestible energy content of the hay. The forage contained 8% protein. Had it contained less than 5% protein the soybean meal probably would have increased the forage energy digestibility. In this case, protein would have been the first limiting nutrient.

It is important that these data were obtained from matured cows receiving only 15 pounds of total ration. For this class of cattle forage probably supplied adequate protein for maintenance, however, 15 pounds of the forage was not enough to meet the energy needs, thus, the logical answer in this case would have been to feed more hay.

Another aspect of the relationship of protein and energy is the effect protein may have on the intake of low quality forage. This was demonstrated in an experiment conducted in the early 1960's at the University of Nebraska.

Two groups of cows, initially 20 months of age, received one of two rations differing in protein content during 5 consecutive winters. They were grazed on bromegrass pasture during the summer except the first summer when they received a full feed of alfalfa hay and three pounds of corn daily.

The supplemental protein increased voluntary consumption of bromegrass hay, which in turn increased the energy intake, the third and fifth winter (table 2). The fourth winter when the hay contained 8.4% protein, the nonsupplemented cows consumed more hay. Protein supplementation may be effective in stimulating increased voluntary forage consumption only when the protein content and the quality of the forage is low.

Table 2. Average daily ration fed during winters prior to calving.

	Low Protein	**High Protein**
1960 (140 days)		
Ration, lb/695 lb heifer	12.00	12.00
Crude protein, lb	0.80	1.18
Digestible energy, megcal	10.80	11.55
1961 (140 days)		
Ration, lb/695 lb heifer	12.00	12.00
Crude protein, lb	0.70	1.22
Digestible energy, megcal	10.80	11.67
1962 (112 days)		
Grass hay (5.8%) protein, lb	21.78	24.18
Soybean meal, lb	0.00	1.00
Crude protein, lb	1.25	1.85
Digestible energy, megcal	14.73	20.54
1963 (115 days)		
Grass hay (8.4% protein), lb	25.76	23.08
Soybean meal, lb	0.00	1.00
Crude protein, lb	2.18	2.38
1964 (112 days)		
Grass hay (4.4% protein), lb	20.48	21.87
Soybean meal, lb	0.00	1.00
Crude protein, lb	0.92	1.45

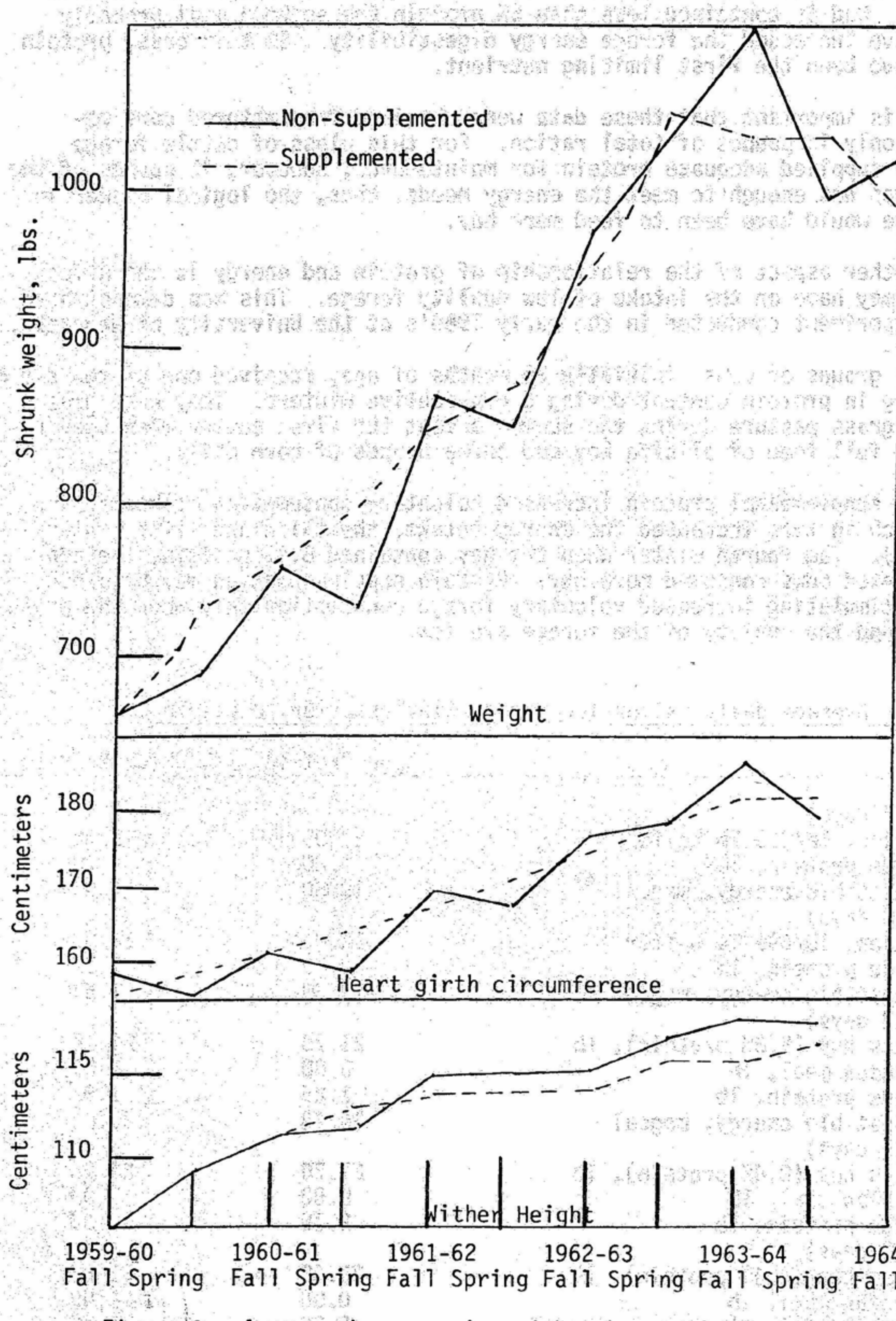

Figure 1. Average increase in weight, heart girth circumference and wither height.

Cows that received the protein supplement gained weight at a more uniform rate during their growth and development period than did the non-supplemented cows (figure 1). The non-supplemented cows generally gained slowly or lost weight during the winter but their gain during the summer compensated enough to maintain a total weight as great as the supplemented cows. However, during the fourth winter when the hay contained 8.4% protein, they gained almost as well as the supplemented cows.

