1966

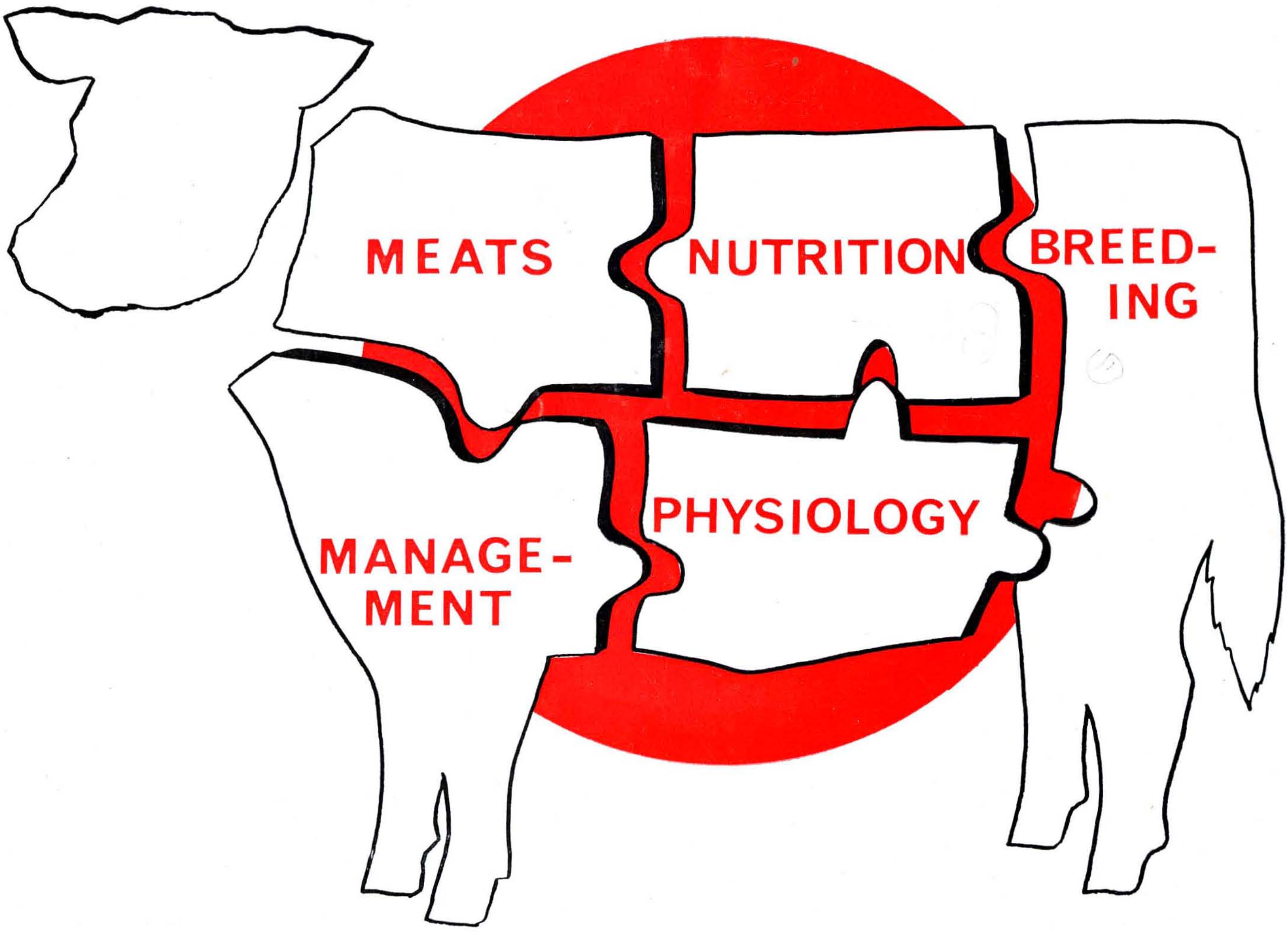
1966 Beef Cattle Progress Report of Research Activities

E. F. Frolik

H. H. Kramer

1966 BEEF CATTLE...

PROGRESS REPORT
of
RESEARCH ACTIVITIES



* Progress in BEEF CATTLE PRODUCTION

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Table 1. Average performance of selection lines for several major traits.

Trait	Sex	1960 Line 21	1960 Line 22	1960 Line 23	1961 Line 21	1961 Line 22	1961 Line 23	1962 Line 21	1962 Line 22	1962 Line 23	1963 Line 21	1963 Line 22	1963 Line 23	1964 Line 21	1964 Line 22	1964 Line 23	1965 Line 21	1965 Line 22	1965 Line 23
200-days weight[a]	Bulls	437	427	418	436	433	460	464	472	457	446	444	443	444	427	421	446	447	451
	Heifers	410	406	408	422	424	405	442	424	440	410	399	412	413	407	406	421	409	424
Yearling weight[b]	Bulls	1208	1206	1200	1214	1212	1210	1180	1213	1182	1192	1235	1210	955	956	953	......	......	......
	Heifers	762	738	741	801	792	772	775	744	769	797	772	801	815	818	797	......	......	......
Yrlg. conformation score	Bulls	10.2	10.0	10.1	10.1	10.0	10.0	9.9	10.1	9.9	9.7	10.2	9.9	10.1	10.2	10.5	......	......	......

[a] Adjusted for age of dam and age of calf.
[b] Yearling weight = 550 days for heifers in all years; 550 days for bulls in years 1960, 1961, 1962 and 1963, but *452 days* in 1964. Yearling weights are adjusted for age of calf.

Is Cattle Selection Effective?

By L. J. Sumption,[1] K. E. Gregory,[2] J. E. Ingalls,[3] J. A. Rothlisberger[4]

Many beef cattle breeders in the United States and other countries are following the progress of the selection experiment at the Fort Robinson Beef Cattle Research Station, Crawford, Nebraska. Three lines of Hereford cattle from the same genetic foundation are under selection. Line 21 is selected for 200-day weight. Line 22 is selected for yearling weight. Line 23 is selected for an index combining yearling weight and a score for muscling and fat thickness.

Each line is operated as a closed herd so it will be possible to determine how much improvement in economic traits can be made by selecting all replacement stock from within the same herd. Starting in 1966 there will be 150 calving cows in each line. Six herd sires are used each year. Two bulls and 25 heifers are selected to add to each line each year. Heifers are bred to calve first as two year olds. Cow numbers will be maintained at 150 by culling the oldest cows and those that fail to conceive or have a major physical unsoundness. Bulls are replaced after their third breeding season.

Sires are assigned a random sample of females from each age group each year to permit accurate comparisons among sire progenies. Matings as close as full sib or half sib are avoided to insure a low rate of inbreeding and permit selection to have major genetic influence on each line.

(continued on next page)

Table 2. Individual performance records of selected bulls.

Line	Calf-crop source	Bull No.	200-day Adj. wt.	200-day Wt. ratio	Yearling[a] Adj. wt.	Yearling[a] Wt. ratio	Conformation score
Line 21 Selected for 200-day weight	1960	60041	483	111	1332	110	11
		60319	509	117	1301	108	11
	1961	61032	572	131	1399	115	11
		61185	482	111	1214	100	10
	1962	62238	539	116	1292	109	11
		62245	526	113	1254	106	11
	1963	63063	527	118	1291	108	10
		63124	501	112	1322	111	13
	1964	64169	546	123	1161	122	11
		64375	580	131	1034	108	11
Line 22 Selected for yearling weight	1960	60190	500	115	1320	109	11
		60195	435	100	1361	113	12
	1961	61004	515	119	1436	118	11
		61011	451	104	1316	109	12
	1962	62097	488	103	1334	110	12
		62103	574	122	1417	117	12
	1963	63029	489	110	1388	112	12
		63241	453	102	1366	111	13
	1964	64168	521	122	1118	117	11
		64285	539	126	1112	116	10
Line 23 Selected for index of yearling weight, low fatness and muscling	1960	60281	482	111	1397	116	12
		60302	498	114	1351	113	12
	1961	61064	452	98	1319	109	11
		61109	475	103	1255	104	14
	1962	62135	472	103	1222	103	13
		62187	416	91	1228	104	13
	1963	63177	424	96	1329	110	12
		63255	482	109	1259	104	12
	1964	64215	460	109	1021	107	13
		64314	474	113	1081	113	12

[a] Yearling weight = 550 days for 1960, 61, 62 and 63 and 452 days for 1964.

[1] Department of Animal Science, University of Nebraska.

[2] Beef Cattle Research Branch, Animal Husbandry Research Division, A.R.S., U.S.D.A., Lincoln, Nebraska.

[3] Animal Husbandry Research Division, Agricultural Research Service, Fort Robinson Beef Cattle Research Station, Crawford, Nebraska.

[4] Nebraska Agricultural Experiment Station, Fort Robinson Beef Cattle Research Station, Crawford, Nebraska.

Is Selection Effective?

(continued from page 3)

This project began in 1960 and will continue to yield results for the next 20 years. It is important to know how rapidly growth rate of cattle can be changed by selection using individual performance records.