Heart girth circumference, which is a good measure of body condition, followed the same trend as weight change (figure 1). The non-supplemented cows lost the most condition during the winter but gained the most during the summer when compared to the supplemented cows. However, much of the weight gain in the younger cows was due to growth as it reflected in wither height.

The birth and weaning weights of the calves from the supplemented cows was consistently greater than those from the non-supplemented cows (table 3). All calves weaned light because of the management associated with handling cows and calves under experimental conditions. The five-year calf crop expressed as a percent of calves that could have been weaned was 75 and 82% for the non-supplemented and supplemented cows, respectively. Several of the calf losses were not associated with treatment, that is they were caused by difficult births, calf scours and unknown causes. The effect the protein supplement had upon the intake of the low quality forage may be as important in this situation as the importance of meeting the protein requirement of the animals. This may not be true in other situations where the cattle have the opportunity to select their own diets, such as in grazing situations, even though forage may be low quality.

Table 3. Average five-year production of the cows.

	1959-60	60-61	61-62	62-63	63-64	Avg.
No supplemental protein						
Birth wt adj for sex, lb	62.9	70.0	59.0	71.9	68.0	66.0
Adj 380 da wn wt, lb	301	271	297	343	354	315
Milk prod, lb/24 hrs[a]	9.7	8.8	---	---	---	9.2
Calving to 1st estrus, days	98	78	60	57	59	70
Services/conception	1.8	1.0	2.0	1.2	1.1	1.4
% conceived of those that calved and were bred	82	67	83	85	85	80
Supplemental protein						
Birth wt adj for sex, lb	66.9	73.9	60.9	73.9	70.0	68.9
Adj 380 da wn wt, lb	308	308	299	350	376	328
Milk prod, lb/24 hrs[a]	10.3	9.9	---	---	---	10.1
Calving to 1st estrus, days	100	66	62	49	41	64
Services/conception	1.2	1.4	1.4	1.5	1.5	1.4
% conceived of those that calved and were bred	100	88	100	85	80	91

[a]The 1960 data is the average of 16 heifers in each group. The 1961 data is the average of 8 cows in each group.

During the 1960's researchers in Nebraska attempted to determine the protein and energy requirement for cattle managed under range conditions and how well the range forage met the requirements. Several of the experiments dealing with the relationship of protein and energy in range supplements are discussed.

Two experiments using calves were conducted during the winters of 1963-64 and 1964-65 on native range at the USDA Beef Cattle Research Station at Fort Robinson in Northwestern Nebraska. They were designed to study the relationship of supplemental protein and supplemental energy intake under range conditions. The supplemental feeding program is outlined in tables 4 and 5. Six heifer calves were individually fed each supplement each day in individual stalls. All the calves grazed together in the same pasture.

Table 4. Daily supplements and average daily gains of calves in the Fort Robinson experiment (December 4, 1963-April 15, 1964).

	Megcal estimated digestible energy/day			
Crude protein/day, lb	**0**	**2.4**	**4.8**	**7.2**
0				
Daily supplement fed, lb	0.0			
Protein in supplement, %	0.0			
Daily gain, lb	0.0			
0.3				
Daily supplement fed, lb		1.5	3.0	4.5
Protein in supplement, %		20.0	10.0	6.7
Daily gain, lb		0.34	0.30	0.34
0.6				
Daily supplement fed, lb		1.5	3.0	4.5
Protein in supplement, %		40.0	20.0	13.3
+ Daily gain, lb		0.52	0.57	0.69

Table 5. Daily supplements and average daily gains of calves in the Fort Robinson experiment (December 29, 1964-April 15, 1965).

	Megcal estimated digestible energy/day			
Crude protein/day, lb	**0**	**3.2**	**5.6**	**8.0**
0				
Daily supplement fed, lb	0.0			
Protein in supplement, %	0.0			
Daily gain, lb	-0.23			
0.4				
Daily supplement fed, lb		2.0	3.5	5.0
Protein in supplement, %		20.0[a]	11.3	7.9[a]
Daily gain, lb		0.41	0.27	0.07
0.8				
Daily supplement fed, lb		2.0	3.5	5.0
Protein in supplement, %		40.0	22.6	15.8
Daily gain, lb		0.60	0.74	0.80

[a]Each of these two supplements was fed to a group of calves in drylot receiving grass hay (9% protein). The daily gains were 0.81 and 0.90 lb. respectively. Daily hay consumption was 10.6 and 8.2 lb. respectively.

The calves that received supplements gained more weight than those not receiving a supplement. The calves that received the higher level of supplemental protein each year gained more weight than those receiving the lower level of supplemental protein. There was no difference in gains resulting from varying the energy intake when calves from both supplemental protein levels were included. However, in 1964-65 there was an interaction between protein level and energy level of supplementation. When the energy intake was increased within the low level of protein supplementation, the gains decreased, whereas they increased when energy intake was increased within the high level of protein supplementation (table 5). This also allowed extra energy to be beneficial. The high amounts of supplemental energy could have influenced the amount of energy derived from the forage by altering intake and/or digestibility of the forage dry matter.

The third and fourth experiments were conducted on a native range at the University of Nebraska North Platte Station in 1967-68 and 1969. The objectives of the studies were to: (1) estimate the relative intake and digestibility of winter-range forage, and (2) determine the influence of supplemental protein and/or energy on intake and digestibililty of winter-range forage consumed by grazing cattle.

In the third experiment, animals received supplements which supplied three levels of crude protein and four levels of estimated digestible energy per day in all combinations (table 6). A control group received a supplement to supply minerals and vitamin A at the same rate as the other supplements. In the fourth experiment, animals received no supplement or a given about of a 34% crude protein supplement. Animals received no supplemental hay.

Table 6. Nature and calculated amount of supplement fed in the experiment conducted at North Platte (1967-68)

Gm. Crude Protein/kg $BW^{0.75}$/day	Control	Megcal. estimated digestible energy per $kg.\ BW^{0.75}$ per day			
		0.020	0.041	0.061	0.081
Control	2.31[a] -4.1%[b]				
1.16		6.14-19%	12.2-9.5%	18.4-6.3%	24.5-4.7%
2.07		6.14-34%	12.2-17%	18.4-11%	24.5-8.5%
3.00		6.60-45%	12.2-24%	18.4-16%	24.5-12%

[a]Gm/kg $BW^{0.75}$ fed daily
[b]Each % refers to the calculated protein content of supplement.

Supplements seemed to depress dry matter intake and increase forage dry matter digestibility regardless of the level of supplemental protein and or energy fed compared to the control group in the third experiment (table 7); but neither intake nor digestibility of the control animals was significantly different from the average of those receiving supplements.

Table 7. Adjusted daily forage intake and dry matter digestibility of the forage and diet of animals receiving varying amounts of supplemental protein and/or energy (1967-68). North Platte.

Gm. Crude Protein/kg $BW^{0.75}$/day	Control	Megcal. estimated digestible energy per $kg.\ BW^{0.75}$ per day				
		0.020	0.041	0.061	0.081	Mean
Intake of forage, gm/kg $BW^{0.75}$						
Control	51					
1.16		46	49	44	37	44
2.07		47	48	40	50	46
3.00		50	52	44	45	48
Mean		48	50	42	44	46
Digestibility of forage, %						
Control	39					
1.16		42	42	40	40	41
2.07		39	42	39	44	41
3.00		43	42	45	43	43
Mean		42	42	41	42	42
Digestibility of diet, %						
Control	41					
1.16		47	49	50	51	49
2.07		43	49	48	53	48
3.00		48	49	53	52	50
Mean		46	49	50	52	49

Supplemental crude protein had a greater influence on forage dry matter digestibility than on intake. A small, but significantly higher forage dry matter digestion coefficient resulted from feeding 3.00 gm crude protein per kg $BW^{0.75}$ compared to the average of the two lower levels. A significant difference in intake of forage was observed among means attributed to differing levels of supplemental protein. However, a comparison of means adjusted for animal effect showed that those means could have been from a homogenous population.

Levels of supplemental energy greater than 0.041 megcal of estimated digestible energy per kg $BW^{0.75}$ depressed intake of forage dry matter (table 7). This adjusted average forage intake of animals receiving the two lower levels of supplemental energy was significantly higher than those receiving the higher levels. Supplemental energy had no influence on the digestibility of the forage (table 7).

Because of heavy snow cover during the first trial of the fourth experiment, animals consumed less forage than during the second trial (table 8). Digestion coefficients were also lower during trial 1 than trial 2 (table 8). Samples collected via esophageal fistulae were composed almost entirely of Yucca glauca. Animals were observed to graze some grass as well. Intakes of the magnitude recorded during trial 1 were obviously below maintenance requirements for energy as evidenced by weight losses in the experimental animals.

Table 8. Daily forage intake and dry matter digestibility of the forage and diet of animals receiving 2.07 gm supplemental protein per kg $BW^{0.75}$ compared to no supplemental protein. (North Platte, 1969).

	Intake of forage gm/kg $BW^{0.75}$		Digestibility, %		
			Forage		
Dates	**Supp.**	**No Supp.**	**Supp.**	**No. Supp.**	**Diet**
1/27 – 2/1	33	25	35	29	42
2/24 – 3/1	61	68	40	40	43

Intake was not significantly altered when supplemental protein was fed during either trial. During trial 1, the dry matter digestibility of the forage supplemented with protein was significantly higher than the control group. Supplemental protein had no influence on forage dry matter digestibility during trial 2 (table 8). This resulted in a significant trial x treatment interaction.

Since the amount of supplement fed was a constant within a supplemental energy level, the total dry matter consumed was a function of forage intake. Therefore, the relative influence of supplemental protein on the total dry matter consumed was the same as on the forage dry matter consumed. Animals consumed increasing quantities of total dry matter as supplemental energy was increased, even though forage dry matter intake was depressed, i.e., 54, 62, 61, and 68 gm per kg $BW^{0.75}$ for the 0.020, 0.041, 0.061 and 0.081 megcal levels of estimated digestible energy per kg $BW^{0.75}$, respectively. Supplements also increased the dry matter digestibility of the diet (table 7). The most pronounced effect was due to supplemental energy because of its higher digestibility in comparison to the forage. Levels of supplemental protein did not influence the digestibility of the total diet.

Therefore, animals receiving increasing levels of supplemental energy consumed a diet of correspondingly higher digestible dry matter.

In the fourth experiment, animals receiving supplements consumed 39 compared to 25 gm per kg $BW^{0.75}$ for the control group, during trial 1. Total intake was about the same during trial 2. Dry matter digestibility of the diet of supplemented animals was significantly improved over the control group during both trials, but was more pronounced during trial 1 (table 8).

Vitamins and minerals

With the exception of vitamin A cattle managed on range forage rarely have a vitamin deficiency. The vitamin A storage ability of cattle makes it not too difficult to manage their vitamin A requirement. The general recommendation is to provide supplemental vitamin A to cattle during the winter when dry mature forages are being fed. Following real droughty summers it may be desirable to give calves at weaning time a vitamin A injection or a supplement with a high level of vitamin A to build their vitamin A storage.

Phosphorus, calcium and possible magnesium and potassium are the minerals of most concern in range nutrition. In the range areas phosphorus is deficient during most of the year (figure 2). Thus, phosphorus supplementation is recommended the year around for cattle on range. Their requirement will vary from season to season but there will be few times when they do not need supplementation, thus it is recommended at all times. The mineral supplement used should contain at least 10% phosphorus. Calcium is a different situation in that most forages contain enough calcium to meet the animals requirement. One exception to this may be the period between calving and available green grass in the spring. Actually the forage at this time has good calcium content but the requirements of the lactating cow go up very sharply following calving and it may be necessary to use some calcium supplementation. Most mineral supplements contain adequate calcium if fed on a free choice basis to meet animal requirements. Like calcium, magnesium may be needed following calving and prior to adequate green grass. This again can be corrected with a supplementation program.