Performance Records

The average performance of Lines 21, 22 and 23 for the first five and a half years is given in Table 1. There is still no indication of a trend in performance. Many foundation cows are still in the herd and it was not until the 1965 calf crop that all calves were sired by bulls selected within each line. Because of the typically long generation interval of cattle, the rate of genetic improvement of a herd is slow and difficult to recognize in a short time.

Performance records of the two bulls selected for use in each line each year since the experiment began are given in Table 2. The *weight ratio* refers to a comparison of the record of each individual (in percentage points) with the average performance of the line. For example, bull 60041 in Line 21 was 111 percent of the average of his line for 200-day weight and 110 percent of average of his line for yearling weight.

It is interesting to compare the ratios for 200-day weight and yearling weight. Some bulls increased their ranking in their group between weaning and the end of the postweaning test. For example, bull 60195 in Line 22 was just average (100) at 200 days but was 13 percent above average for yearling weight. Apparently, bull 60195 was raised by a cow with only average milking ability but he did have the inherent ability to grow, as indicated by his yearling weight ratio.

Bull number 61185 provides a sharp contrast. Raised by a cow with sufficiently high milking ability, 61185 was 11 percent above herd average at 200 days but decreased in rank to herd average for yearling weight, apparently not possessing superior genetic potential for growth rate. All selected bulls were substantially above herd average in total performance.

The amount of selection practiced (selection differential) among bulls is shown in Table 3. Selection differentials are determined by subtracting the average performance of the line from the average performance of the selected bulls for the trait under selection. In the case of Line 21 bulls for 1960, the selection differential for 200-day weight was 59 lbs. Therefore, bulls 60041 and 60319 have an average 200-day weight that is 59 lbs. above the average of Line 21 bulls for 1960. This information does indicate the amount of pressure it was possible to apply through bull selection from within the herd to increase 200-day weight. Selection differentials are also large for yearling weight in Line 22 and index points in Line 23.

Correlated Response

The way in which other traits change when selection is practiced for one trait is called correlated

Table 3. Amount of selection practiced among bulls.

Line	Bull No.	Individual records of selected bulls: 200 day wt.	Yrlg. wt.	Index[a]	Average record of selected bulls: 200 day wt.	Yrlg. wt.	Index	Average record of all bulls: 200 day wt.	Yrlg. wt.	Index	Selection differentials: 200 day wt.	Yrlg. wt.	Index
Line 21 Selected for 200-day weight	0041	483	......	......	496	......	......	437	......	......	59	......	......
	0319	509	......	......									
	1032	572	......	......	527	......	......	436	......	......	91	......	......
	1185	482	......	......									
	2238	539	......	......	533	......	......	464	......	......	69	......	......
	2245	526	......	......									
	3063	527	......	......	514	......	......	446	......	......	68	......	......
	3124	501	......	......									
	4169	546	......	......	563	......	......	444	......	......	119	......	......
	4375	580	......	......									
Line 22 Selected for yearling weight	0190	......	1320	......	......	1340	......	......	1206	......	......	134	......
	0195	......	1361	......									
	1004	......	1436	......	......	1376	......	......	1212	......	......	164	......
	1011	......	1316	......									
	2097	......	1334	......	......	1375	......	......	1213	......	......	162	......
	2103	......	1417	......									
	3029	......	1388	......	......	1377	......	......	1235	......	......	142	......
	3241	......	1366	......									
	4168	......	1118	......	......	1115	......	......	956	......	......	159	......
	4285	......	1112	......									
Line 23 Selected for index of yearling weight, low fatness and muscling	0281	......	......	......	......	......	......[b]	......	......	......	......	......	......
	0302	......	......	......									
	1064	......	......	129.0	......	......	132.5	......	......	101.7	......	......	30.8
	1109	......	......	136.0									
	2135	......	......	120.8	......	......	131.5	......	......	100.2	......	......	30.9
	2187	......	......	141.4									
	3177	......	......	126.8	......	......	125.5	......	......	102.4	......	......	23.1
	3255	......	......	124.1									
	4215	......	......	132.6	......	......	133.6	......	......	102.2	......	......	31.4
	4314	......	......	134.6									

[a] $\text{Index} = 100 + \left[10 \left(\frac{\text{Individual bull wt. deviation from ave. wt.}}{\text{standard deviation of yearling wt.}} \right) + 10 \left(\frac{\text{Individual bull score deviation from ave. fat-muscle score}}{\text{standard deviation of fat-muscle score}} \right) \right]$

[b] Index not reported—calculated on a different basis than the succeeding years.

response. Bulls selected for 200-day weight tend to be higher than average in yearling weight.

For example, in 1960 the bulls selected in Line 21 that were 59 lbs. above line average for 200-day weight were also 109 lbs. above line average for yearling weight.

A worthwhile fact for breeders to observe is that when selection is practiced for one weight trait, there is a favorable effect on another useful trait.

Heifer Selection Limited

The amount of selection practiced among heifers is given in Table 5. No selection differentials are reported for 1960 because line numbers were being increased by outside introductions and the use of practically all available females produced.

It is common knowledge that only a small part of total herd improvement can be accomplished by performance selection of heifers. This experiment illustrates further that because breeders must keep such a large fraction of their heifers for replacements, the selection differentials are naturally low.

This information should help make it more clear to both seedstock breeders and commercial producers that the key factor is intense performance selection of *bulls*. Using a few bulls of low genetic merit can nullify the effects of the most careful heifer selection program.

Foundation Sires Become Obsolete

The design of the Fort Robinson selection experiment is such that older foundation sires are producing progeny in the same year as younger sires selected in each line. During the experiment this permits a sound comparison of sire progeny performance. If selection is effective, progeny of younger sires should be superior to that of the foundation sires. The available data are given in Table 6.

There is a trend for the progeny averages of foundation bulls to decrease from year to year as they are compared with the progeny of

(continued on next page)

Table 4. Comparison of selection differentials of bulls and correlated responses for each selection line.

Line	Year	Selection differential for 200-day wt., lbs.	Correlated response in yearling wt., lbs.	
Line 21 Selected for 200-day weight	1960	59	109	
	1961	91	93	
	1962	69	93	
	1963	68	115	
	1964	119	143	
		Correlated response in 200-day wt.	Selection differential for yearling wt., lbs.	
Line 22 Selected for yearling weight	1960	41	134	
	1961	51	164	
	1962	59	162	
	1963	30	142	
	1964	103	159	
		Correlated repsonses 200-day wt., lbs.	Yrlg. wt., lbs.	Selection differential for index
Line 23 Selected for index	1960	72	174	[a]
	1961	4	77	30.8
	1962	−8	43	30.9
	1963	10	84	23.1
	1964	46	98	31.4

[a] Not reported.

Table 5. Amount of selection practiced among heifers.

Line	Year	Average record of selected heifers		Average record of all heifers		Selection differentials	
		200 day weight	Yearling weight	200 day weight	Yearling weight	200 day weight	Yearling weight
Line 21	1961	440	......	422	......	18	......
	1962	465	......	442	......	23	......
	1963	430	......	416	......	14	......
	1964	429	......	413	......	16	......
Line 22	1961	......	808	......	792	......	16
	1962	......	752	......	736	......	16
	1963	......	784	......	760	......	24
	1964	......	852	......	819	......	33
Line 23	1961	......	788	......	772	......	16
	1962	......	803	......	760	......	43
	1963	......	832	......	789	......	43
	1964	......	838	......	797	......	41

Table 6. A comparison of weight ratios of sire progenies.

Sire No.	Line	200-day weight ratios[a] 1962	1963	1964	1965	Yearling weight ratios[a] 1962	1963	1964
55135	Foundation	104	99	......	......	105	103	......
55836	Foundation	97	96	......	......	99	99	......
56029	Foundation	99	99	......	......	102	100	......
58094	Foundation	99	104	......	......	101	106	......
58278	Foundation	102	100	96	......	101	104	97
58359	Foundation		94	92	......		97	92
59023	Foundation	104	101	104	......	100	99	101
60853	Foundation	......	93	93	......	......	92	93
60041	21	......	100	102	103	......	100	102
60319	21	......	102	98	97	......	101	98
60190	22	......	104	102	97	......	104	98
60195	22	......	103	103	102	......	100	101
60281	23	......	103	102	106	......	103	103
60302	23	......	103	102	101	......	100	104
61032	21	......	......	110	103	......	......	108
61185	21	......	......	99	97	......	......	98
61004	22	......	......	100	95	......	......	102
61011	22	......	......	100	103	......	......	104
61064	23	......	......	97	99	......	......	100
61109	23	......	......	104	101	......	......	102
62238	21	......	......	......	102	......	......	......
62245	21	......	......	......	100	......	......	......
62097	22	......	......	......	105	......	......	......
62103	22	......	......	......	99	......	......	......
62135	23	......	......	......	93	......	......	......
62187	23	......	......	......	101	......	......	......

[a] Average weight ratios for all calves raised from each sire each year.

Is Selection Effective?

(continued from page 5)

younger selected bulls. There is less of a trend in the progeny of younger bulls but there is little information available at this time.

In 1963, the 200 day and yearling weight ratios of *all* young selected sires was 100 or above. Only three out of eight foundation sires were 100 or above for 200-day weight ratio; four of the eight were 100 or higher for yearling weight ratio. In 1964 three fourths of the foundation sires were below average for both traits whereas only one fourth of the young sires were below line average.

These results provide an early indication that selection has been effective. By selecting high performing young bulls on their own performance record, it has been possible to make most of the foundation sires obsolete in their contribution to the gentics of these lines. This point is illustrated further in Table 7.

A direct comparison is made of the progeny performance of three foundation sires and their sons. In the case of sire 55135, the progeny of his son, bull 60281, were four percent higher in weaning weight but equal in yearling weight. However, sires 58278 and 58359 had progeny averages substantially below that of their selected sons. These results show still further how it is possible to improve the genetic merit of a breeding herd by selecting superior performing young bulls from within that herd for replacements.

These results indicate that there need be little fear of losing the favorable effects of an individual considered to be a key herd sire. Those key sires that really have high genetic merit will replace themselves with genetically superior sons and daughters.

Selection for Greater Profit

The most important "competition" for high performance that any beef cattle breeder has is his own herd average last year. One effective means of bringing about slow, but continuous improvement in that herd average is to select and use the highest performing progeny produced in the herd.

In cases where outside introductions are considered necessary or desirable, progeny comparisons could be made in such a way that this new material was added only when it had proved superior to the existing herd.

Most of the improvement that commercial cattle can make will be through the purchase of bulls of high genetic merit for growth, feed efficiency and carcass desirability. Effective purchase and use of superior bulls can be supplemented by performance selection of heifer replacements and cows.

Finally, the key question is what traits should receive emphasis? Nebraska has conducted the most critical analysis yet made of this issue, after extensive work with individual feeding and complete carcass cutout studies.

Based on this research, if breeders were to select for only one trait, it would be adjusted yearling weight. Yearling weight is favorably correlated with feed efficiency and the pounds of trimmed retail product produced per animal.

Selection for weaning weight is less accurate but still an effective method of improving the profit making ability of seedstock herds.

In practice most breeders will select for more than weight. Nevertheless, breeders must remember that the main product his ultimate customers—commercial cattlemen and feeders—have to sell is *pounds* of desirable beef.

Table 7. Comparison of progeny performance of foundation sires and their sons producing progeny in the same year.

	1963 calf crop		1964 calf crop				
	Sire 55135	Son 60281	Sire 58278	Son 61004	Son 61011	Sire 58359	Son 61109
200-day weight ratio	99	103	96	100	100	92	104
Yearling weight ratio	103	103	97	102	104	92	102

Protein Levels In Wintering Cattle Rations

By D. C. Clanton[1] and D. R. Zimmerman[1]

In recent years much attention has been given to the fact that inadequate energy intake impairs reproductive performance in beef cattle. It has also been shown that protein deficiency will impair reproductive performance in beef cattle and reduce weaning weights of calves.

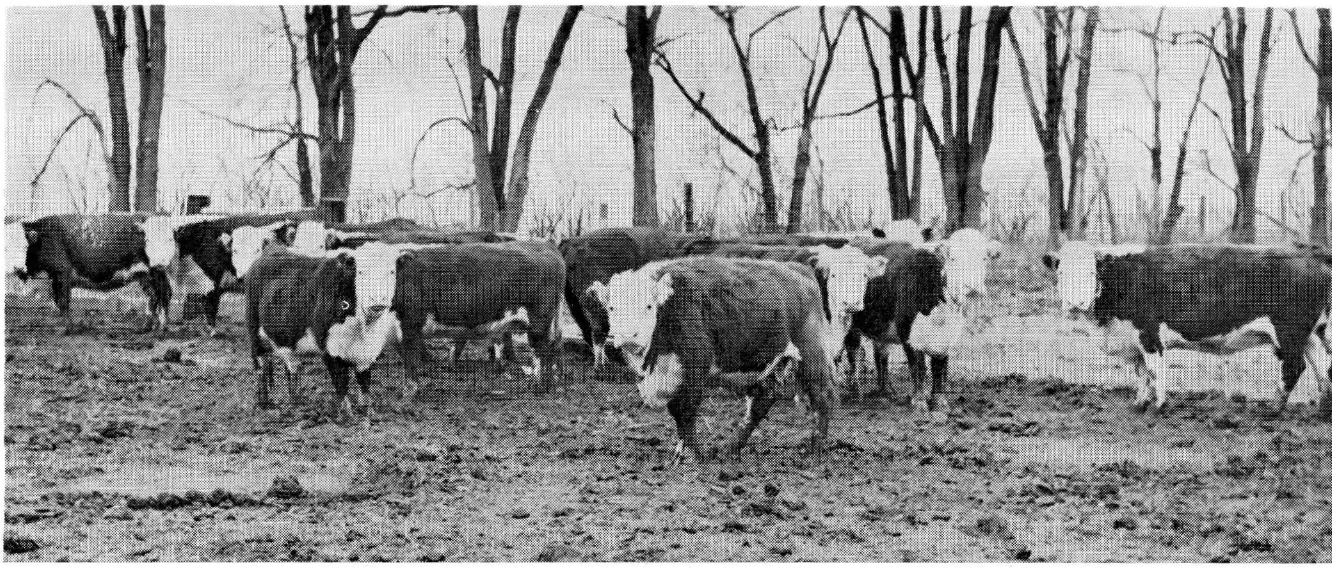
The National Research Council (1963) suggests that for wintering mature pregnant beef cows they should receive 1.3 to 1.7 pounds of total protein daily. In Nebraska, many good producing cows are wintered on native range forage, which falls as low as three percent protein, and one pound of a 30 to 40 percent protein supplement. A cow would have to eat more than 30 pounds of native forage to meet the above requirement. It has been shown that pregnant first calf heifers can be wintered on lower levels of protein and energy than normally recommended.

Experiment

Two groups of 16 cows, initially 20 months of age, each received one of two rations differing in protein content during five consecutive winters. They were grazed on bromegrass pasture during the summer except in 1960 when they received a full feed of alfalfa hay and three pounds of corn daily.

During the first two winters (1959-60 and 1960-61) the two protein levels were superimposed upon two energy levels (Table 1). Each heifer was individually fed on the basis of body size for a 140-day period before calving.

[1] Department of Animal Science, University of Nebraska.



Cows fed high protein during the winter.

The last three winters the two groups previously fed low protein rations were combined and group-fed all of the low quality brome-grass hay they would eat. The two groups previously fed high protein rations were also combined and full fed the same hay plus one pound of soybean meal per head per day (Table 1). The energy variable dropped because of poor reproductive performance in the low energy fed groups.

All cows remained in the experiment during the five years. The data from dry cows were used in the analyses where possible. The data from three cows, which died from causes not related to the experiment, were not used.

The measures used in the experi-

(continued on next page)

Table 1. Average daily ration fed during winters prior to calving.

	Low protein		High protein	
	Low energy	High energy	Low energy	High energy
1960 (140 days)				
Ration, lb./695 lb. heifer	12.0	12.0	12.0	12.0
Crude protein, lb.	0.75	0.84	1.14	1.21
Digestible protein, lb.	0.28	0.35	0.65	0.67
Digestible energy, megcal.	9.53	12.08	10.21	12.89
1961 (140 days)				
Ration, lb./695 lb. heifer	12.0	12.0	12.0	12.0
Crude protein, lb.	0.75	0.66	1.25	1.19
Digestible protein, lb.	0.35	0.35	0.66	0.70
Digestible energy, megcal.	10.31	11.29	10.96	12.38
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 protein, lb.	0.48		1.06	
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	

Cows fed low protein during the winter.

Protein Levels

(continued from page 7)

ment were voluntary hay consumption the last three winters, growth, condition and weight changes of the cows, milk production the first two years, fertility and calf production.

Digestible protein and energy were determined on the rations used the first three winters. Milk production was determined by weighing the calves before and after nursing. Two checks were made during a 24-hour period which began immediately after the cow had been nursed dry. The increase in calf weight was recorded as milk production. Five monthly milk determinations were made during the summer starting when the calf was 2-weeks old. The use of vasectomized bulls, breeding records and rectal palpation provided data on reproductive performance. Calf weights were adjusted for sex and age.

Results and Discussion

The supplemental protein increased voluntary consumption of bromegrass hay, which in turn increased the energy intake, the third and fifth winter (Table 1). The fourth winter when the hay contained 8.4 percent protein, the nonsupplemented cows consumed more hay. Protein supplementation may be effective in stimulating increased voluntary forage consumption only when the protein content of the forage is low.

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 winters 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 percent 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 is reflected in wither height.

The two groups of cows had very similar growth curves, however, the non-supplemented cows did grow a little larger. There is no explanation why the cows stopped growing between 3½ and 4½ years of age. According to the data they did not reach mature size until they were over 5 years of age. A new technician supervised the measuring after the fall of 1962; this may have contributed to the increase in wither height.