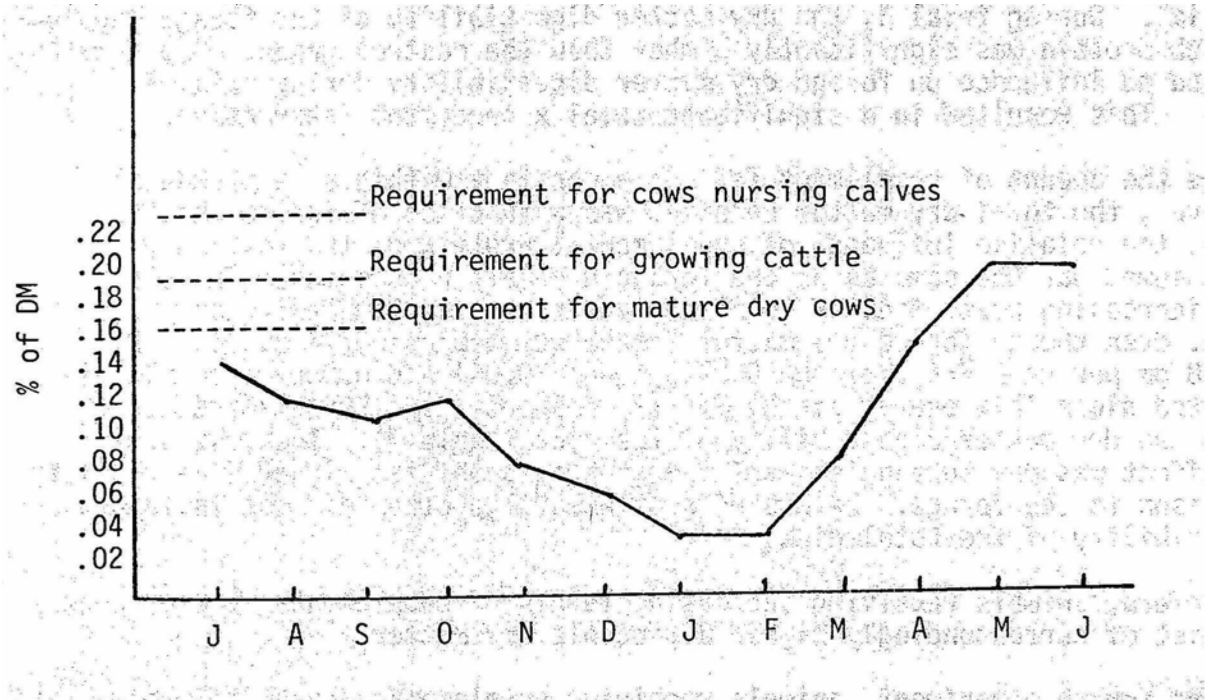

Figure 2. Phosphorus content of range forage at Miles City average over 6 years (Mont. Ag. Exp. Sta. Bul. 549)

A more recent discovery is the fact that mature range forage may be low in potassium. Native winter grasses collected by esophageal fistula were extremely low in potassium during February and March at both the North Platte Station and the Sandhills Ag Lab (table 9). They were actually lower at the Sandhills Ag Lab over a longer period during the winter than at the North Platte Station. Most of these levels are far below National Research Council recommendations for growing-finishing calves (0.6 to 0.8% potassium in the diet), clearly indicating that potassium may be a limiting nutrient under winter grazing conditions. The forage samples at the Sandhills Ag Lab are all warm season grasses, whereas at the North Platte Station several cool-season grasses are mixed in with the warm season grasses in the range site. It is a unique range site where as the Sandhills Ag Lab range site is a characteristic site of the Sandhills proper. The cool-season grasses which have a longer growing season contain more potassium.

Table 9. Potassium content of native winter forage collected via esophageal fistula.

North Platte Station		Sandhills Ag Lab	
Date of collection	**Potassium, % of DM**	**Date of collection**	**Potassium, % of DM**
Dec. 1973	1.07	Dec. 1974	.09
Jan. 1974	.46	Jan. 1975	.09
Feb. 1974	.23	Feb. 1975	.10
Mar. 1974	.15	Mar. 1975	.11
Apr. 1974	.57	Apr. 1975	.59

When soybean meal based supplements were fed to steer calves grazing native winter grass at North Platte, potassium appeared to be adequate. However, when urea and corn replaced part of the soybean meal in range supplements potassium was decreased and gains were depressed. Potassium is required on a daily basis, thus it is necessary to meet minimal requirements at all times.

Two experiments carried out at the Sandhills Agricultural Laboratory during the winter of 1974-1975 and 1975-1976 showed similar results. The first experiment was with weaning steers fed 1.5 pounds of a 40% protein supplement per day while grazing winter range. Results showed that steers fed a supplement containing 5% urea plus potassium chloride had greater gains (0.2 pounds per day) than steers fed a similar supplement without potassium (0.09 pounds per day). Steers fed a soybean meal based supplement had greater gains (0.34 pounds per day) than either group fed urea containing supplements (table 10). Pasture samples collected during the experiment December through March contained about 0.1% potassium.

The second experiment was with dry bred cows fed two pounds of a 40% protein supplement every other day while grazing winter range. Supplements contained corn gluten meal with different levels of potassium chloride. Corn gluten meal is low in potassium but high in protein. During this experiment all cows lost weight but cows that received the highest level of supplemental potassium lost only 0.12 pounds per day while cows fed the low potassium supplement lost 0.53 pounds per day (table 11). Results of these two experiments show that potassium can be low enough in Sandhills winter range forage to affect performance of weaning calves and bred cows. Precise requirement of supplemental potassium was not determined for either calves or cows, however, it would appear that supplements fed to calves at the rate of 1.5 pounds per day should contain at least 2% potassium (the level in the soybean meal supplement).

The supplement resulting in the lowest weight loss of cows contain 6.6% potassium and was fed at the rate of two pounds every other day. However, it will be necessary to determine whether low cow weight losses resulted in more rapid rebreeding or heavier calf weaning weights before a specific level of supplemental potassium can be recommended or cows.

Table 10. Supplemental potassium concentrations and average daily gains of calves. (Sandhills Ag Lab 1974-75).