The birth and weaning weights of the calves from the supplemented cows were consistently greater than those from the non-supplemented

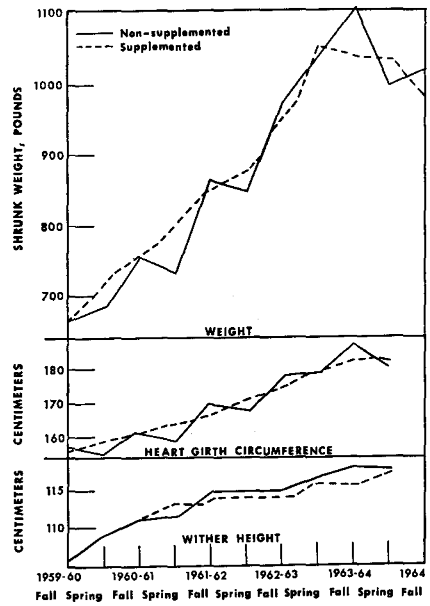


Figure 1. Average increase in weight, heart girth circumference and wither height.

cows; however, in some years the differences were not great (Table 2). 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 percent for the non-supplemented and supplemented cows, respectively. Several of the calf losses were not associated with treatment, i.e., they were caused by difficult births, calf scours and unknown causes. These kinds of losses, along with the small numbers of cows available, make the calf crop percent difficult to interpret. The percentages of both groups are low because the heifers fed the low energy rations the first winter failed to calve as 3-year-olds. This was true regardless of protein supplementation. Had they calved, the percentages would have been 82 and 89, respectively.

The lower protein ration fed during the winters had little effect on the interval from calving to first estrus (Table 2). The average number of services per conception was not different. However, there was a larger percent settled of those that calved and were bred in the protein supplemented group.

Table 2. Average five-year production of the cows.

	1959-60	60-61	61-62	62-63	63-64	Avg.
No supplemental protein						
Birth weight adjusted for sex, lb.	62.9	70.0	59.0	71.9	68.0	66.0
Adjusted 180 day weaning weight, lb.	301	271	297	343	354	315
Milk production, lb./24 hours[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 weight adjusted for sex, lb.	66.9	73.9	60.9	73.9	70.0	68.9
Adjusted 180 day weaning weight, lb.	308	308	299	350	376	328
Milk production, lb./24 hours[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.

Table 1. Experimental design showing the total number of sires, dams and calves weaned (both sexes) for the four years.

Dams		Sires and number of offspring			
Breed	No.[a]	Hereford[b] (16)	Angus (17)	Shorthorn (16)	Total
Hereford	80	HH[c]—118	AH— 60	SH— 72	250
Angus	80	HA[c]— 66	AA—115	SA— 65	246
Shorthorn	80	HS[c] — 68	AS — 62	SS —125	255
Total	240	252	237	262	751

[a] Experiment was initiated with 80 females of each breed and open females were removed each fall.
[b] General plan was to use four sires of each breed per year. Sixteen Hereford, 17 Angus and 16 Shorthorn sires were used duing the four years.
[c] Breed of sire is listed first. H = Hereford, A = Angus and S = Shorthorn.

Table 2. Heterosis effects on preweaning traits—sexes combined.

	No.	Birth wt.	Wn. wt. 200 days	Wn. sc.[a] 200 days
		Lbs.	Lbs.	
Crossbreds	393	74.2	437.4	10.87
Straightbreds	358	71.5	418.0	10.70
Difference		+2.7	+19.4	+.17
H x A and reciprocal	126	73.8	440.8	10.94
Average of H & A	233	71.3	419.0	10.70
Difference		+2.5	+21.8	+.24
H x S and reciprocal	140	79.6	441.1	10.72
Average of H & S	243	74.9	417.3	10.62
Difference		+4.7	+23.8	+.10
A x S and reciprocal	127	69.5	430.4	10.95
Average of A & S	240	68.4	417.6	10.75
Difference		+1.1	+12.8	+.20

[a] Scores of 10, 11 and 12 = Low, average and high choice, respectively.

Table 3. Heterosis effects on postweaning traits of steers—growth and feed efficiency.

	No.[a]	Wn. wt. 200 days	452-day weight	TDN req. per lb. gain	Sl. grade[b] 452 days
		lbs.	lbs.	lbs.	
Crossbreds	191/143	447	912	5.76	10.6
Straightbreds	183/143	431	883	5.77	10.5
Difference		+16	+29	-.01	+.1
H x A and reciprocal	64/44	449	919	5.55	10.7
Average of H & A	117/92	431	880	5.73	10.4
Difference		+18	+39	-.18	+.3
H x S and reciprocal	67/52	452	938	5.64	10.4
Average of H & S	129/98	430	898	5.58	10.3
Difference		+22	+40	+.06	+.1
A x S and reciprocal	60/47	439	877	6.09	10.7
Average of A & S	120/96	433	871	6.00	10.8
Difference		+6	+6	+.09	-.1

[a] Number on left is the number of steers for measures of growth rate. Number on right is the number of steers for measures of feed efficiency.
[b] Grades of 10, 11 and 12 = Low, average and high choice, respectively.

Hybrid Vigor In Beef Cattle

By K. E. Gregory,[2] L. J. Sumption,[3] R. M. Koch,[3] J. E. Ingalls,[2] J. A. Rothlisberger,[3] W. W. Rowden[3] and C. W. Kasson[3,4]

Comprehensive analyses have been made of the data from an extensive crossbreeding experiment conducted at the Fort Robinson

(continued on next page)

[1] Cooperative between the Beef Cattle Research Branch, Animal Husbandry Research Division, ARS, USDA and the Nebraska Agricultural Experiment Station.

[2] Beef Cattle Research Branch, Animal Husbandry Research Division, ARS, USDA.

[3] Department of Animal Science, University of Nebraska.

[4] L. A. Swiger and J. N. Wiltbank were formerly associated with this experiment and made major contributions to the collection and analysis of the data.

Table 4. Heterosis effects on carcass traits and returns per steer.

	No.[a]	Carc. wt. 452 days	Carc. grade[b] 452 days	Fat[c] thick-ness	Ribeye area	Cuta-bility[d]	Retail product[e]	Retail[f] product at 452 days	Retail product at 452 da. Wt. adj.	Fat trim 452 days Wt. adj.	Retail product/ lb. TDN	Net merit[g]
		lbs.		in.	sq. in.	%	%	lbs.	lbs.	lbs.	lbs.	$
Crossbreds	191/143	564	10.2	.51	10.8	52.2	63.4	331	332	118	.1345	220.33
Straightbreds	183/143	541	9.9	.45	10.5	52.5	63.9	320	332	118	.1338	211.52
Difference		+23	+.3	+.06	+.3	-.3	-.5	+11	0	0	+.0007	+8.81
H x A and reciprocal	64/44	563	10.0	.51	11.0	53.7	65.2	339	340	109	.1391	226.80
Average of H & A	117/92	534	9.7	.43	10.7	54.1	65.9	325	341	107	.1381	215.89
Difference		+29	+.3	+.08	+.3	-.4	-.7	+14	-1	+2	+.0010	+10.91
H x S and reciprocal	67/52	578	10.0	.48	10.7	51.7	62.6	337	329	119	.1333	224.29
Average of H & S	129/98	548	9.6	.44	10.3	52.4	63.6	322	330	118	.1325	211.45
Difference		+30	+.4	+.04	+.4	-.7	-1.0	+15	-1	+1	+.0008	+12.84
A x S and reciprocal	60/47	551	10.5	.54	10.6	51.1	62.5	316	326	125	.1313	209.91
Average of A & S	120/96	543	10.3	.49	10.5	51.1	62.4	313	324	127	.1309	207.21
Difference		+8	+.2	+.05	+.1	0	+.1	+3	+2	-2	+.0004	+2.70

[a] Number on left is number of steers for routine carcass traits. Number on right is the number of steers for detailed carcass cut-out data and feed efficiency.
[b] Grade of 10, 11 and 12 = low, average and high choice, respectively.
[c] Single measure at 12th rib.
[d] Actual yield of closely trimmed boneless retail cuts from round, loin, rib and chuck.
[e] Actual yield of closely trimmed boneless retail cuts from entire carcass.
[f] Pounds of closely trimmed, boneless cuts from entire carcass.
[g] Net merit is the value of the retail product (dollars) minus feed costs from weaning to slaughter.

Hybrid Vigor

(continued from page 9)

Beef Cattle Research Station. The experiment involves the Hereford, Angus and Shorthorn breeds.

In the first phase of this experiment the three straightbreds and all reciprocal crosses among them were produced. Heterosis or hybrid vigor was evaluated by comparing the crossbreds with the average of the straightbreds. Crossbreds and straightbreds were sired by the same bulls and were out of comparable cows.

Effects of Hybrid Vigor

These studies involved an evaluation of the effects of hybrid vigor on:

1. Embryo survival.
2. Postnatal mortality.
3. Birth weight.
4. Preweaning growth rate.
5. Weaning weight.
6. Weaning conformation score.
7. Postweaning growth rate and yearling weight of heifers developed under two management programs.
8. Age and weight at first heat of heifers developed under two management programs.
9. Postweaning growth rate and yearling weight of steers on a growing-fattening ration.
10. Postweaning feed efficiency of steers on a growing-fattening ration.
11. Slaughter grade of steers.
12. Detailed information on carcass characteristics of steers involving complete cut-out data on one side of each carcass.