Supplements	**Potassium in supplements**	**Average daily gain**
	%	**lb**
Soybean meal	1.90	0.34
Soybean meal, corn, + urea (5%)	1.35	0.09
Soybean meal, corn, + urea (5%) + 1.2% potassium chloride	1.85	0.20

Table 11. Supplemental potassium concentrations and average daily weight losses of cows. (Sandhills Ag Lab 1975-76)

	Potassium in supplements	Average daily gain
	%	lb
Corn gluten meal	0.48	0.53
Corn gluten meal + 4.02% potassium chloride	2.74	0.38
Corn gluten meal + 8.08% potassium chloride	4.02	0.28
Corn gluten meal + 12.16% potassium chloride	6.57	0.12

Physical factors affecting forage quality

General recommendations on the proper supplements to use for range forage or native hay are difficult to make because of the many factors that effect forage quality and voluntary intake by the cattle.

The effect of inclement weather as expressed with heavy snow cover was demonstrated in an experiment conducted by the North Platte Station in 1969. (table 8). It appears that heavy snow cover has two general effects on range forage utilization. 1) It reduces forage intake and 2) it alters the quality of the diet because the cattle are not as selective in their grazing habits and generally end up consuming a diet that is less digestible, thus, their total dietary intake is lowered in quality by both a limited intake and a limited digestibility. Other climatic factors such as cold weather and wind also effect the quality of the diet in the same manner, however, they are generally of a more short-lived nature and as soon as the cold spell or the cold winds subside the cattle will go back to normal grazing pattern. This is not the case with heavy snow because the longer it persists generally the more problems you might expect with cattle not grazing normally.

The effect of year has been demonstrated in a study of the effect of early and late harvesting on nutritive quality of Sandhills forage (table 12). In this study hay was cut early (July 13) and late (August 27) in both 1962 and 1963 and stored by: 1) baling with a rotobaler; 2) windrowing with a dump rake; 3) bunching with a basket attached to the bar of a tractor mounted mower; 4) letting the forage remain standing. Samples from the 4 storage treatments of both the early and late cutting were collected monthly from July through January for chemical analyses.

Table 12. Nutritive quality of early and late cut Sandhills hay.

	Cut July 13		Cut Aug. 27	
	1962	1963	1962	1963
Crude protein, %	6.24	8.10	4.56	8.30
Digestible protein, %	2.29	3.50	1.01	4.10
Digestible energy (kcal/lb)	760	695	580	700

Results of this work indicated that early cut hay was higher in nutritive value but produced less forage than late cut hay. The nutritive value of the standing forage was considerably lower than that of the other storage treatments, while relatively little difference was found between the nutritive values of the bunched, windrowed and baled hays. Hence, it was thought that these forages should be more thoroughly evaluated to determine if in fact the nutritive value of prairie hay was maintained as well throughout the storage period when stored in bunches and windrows as when stores in bales. All the samples collected were subjected to an in vitro dry matter digestibility study and the results are shown in figures 3 and 4. There was a very sharp decline in digestibility both in 1962 and 1963 between July and September. However, there was essentially no change in either year between September and January.

Data for 1963 indicated that there was a much greater decrease in digestibility between July and September than in 1962. Although the hays for 1963 had a higher initial dry matter digestibility, by September they had decreased below the dry matter digestibility for the 1962 hays. This sharp decrease in 1963 was probably due in part to the rainfall pattern. In 1963 there was 5 inches of rainfall the month before both August and September sampling dates. In 1962 there was 9 inches of rainfall before the August sampling date but only 1.4 inches between the August and September sampling date.

In 1962 there was a much greater difference between the dry matter digestibilities between the early and late cut forages than in 1963 (figure 3). One of the reasons for the wide difference between the early and late dry matter digestibilities in 1962 was probably related to the yields. As was previously mentioned 9 inches of rain fell between the early and late cutting dates with the result of the late cutting hay yielded 405 pounds per acre more than the early cut hay. The late cut hay was course and more highly lignified than the early cut hay, which no doubt led to its lower dry matter digestibility. In 1963 there was only 102 pounds greater yield from the late cut than from the early cut hay. There was much less forage growth between cuttings in 1963 than in 1962 and thus less physical change in the forage which would be reflected in its digestibility. Apparent digestible and metabolizable energy values collected in conventional trials using the baled hay would tend to substantiate the laboratory dry matter digestibility differences as related to year and cutting date shown in figure 3.

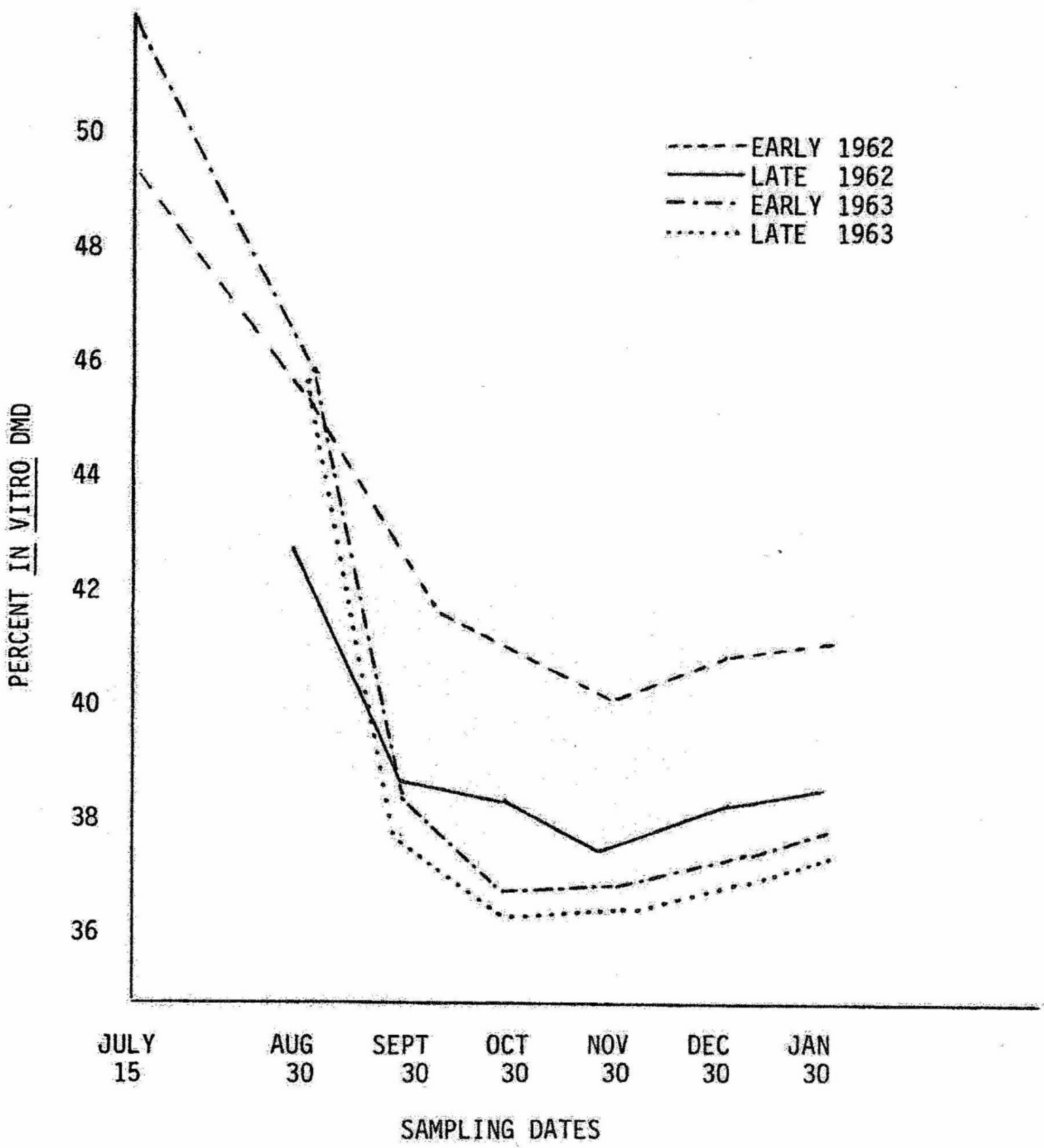

Figure 3. The relationship of cutting date and storage time on in vitro DMD

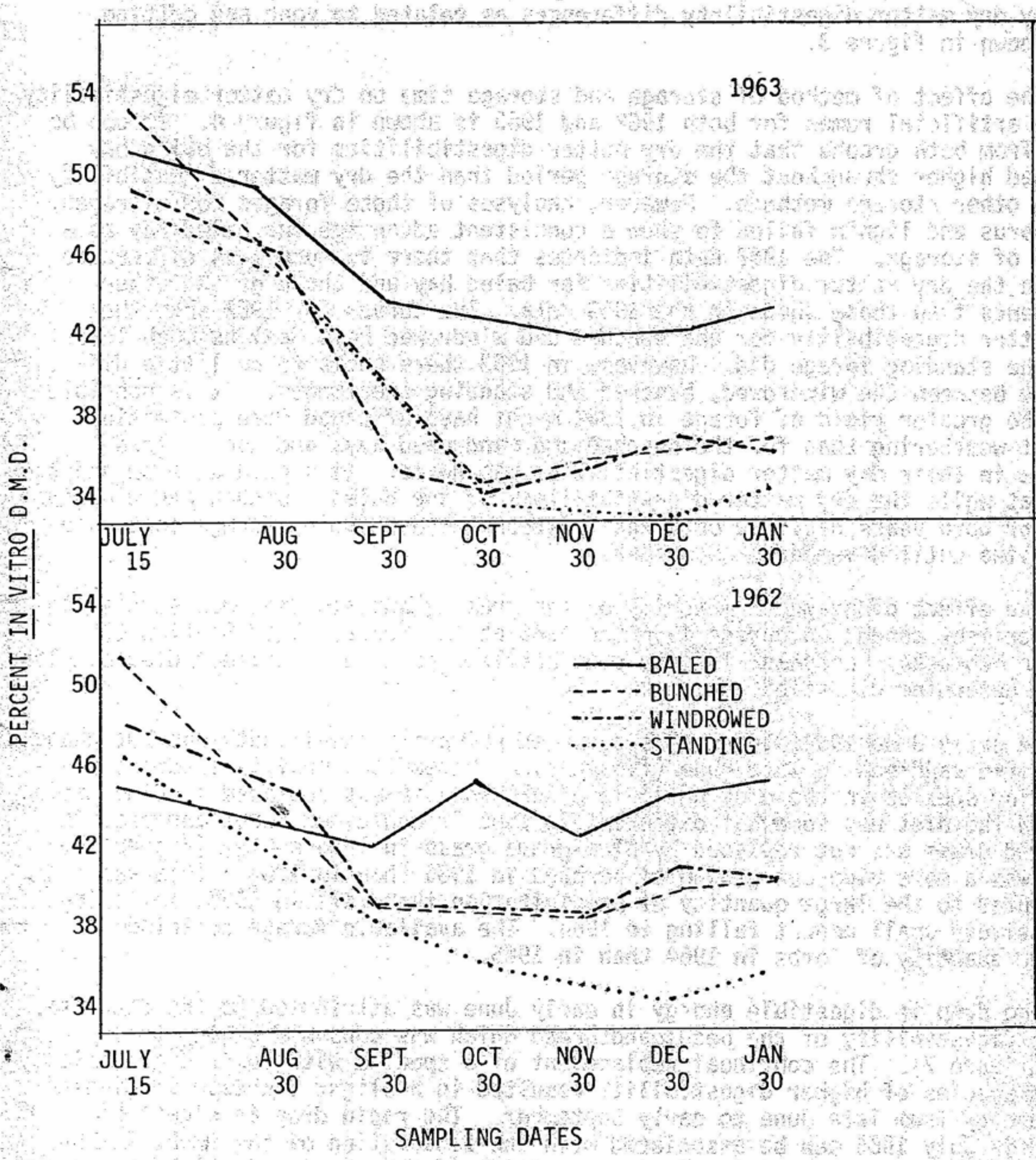

Figure 4. The relationship of method of storage and storage time on in vitro DMD

The effect of method of storage and storage time on dry matter digestibility in the artificial rumen for both 1962 and 1963 is shown in figure 4. It can be noted from both graphs that the dry matter digestibilities for the baled hay remained higher throughout the storage period than the dry matter digestibility of the other storage methods. However, analyses of these forages for nitrogen, phosphorus and lignin failed to show a consistent advantage for baled hay as a method of storage. The 1962 data indicates that there is much less difference between the dry matter digestibilities for baled for baled hay and those of the other treatments than those shown in the 1963 data. The curves for 1962 show that dry matter digestibility for the bunched and windrowed hays decline much less than the standing forage did. However, in 1963 there seems to be little difference between the windrowed, bunched and standing treatments. It is possible that the greater yield of forage in 1962 might have afforded more protection against weathering than for the bunched and windrowed hays and hence, less decline in their dry matter digestibilities was noted. It should also be pointed out that while the dry matter digestibilities of the baled, bunched and windrowed hays for both years declined only until October, the standing forage continued to decline until November or December.