These studies included a total of 751 calves from four calf crops sired by 16 Hereford, 17 Angus and 16 Shorthorn bulls. Summaries of the results from this experiment are presented in Tables 1 through 10.

The effects of hybrid vigor were significant for most of the economic traits evaluated. A three percent greater calf crop was weaned in the crossbred than in the straightbred calves because of differences in early postnatal mortality. The heterosis effect on 200 day weight was 24 lbs. in heifers and 16 lbs. in steers. The heterosis effect on postweaning growth rate of heifers on a low level of feeding was greater than in steers on a growing-fattening ration.

The magnitude of the heterosis effect on growth rate was related to level of feeding and age. That is, heterosis or hybrid vigor tended to decrease with increasing age after about one year and was greatest on a restricted feed intake when comparing heifers with steers. The heterosis effect was 50 lbs. on 550 day weight of heifers and 29 lbs. on 452 day weight of steers. The heterosis effect on carcass weight at 452 days was 23 lbs. for steers. Heterosis effects on age at first heat of heifers were 41 and 35 days for low and moderate levels of feeding, respectively.

After adjusting age at puberty

Table 5. Heterosis effects on growth rate of heifers.

	1960 and 1961 calf crops[a]					1962 and 1963 calf crops[a]				
	No.	Wn. wt. 200 da.	396-day wt.	550-day wt.	550-day score[b]	No.	Wn. wt. 200 da.	396-day wt.	550-day wt.	550-day score[b]
		lbs.	lbs.	lbs.			lbs.	lbs.	lbs.	
Crossbreds	97	415	511	764	10.7	96	440	653	853	10.3
Straightbreds	86	388	463	712	10.2	77	418	611	805	10.0
Difference		+27	+48	+52	+.5		+22	+42	+48	+.3
H x A and reciprocal	33	419	514	783	10.8	29	445	657	869	10.6
Average of H & A	56	389	468	719	10.3	52	423	615	814	10.1
Difference		+30	+46	+64	+.5		+22	+42	+55	+.5
H x S and reciprocal	30	416	512	772	10.6	36	443	667	864	10.3
Average of H & S	56	388	456	715	10.1	52	419	619	817	10.1
Difference		+28	+56	+57	+.5		+24	+48	+47	+.2
A x S and reciprocal	34	409	506	737	10.6	31	433	636	826	10.0
Average of A & S	60	388	465	701	10.2	50	412	600	784	10.0
Difference		+21	+41	+36	+.4		+21	+36	+42	0

[a] Heifers from 1960 and 1961 calf crops were developed for calving as threes, while heifers from 1962 and 1963 calf crops were developed for two-year-old calving.
[b] Scores of 10, 11 and 12 = low, average and high choice, respectively.

Table 6. Experimental design for phase 2 of the experiment.

Dams	Sires[a]		
	Hereford	Angus	Shorthorn
Hereford		A x H	S x H
Angus	H[b] x A		S x A
Shorthorn	H x S	A x S	
H x A and reciprocal			S x (H x A)
H x S and reciprocal		A x (H x S)	
A x S and reciprocal	H x (A x S)		

[a] Object is to compare crossbred cows with their straightbred half-sisters when both produce crossbred calves by the same sires.
[b] Breed of sire is listed first. Comparisons will be between crossbred and straightbred cows for each column and the average of all crossbred cows with the average of all straightbred cows.

Table 7. Weaning weight of calves, weaning scores of calves and estimated milk production of dams in phase 2 of the experiment—1963, 1964 and 1965 (preliminary report of results).

Dams	No.	Wn. wt.[a] 200 days	Wn. score[b] 200 days	Est. milk production 12-hour period[c]
		lbs.		lbs.
		1963 calf crop		
Crossbreds	27	472	10.3	9.44
Straightbreds	24	455	9.6	8.97
Difference		+17	+.7	+.47
		1964 calf crop		
Crossbreds	97	474	11.0	7.87
Straightbreds	73	443	10.2	7.03
Difference		+31	+.8	+.84
		1965 calf crop		
Crossbreds	105	457	10.6	7.37
Straightbreds	74	437	10.2	6.70
Difference		+20	+.4	+.67

[a] Adjusted to a mature equivalent dam basis—average of steers and heifers.
[b] Scores of 10, 11 and 12 = low, average and high choice, respectively.
[c] Calves averaged 2-3 months of age and dams were on summer range when estimates were made.

Table 8. Heterosis effects on survival (phase 1 of experiment).

	No. matings	Calves born	Calves born alive	Calves alive at 2 weeks	Calves weaned
		%	%	%	%
Crossbreds	470	89	87	86	84
Straightbreds	447	89	84	82	81
Difference		0	+3	+4	+3
H x A and reciprocal	154	87	86	84	83
Average of H & A	290	89	85	82	82
Difference		-2	+1	+2	+1
H x S and reciprocal	160	94	91	90	88
Average of H & S	307	88	84	82	80
Difference		+6	+7	+8	+8
A x S and reciprocal	156	87	85	84	83
Average of A & S	297	88	84	83	82
Difference		-1	+1	+1	+1

for the effects of average preweaning and postweaning daily gains, about one-half to three-fourths of the heterosis effect on age at puberty (days) remained. Thus, there was a heterosis effect on age at puberty independent of its effects through average daily gains.

The advantage of the crossbred steers in feed efficiency was small. The crossbred steers produced slightly fatter carcasses when killed at the same age. However, when adjustments were made for the effects of weight there was no difference in carcass composition. Thus, if they had been slaughtered at the same weight, the composition of the carcasses would have been the same.

In net merit (value of the boneless, closely trimmed retail meat, adjusted for quality grade, minus feed costs from weaning to slaughter) the advantage of the crossbred steers over the straightbred steers was $8.81 per carcass. This net merit difference is among the steers that lived to slaughter. The three percent advantage for the crossbreds in calf crop weaned was not involved in computing this difference.

For growth, feed efficiency and carcass traits the heterosis effect was greater in the Hereford-Angus and Hereford-Shorthorn combinations than for the Angus-Shorthorn combination, while for age and weight at puberty the heterosis effect was greatest for the Hereford x Shorthorn and reciprocal cross. In evaluating all traits for the effects of heterosis, it can be concluded that heterosis results in an increased rate of maturity.

Second Phase

The second phase of this experiment is now in progress. This involves the evaluation of the effects of hybrid vigor on fertility and mothering ability. Straightbred cows of the three breeds are being compared with their crossbred half sisters when both are bred to the same bulls.

For the three years (1963, 1964 and 1965) on which data have been collected, the advantage of the crossbred cows has been 17, 6 and 10 percent, respectively, for calf crop weaned and 17, 31 and 20 lbs., respectively, in average weaning weight of calves at 200 days. The results of heterosis effects on cow performance traits (fertility and mothering ability) should be regarded as preliminary because data are still being collected from this phase of the experiment.

Table 9. Heterosis effects on age and weight at first heat.

	1960 and 1961 calf crops[a]					1962 and 1963 calf crops[a]			
	No.	Age at 1st heat	Wt. at 1st heat	Age at 1st heat adj. for A.D.G. birth to weaning	Age at 1st heat adj. for A.D.G. weaning to 396 da.	No.	Age at 1st heat	Wt. at 1st heat	Age at 1st heat adj. for A.D.G. birth to weaning
		days	lbs.	days	days		days	lbs.	days
Crossbreds	97	382	528	386	392	95	321	580	324
Straightbreds	85	422	534	417	412	76	356	587	351
Difference		-40	-6	-31	-20		-35	-7	-27
H x A and reciprocal	33	398	554	404	408	28	361	630	364
Average of H & A	55	427	552	422	421	51	375	613	372
Difference		-29	+2	-18	-13		-14	+17	-8
H x S and reciprocal	31	382	526	384	392	36	300	559	303
Average of H & S	56	436	544	428	419	51	366	604	359
Difference		-54	-18	-44	-27		-66	-45	-56
A x S and reciprocal	34	366	504	369	376	31	303	551	305
Average of A & S	59	405	504	400	397	50	328	544	322
Difference		-39	0	-31	-21		-25	+7	-17

[a] Heifers from 1960 and 1961 calf crop were developed for calving as threes, while heifers from 1962 and 1963 were developed for two-year-old calving.

Table 10. Heterosis effects on fertility (preliminary).

	No. matings	Calving to first heat	Settled on first service	Pregnant	Calves born	Calves weaned
		days	%	%	%	%
1962—to calve as 3 year olds						
Crossbreds	30	....	64	94	92	89
Straightbreds	30	....	56	89	78	72
Difference	....	....	+8	+5	+14	+17
1963—to calve as 2, 3, and 4 year olds						
Crossbreds	131	56	59	84	79	75
Straightbreds	109	59	44	81	73	69
Difference	....	-3	+15	+3	+6	+6
1964—to calve as 2, 3, 4, and 5 year olds						
Crossbreds	139	68.9	72	97	90	76
Straightbreds	116	69.4	63	90	80	66
Difference	....	-.5	+9	+7	+10	+10
1965—to calve as 3, 4, 5, and 6 year olds						
Crossbreds	133	55.6	60.2	86.5	....	....
Straightbreds	108	59.6	51.9	92.6	....	....
Difference		-4.0	+8.3	-6.1	....	....