The effect of stage of maturity on the grazing animals diet was studied in an experiment conducted during 1964 and 1965 at the Scotts Bluff Station in western Nebraska. Esophageal fistulated cattle were used to collect diet samples and to determine digestibility.

In early June 1964, the steers consumed primarily needleandthread but changed to prairies sandreed in late June (figure 5). Thereafter, prairie sandreed was the major species in the diet until late July when it was replaced by blue grama. In 1965 the diet was somewhat different in that it contained forbs and prairie sandreed grass was not replaced by blue grama grass in late summer (figure 6). There was a more vigorous growth of herbage in 1965 than in 1964. This was attributed to the large quantity of precipitation that fell in 1965, following a relatively small amount falling in 1964. The available forage contained a smaller quantity of forbs in 1964 than in 1965.

The drop in digestible energy in early June was attributed to the decrease in the digestibility of the needleandthreat which was consumed during this time (figure 7). The continual replacement of a species with lower digestibility with a species of higher digestibility resulted in a slight increase in digestible energy from late June to early September. The rapid drop in digestible energy in July 1965 can be associated with the consumption of the forb, lambs-quarters. They were consuming large quantities of the weed seed which was undigestible. The digestible energy content of the forage consumed in 1965 increased in August when the cattle consumed more prairie sandreed.

The nitrogen (protein) content of the forage consumed, decreased during the season except in 1964 it increased slightly in early August (figure 8). The decrease was due to the decrease in amount of nitrogen in the forage available. It is of interest to note that, unlike the digestible energy content of the diet, the nitrogen content was higher in 1965 than 1964. This would indicate that the protein and energy content of range forages are not influenced similarly by changes in environmental conditions.

This brief look at the effects of climate, years, methods of handling forage and stage of maturity on the quality and utilization of the forage merely indicates the complexity of the problem of determining how well the forage at any given time meets the requirements of the animals.

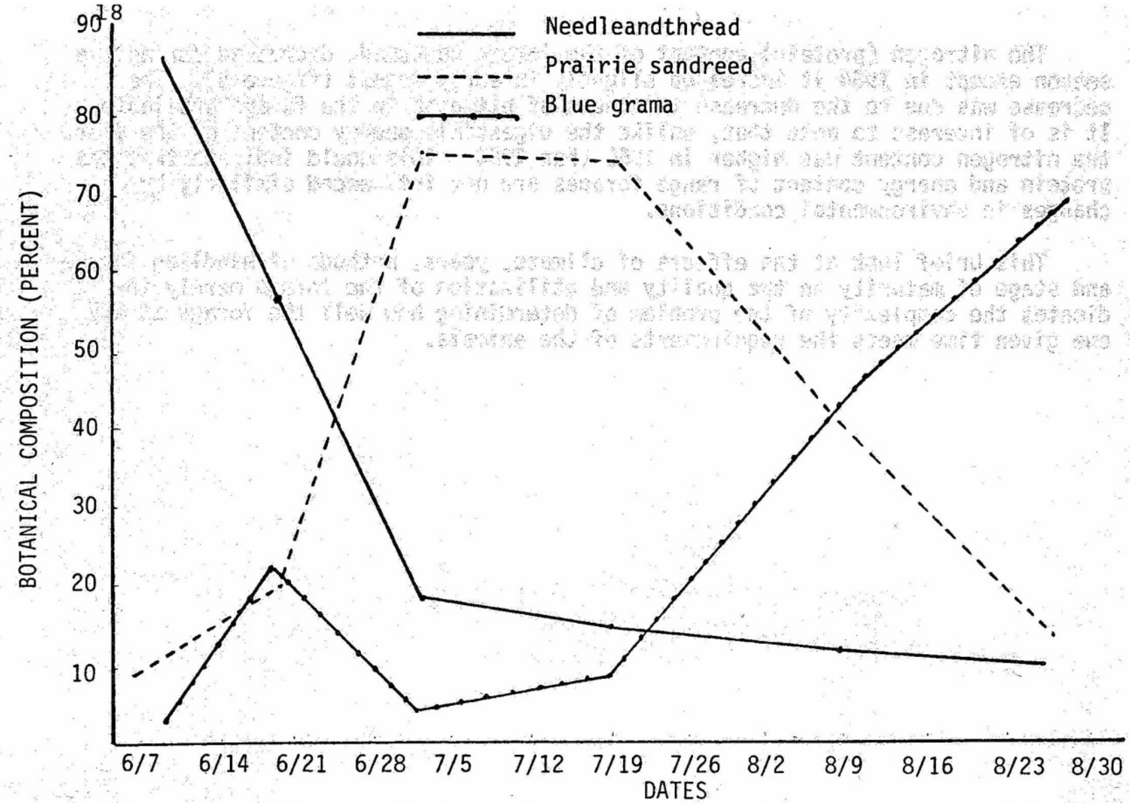

Figure 5. Influence of advance in season on botanical composition of forage consumed in 1964.