Hereford calves wintered on windrowed sugar beet tops (December 1965, Scotts Bluff Experiment Station).

Beet Tops: Silage vs Pasturing

By D. C. Clanton[1]
and Lionel Harris[2]

Three experiments have been completed during the last three years at the Scotts Bluff Experiment Station to compare wilted and unwilted sugar beet top silage with pastured sugar beet tops.

Three equal acreages of comparable beets were used each year. One acreage was harvested with a topper that chopped and elevated the tops into a wagon. They were ensiled immediately and referred to as unwilted silage. The other two acreages were topped and windrowed in the field. After wilting, to between 50 and 60 percent moisture, one acreage was ensiled and the other remained for pasturing. The ensiled tops were piled on the ground and immediately covered with black plastic material.

Each type of forage was fed to comparable groups of calves. In addition to the beet tops, the calves received two pounds of corn and three pounds of alfalfa hay per head per day.

Gains Increase

Results of the three experiments are shown in Table 1. The calves fed wilted beet top silage gained more than those fed unwilted silage or pastured tops. The latter two groups had the same gains in 1963 and 1964. The calves in the pasture gained more in 1965 than in 1963 or 1964. The difference could have been the result of climatic conditions. The weather was milder in 1965 than in either 1963 or 1964.

It can be concluded that wilting and ensiling beet tops will provide the most weight gain in calves when compared to unwilted silage or pastured tops.

It appears that there is an economic advantage to hauling and ensiling the beet tops. Fourteen pounds more weight gain from the tops from one ton of roots was received from the wilted silage than from the pastured tops (38 – 24 = 14). If a producer averaged 15 tons of beet roots per acre, he would expect 210 pounds more weight gain from an acre of tops handled as wilted silage (14 x 15 = 210). If the weight gains were worth 25 cents per pound, the gains would gross $52.50 (210 x $.25 = $52.50).

Returns Increase

In previous research at the Station it has been shown that the cost of harvesting beet top silage is near $2.50 per ton of edible silage. The yield of edible silage per ton of roots was 618 pounds or 39 percent. The yield of edible silage per acre would be 5.85 tons if there were 15 tons of roots per acre (.39 x 15 = 5.85). Thus, it would cost $14.62 to harvest the edible silage from an acre of beets that yielded 15 tons of roots (5.85 x $2.50 = $14.62). Not considering the relative costs of feeding silage and managing calves in pastures, the wilted silage feeding program would net $37.88 per acre more than the pasturing program.

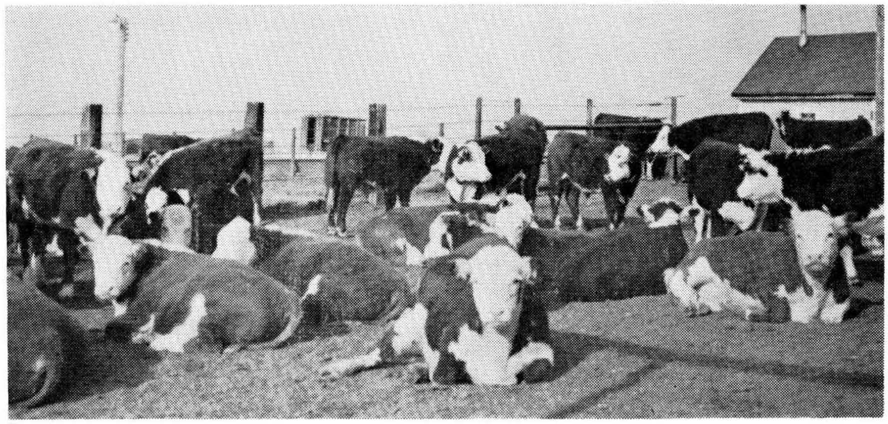
If it is deemed necessary to pasture beet tops, it would be better to use yearling cattle or even old cows. There are three reasons why: (1) less choking on root crowns will be experienced; (2) older cattle utilize roughages like beet tops more efficiently and (3) in drylot feeding the increase in weight gain on mature cows may not represent an increased income because of the fixed costs involved.

Table 1. Beet top silage yields and performance of calves fed silage or pastured beet tops.

	Year	Beet top silage		Pastured Tops
		Wilted Tops	Unwilted Tops	
Beet root yield, tons	1963	83.4	98.8	77.0
	1964	74.0	76.7	67.7
	1965	55.6	68.9	37.4
Average	....	71.0	81.5	60.7
Edible silage/ton of beets, lbs.	1963	538	819	......
	1964	485	1185	......
	1965	832	1018	......
Average	....	618	1007	......
Average weights, lbs.				
Initial 3-year average	....	426.1	423.4	432.2
Daily gain	1963	1.23	0.97	1.02
	1964	1.38	1.00	1.00
	1965	1.40	1.25	1.53
Average	....	1.34	1.07	1.18
Gain from tops from one ton of beets	1963	31.2	19.8	16.9
	1964	37.0	33.0	21.0
	1965	46.8	46.3	33.2
Average	....	38	33	24
Average daily silage consumption, lbs.	1963	21.2	40.0	......
	1964	18.0	35.3	......
	1965	25.0	31.9	......
Average	..	21.4	35.7	......

[1] Department of Animal Science, University of Nebraska.
[2] Department of Animal Science, Scotts Bluff Experiment Station.

Use of Urea In Finishing Rations



Animals used in the urea experiments.

By Walter Woods,[1] Walter Tolman[2] and Guy Baker[3]

Urea in beef cattle finishing rations serves as an effective source of part of the protein (nitrogen) and may supply all the supplemental protein needed in fattening rations. The use of urea is limited to the amount that the rumen microorganisms can convert into microbial protein in the rumen.

When used properly, urea can replace plant sources in the supplemental protein. Urea is a source of protein (nitrogen) only, and when comparing it to a protein source like soybean meal, it becomes necessary to supply those nutrients that soybean meal supplies to make an equal or proper comparison.

Important Factors

Factors important in utilizing urea in beef cattle rations can be divided into two areas: (1) nutrition and (2) feed and livestock management. Important nutritional factors are:

1. Energy is necessary for the synthesis of urea nitrogen into bacterial protein. This is noted by the more efficient utilization of high levels of urea in high grain rations.

2. Available energy in the rumen at the time ammonia is being produced from urea by the bacteria is necessary for the synthesis of protein. When energy is not available, much ammonia may be lost from the rumen because of adsorption into the blood. This action has the effect of limiting the extent of protein synthesis that may occur.

3. Adequate levels of mineral and vitamin supplementation are necessary for the best usage of urea. In rations supplemented with high levels of urea the need for mineral and vitamin supplementation is increased, as compared to a supplement containing plant protein sources. The same factors or nutrients are likely to be important when the natural protein sources are used. However, since the protein sources may supply minerals and vitamins, the total supplemental amounts needed may be lessened.

Livestock and feed management factors influencing the utilization of urea are:

1. High levels of urea are utilized more efficiently when thoroughly mixed with the entire ration. This is true whether a high urea supplement is used or the urea is mixed directly into the ration.

2. Limiting the concentration of urea in the rumen increases its utilization by the rumen microorganisms. This can be accomplished by feeding complete rations.

The optimum level of urea in finishing rations for beef cattle can vary widely. The University of Nebraska research data give guidelines to optimum levels of urea for a number of fattening rations.

Rations for finishing beef cattle may range from high grain with limited roughage to high corn silage rations. The wide range in protein and energy levels represented in beef cattle rations fed in Nebraska indicates that several levels of urea may be optimum to use.

The research data reported are based upon several trials conducted to determine factors influencing urea utilization. They are summarized in this report to try to show the proper levels of urea usage in supplying supplemental protein to beef cattle.

(continued on next page)

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[3] Department of Animal Science, North Platte Experiment Station.

Table 1. Performance of calves fed corn silage supplemented with urea and soybean meal supplements, North Platte.

	Control[a]	Control +	
		Urea[b]	Soybean meal
No. steers	24	24	24
Daily gain, lb.	1.02	1.62	1.91
Daily feed, lb.			
Corn silage	32.3	36.2	36.7
Supplement	1.05	1.25	1.25
Feed/cwt. gain, lb.			
Corn silage	3177	2247	1921
Supplement	103	78	66

[a] Control group was fed as a supplement (corn carrier) containing adequate levels of minerals and vitamins.

[b] The supplement contained .17 lb. of urea. The trial was 126 days in length.

Use of Urea

(continued from page 13)

Other Station Work

Research at the North Platte Experiment Station indicated a supplement containing 14.4% urea and fed at the rate of 1.25 pounds per day with corn silage did not support performance as efficiently as a plant protein source (Table 1). The supplements in this trial were top dressed on corn silage and this is suggested as being an important factor in limiting the usage of urea.