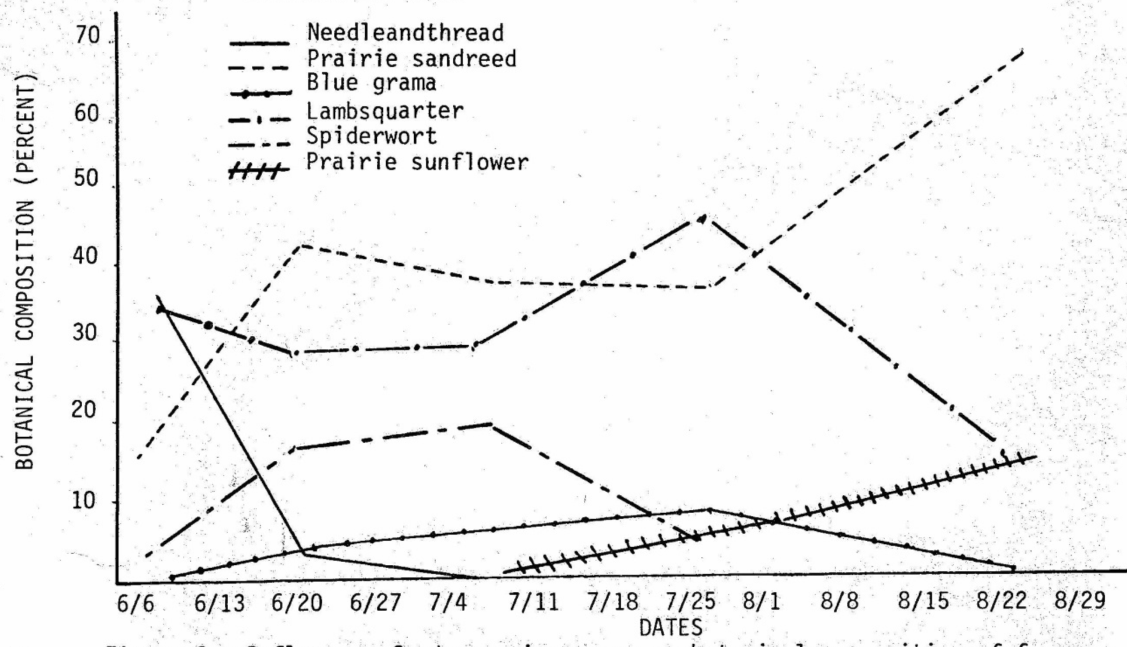

Figure 6. Influence of advance in season on botanical composition of forage consumed in 1965.

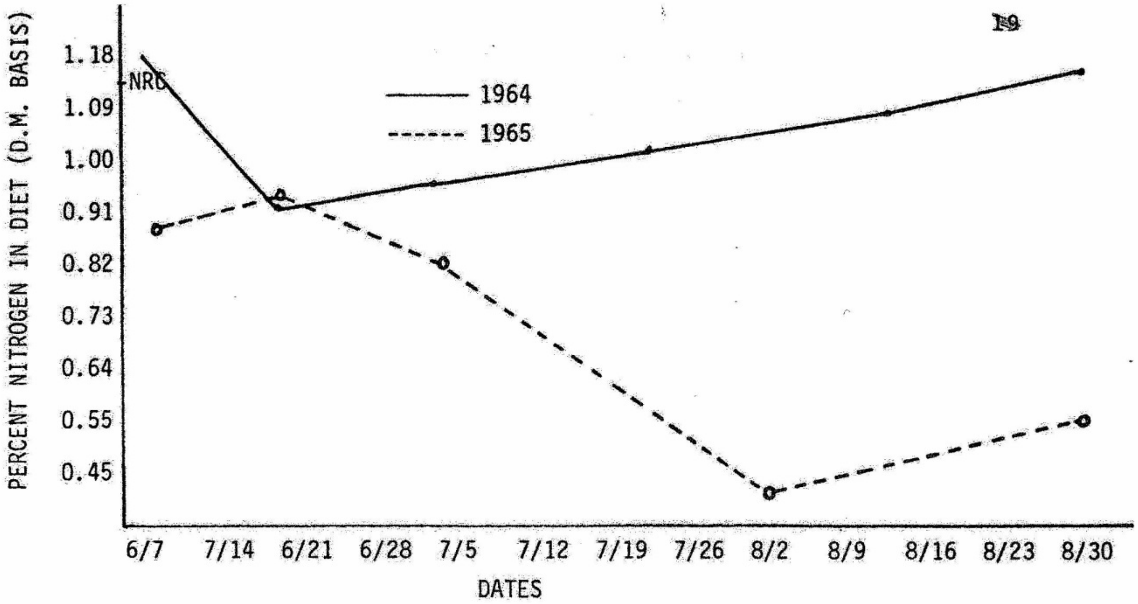

Figure 7. Influence of advance in season on digestible energy, NRC = National Research Council's recommended nutrient allowanced for normal growth of yearlings.

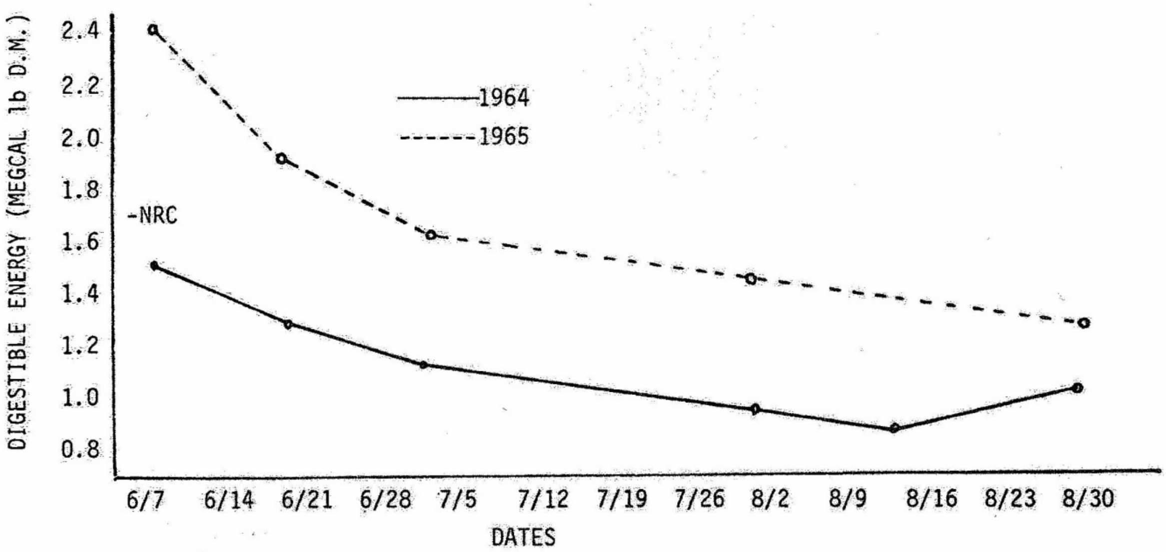

Figure 8. Influence of advance in season on nitrogen content of diet.NRC = National Research Council's recommended nutrient allowances for normal growth of yearlings