The addition of a urea containing supplement increased gains by .6 lb. per steer per day but did not equal the increase of .89 lb. as the result of using soybean meal as a source of protein. The effects on feed conversion had a similar pattern.

Research at the Northeast Station compared the effectiveness of supplying 0, 1/3, 2/3 or 3/3 of supplemental protein from urea to a corn silage ration. The remainder of the protein was supplied by soybean meal. Minerals and vitamin supplementation were similar among the lots. Supplements were mixed with the corn silage at feeding time. The data are reported in Table 2.

It appears that up to about .12 lb. of urea could be used to supply supplemental protein. Although gains were slightly lower at this level of urea, the differences were not significant. The feeding of all the supplemental protein from urea decreased gains. The amount of urea required to balance a corn silage ration is about .18 to .2 lb. of urea. This level of urea usage in rations high in corn silage appears excessive. Lower levels appear to be utilized more efficiently.

The upper limit for urea in high grain fattening rations may, in most cases, exceed the requirement needed to balance the ration for protein. A test at the Lincoln Station in which steers were fed ground ear corn and supplemented with urea performed as well (Table 3) as steers fed ground ear corn and supplemented with soybean meal. In the first trial the steers on urea supplement were fed .183 pounds of urea per day mixed in 1.5 pounds of supplement.

In the second trial, data were collected at the Lincoln Station from feeding 1.9 lbs. of a supplement containing .224 lbs. of urea to steers fed ground ear corn, prairie hay and supplement (Table 3). The cattle fed urea gained slightly less, but the differences in gains and feed conversion were small. Both supplements were top dressed on the grain portion of the ration.

The data with high corn ration would indicate that urea can efficiently supply all the supplemental nitrogen required.

The data presented indicate that high levels of urea can be utilized in rations adequate in energy; however, the management of the urea supplements may influence the usage of them.

Suggestions

In feeding .15 to .25 pound of urea per day in high energy ration, follow these suggestions for more efficient utilization.

Table 2. Urea in supplements for corn silage rations.

	Protein source of supplements[a]				
	Soybean meal 3/3	Soybean meal 2/3 Urea 1/3	Soybean meal 1/3 Urea 2/3	Urea 3/3	Soybean meal 1/3 Urea 1/3 Corn gluten meal 1/3
Amount of urea/head/day, lb.	.....	.06	.12	.18	.06
No. head	20	20	20	20	20
Initial weight	518	512	521	521	526
Av. daily gain	1.58	1.50	1.52	1.44	1.62
Av. daily consumption (feed)					
Silage	43.1	43.4	43.1	42.8	43.4
Supplement	1.25	1.25	1.25	1.25	1.25
Feed/cwt. gain					
Silage (as fed)	2734	2894	2850	2984	2683
Supplement	80	84	82	87	78

[a] The source of supplement protein is indicated with the amount of supplemental protein supplied.

Table 3. Comparison of protein supplements for ground ear corn rations.[a]

	Supplemental protein source from			
	Trial 1		Trial 2	
	Soybean meal	Urea[b]	Soybean meal	Urea
No. steers	14	14	42	42
Initial weight, lb.	693	689	575	577
Av. daily gain, lb.	2.57	2.57	2.81	2.70
Daily feed consumption, lb.				
Ground ear corn	19.6	19.0	18.1	17.7
Supplement	1.5	1.5	1.9	1.9
Hay	0.3	0.3	1.7	1.7
Total	21.4	20.8	21.7	21.2
Feed/cwt. gain, lb.	836	810	770	787
Carcass grade score[c]	18.8	18.6	18.7	18.6
Dressing %[d]	57.9	57.9	56.6	56.2

[a] Length of trial—151 days for Trial 1 and 155 days for Trial 2.
[b] Urea fed at the rate of .183 lb. daily in Trial 1 and .224 lb. daily in Trial 2 as top dress to the ration.
[c] Carcass grade score assigned high good = 18, low choice = 19.
[d] Based on full weights off experiment and hot carcass weight shrunk 2½%.

Table 4. Suggested levels of urea to be fed in fattening rations for supplying supplemental protein.[a]

Type of ration	Level of urea, lb.[b]	Percent of ration nitrogen
Corn silage	up to .12	15–20
Corn silage—½ feed Grain—½ feed	up to .20	20–25
Full feed of grain Limited roughage	up to .25	25–33

[a] It is assumed that the supplements are not highly concentrated or if they are the supplements are blended with the rest of the ration.
[b] The pounds of urea fed per day can be influenced by the management of the ration and livestock. When economics permit, the higher levels can be used in mixed ration. It is suggested that lower levels be utilized when hand fed or supplement top dressed.

1. Complete mixed ration should be fed. The final ration should be formulated to contain about 10.5 percent protein. Providing higher levels of protein in the ration will not increase animal performance.

2. The cattle should be accustomed to the high level of urea in the rations or supplements and should be managed to prevent individual animals from over consuming. With high levels of urea, there is the danger of toxicity if the ration or cattle are improperly managed.

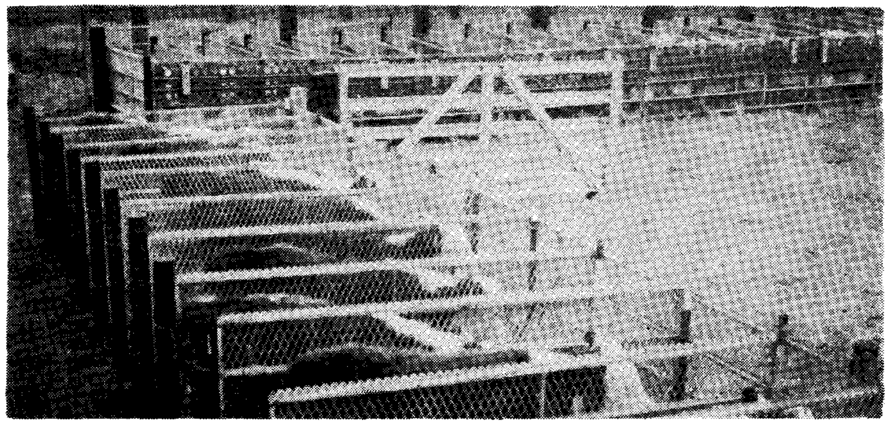
3. The ration must be blended or mixed so that sifting or sorting of urea or urea containing supplements does not occur.

4. Mineral and vitamins fortification must be adequate.

A guide to maximum levels of urea in three rations differing in energy levels is given in Table 4. These values are suggested as guides and since management and other nutrients influence the utilization of urea, they cannot be considered absolute levels. These levels are expected to give efficient utilization of urea for protein synthesis by rumen bacteria. In all cases there is no benefit in utilizing more of a urea supplement than is required to balance the ration for protein.

The economics of urea utilization are difficult to apply to the many systems of feed merchandising and may result in an unfair comparison for certain merchandising methods. However, it must be realized that cost per unit of protein is not the only factor to consider in formulating high urea supplements.

Advantages of using high levels of urea are shown for the beef cattle feeder in times of high cost of natural protein and lower cost of nitrogen from urea. Under these conditions urea should be utilized to its maximum for producing economical gains. However, utilizing high levels of urea does not require it to be utilized in concentrated supplements unless merchandising, transportation, mixing and other considerations weigh in favor of the concentrated urea supplement.



Individual feeding facilities used in the experiments at the Fort Robinson Experiment Station.

For Range Supplementation

Protein and Energy Relationship

By D. C. Clanton,[1] J. A. Rothlisberger,[2] G. N. Baker[3] and J. E. Ingalls[2]

A far-reaching concept in animal nutrition is the balance between the ration nutrients and the realization that relative excess may be as undesirable as relative deficiencies. We have only begun to understand nutrient interrelationships. 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 protein and energy 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 their 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.

Techniques Available

Research techniques are available to acquire the above information on a limited basis. However, lack of facilities and funds has made it impossible to do the research. The research that has been done has involved the trial and error approach.

Many years ago it was determined through chemical analyses that some grass winter ranges and poor quality grass hays were low in protein. In fact, they were so low in mid-winter that it was not necessary to know the percent protein utilization or the amount the animal ate to determine that a protein supplement was necessary. If range forage contains 4 percent protein, of which a half is digestible, a calf would have to eat at least 35 pounds of forage to meet his requirement. This would be impossible, thus, feeding a protein supplement is recommended. This same principle would apply for other classes of cattle.

While determining that range grasses in mid-winter were low in protein, researchers also found that they were relatively high in crude fiber and nitrogen-free extract (carbohydrates), the primary sources of

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Protein and Energy

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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 limiting. Also, the amount of digestible energy received by an animal is greatly influenced by the amount of forage intake.

Which Is First?

When providing supplemental nutrients to cattle the first limiting nutrient should be supplemented first, then the second, etc. 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 a protein need.

Data in Table 1, which were taken from Nebraska research, demonstrate this principle. The distinguishing feature of protein is the fact it contains, on the average, 16 percent nitrogen. When you chemically analyze for protein you determine the percent nitrogen in the feed and multiply 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.

Table 1 shows that the cows were in negative nitrogen balance when receiving 15 pounds of bromegrass hay containing 8 percent crude protein. This means that the cows were excreting through feces and urine more ntirogen than they were 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 they went to positive nitrogen balance. This demonstrates that of the two, energy was the first limiting. Had the protein been first limiting there 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 a plant protein (Ration 1 vs. 2), digestible and metabolizable energy values rise. This is because the 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 vs. 3). If the soybean meal and corn had not reduced the digestible energy of the hay, Ration 2 and 3 would have had 0.89 and 1.10 megacalories digestible energy per pound.

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	0.00
Energy, megacal./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./day	–10.7	0.6	8.2

The reason for the reduction in forage energy digestibility is that the microorganisms in the rumen will utilize the readily available carbohydrates in soybean meal and corn in preference to that not so available in the low quality forage. The end result is a lower digestible energy content of the hay. This forage contained 8 percent protein; had it contained 3 to 6 percent, such as many range forages, the soybean meal probably would have increased the forage energy digestibility. In this case protein would have been the first limiting nutrient. Referring to Table 1 again, the practical way to have increased the energy intake would have been a full feed of hay. Cows will eat 25 pounds of hay; this would give as much digestible energy as 15 pounds of hay and 5 pounds of corn.

Experiments

During the winters of 1963–64 and 1964–65 experiments were con-

Table 2. Daily supplements and average daily gains, feed/cwt. gain, pubertal age and carcass data of the heifers in the Fort Robinson experiment (December 4, 1963-April 15, 1964).

Crude protein/day, lb.	Megacalories digestible energy/day			
	0	2.4	4.8	7.2
0	0			
Winter gain, lbs.	0.01			
Feedlot gain, lbs.	2.98			
Feed/cwt. gain, lb.	936			
Heat cycle by May 20, %	0			
Carcass grade[b]	15.7			
0.3		1½#–20.6%[a]	3#–10.4%	4½#–6.9%
Winter gain, lb.		0.34	0.30	0.34
Feedlot gain, lb.		2.92	2.90	2.78
Feed/cwt. gain, lb.		913	962	1030
Heat cycle by May 20, %		0	0	16
Carcass grade[b]		16.3	16.0	15.8
0.6		1½#–39.1%	3#–19.6%	4½#–13.7%
Winter gain, lb.		0.52	0.57	0.69
Feedlot gain, lb.		2.73	2.82	2.67
Feed/cwt. gain, lb.		1014	980	1031
Heat cycle by May 20, %		50	16	33
Carcass grade[b]		15.5	16.2	15.8

[a] % refers to protein content of supplement.
[b] High, medium and low choice = 18, 17 and 16 respectively; High good = 15.

Table 3. Daily supplements and average daily gains, pubertal age and carcass grades of the heifers in the Fort Robinson experiment (December 29, 1964-April 15, 1965).

Crude protein/day, lb.	Megacalories digestible energy/day			
	0	3.2	5.6	8.0
0	0			
Winter gain, lb.	-0.23			
Feedlot gain, lb.	2.85			
Date first heat	6/25			
Carcass grade[b]	16.5			
0.4		2#-20.3%[a]	3.5#-11.8%	5.0#-8.9%
Winter gain, lb.		0.41	0.27	0.07
Feedlot gain, lb.		2.77	2.76	2.77
Date first heat		6/18	6/6	6/15
Carcass grade[b]		16.5	15.7	16.5
0.8		2#-39.8%	3.5#-23.5%	5.0#-16.5%
Winter gain, lb.		0.60	0.74	0.80
Feedlot gain, lb.		2.64	2.46	2.48
Date first heat		6/21	6/7	6/19
Carcass grade[b]		16.3	17.5	17.2

[a] Each supplement was fed to a group of calves in drylot receiving grass hay (9% protein). The winter gains were 0.81 and 0.90 lb. respectively. Daily hay consumption was 10.6 and 8.2 lb. respectively. The feedlot gains were 2.19 and 2.44 lb. respectively. Average dates of first heat were 6/19 and 6/12 respectively. Average carcass grades were 16 and 17.2 respectively.
[b] High, medium and low choice = 18, 17 and 16 respectively; High good = 15.

ducted on the range at the North Platte and Fort Robinson Experiment Stations. These experiments were of a practical nature but pointed out the same principle concerning protein and energy relationship.

Tables 2 and 3 show the supplemental feeding program and average performance of heifer calves used in individual feeding experiments on the range at Fort Robinson. These data indicate that protein was the first limiting and there was no advantage in supplementing additional energy above 1½ pounds when crude protein supplementation was held at 0.3 or 0.4 pound daily. Note the increased gains when protein intake was elevated to 0.6 or 0.8 pound per day. This also allowed extra energy to be beneficial.

Results obtained in North Platte experiments also show that protein was the first limiting nutrient (Tables 4 and 5). Group feeding procedures were used with 30 steer calves per group, rotated every two weeks in three pastures in the first experiment and four pastures in the second experiment. Although data are not as complete as we need, with pregnant cows protein appears to be the first limiting.

The protein requirement is not as great for cows and they can eat more forage. Thus, there are two reasons why it would not take as much protein supplementation with mature cows as with calves or growing replacement heifers.

General recommendations on the proper supplements to use for range forage or native hay are difficult to make because of the effect of years and range condition on forage quality and voluntary intake by the cattle. 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 6).

Quality, Quantity

The quality and quantity of available forage, class and use of livestock, time of year and climatic conditions are factors which should be considered in recommending a supplemental program.

Recently, we have heard much about the feeding of high energy supplements to range cows. Much of this stems from the fact that it has been shown in recent years that inadequate energy before or following calving influences reproductive performance. Practically all of this research, most of which was done in Nebraska, was conducted in drylots where energy intake was limited by reducing the amount of feed fed. This, in turn, reduced reproductive performance when compared to those allowed to consume more feed or fed a higher quality feed. Protein was not a limiting nutrient. These results do not indicate that cattle feeding on the range or on native hay are not getting enough energy. It indicates the level of energy intake should be considered when trying to determine why there is poor reproductive performance.

If it is determined that the energy should be supplemented it is doubtful if one or even two pounds of supplemental energy would do much good if adequate forage was

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Table 4. Supplements used and average daily weight gains in the North Platte experiment (Dec. 11, 1963-May 12, 1964).

Lbs. crude protein/day		Megacalories digestible energy/day		
		1.6	4.8	7.2
0.42	Supplement	1#-42.3%[a]	3#-14.2%	5#-8.7%
	Average daily gain	0.54	0.56	0.64

[a] % refers to protein content in supplement.

Table 5. Supplements used and average daily gain in the North Platte experiment (Jan. 3, 1964-May 8, 1965).

Lbs. crude protein/day		Megacalories digestible energy/day	
		3.2	8.0
0.4	Supplement	2#-20%[a]	5#-8%
	Gain	0.42	0.31
0.8	Supplement	2#-40%	5#-16%
	Gain	0.47	0.42

[a] % refers to protein content in supplement.

Table 6. 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

Protein and Energy

(continued from page 17)

available. This small amount of supplemental energy would reduce the digestibility of the energy in the forage and the actual result may be no more total digestible energy than if the supplement were not fed.

Quite often terminology is confusing while discussing protein and energy. The term "high energy" as applied to supplements has, in numerous instances, been used to refer to low protein supplements. Most supplements are high energy supplements. High and low protein supplements are really what is being referred to. The protein content of supplements varies from 10 to 40 percent. The digestible energy content will usally range from 75 to 80 percent for most supplements. Thus, what is being talked of is high and low protein supplements, not high and low energy supplements. For example, soybean meal (44 percent protein) and corn (9 percent protein) both have approximately 80 percent digestible energy.

It is less costly to provide supplemental energy in low protein than in high protein supplement. It is cheaper to provide supplemental protein in a high protein supplement if it is the first limiting nutrient because one pound of a high protein supplement will do much toward correcting a deficiency as well as increasing forage intake which will provide some additional energy. If energy is first limiting, then it may be cheaper to change the forage feeding program rather than feed several pounds of grain. This is why ranchers are encouraged to save the best hay until late winter or during calving because this is when energy is more apt to become limiting.

In conclusion, it appears that protein and energy must be in some kind of balance. This balance will be different for different classes of livestock. The calf will require more protein per unit of energy during the winter than the mature cow. This is understandable because the calf must grow while the cow has only to maintain herself.

Feeding facilities.

Hay vs Grain as Energy Source

By L. E. Jones,[1] D. C. Clanton,[2] D. R. Zimmerman,[2] R. L. Tribble[1] and R. K. Christenson[2]

Following drought periods and when feed grains are relatively inexpensive, it may be justifiable to use grain for supplying energy to bred cows during the winter.

Two year's data collected at the Lincoln Station show that replacement heifers and cows perform as well when given a limited feed of bromegrass hay and corn as when given a larger feed of straight bromegrass hay.

During the winter of 1963–64, three groups of bred cows were individually fed one of three rations for 140 days and 112 days, respectively (Table 1). They received 3 lbs. of corn per head per day and a full feed of alfalfa for 60 days following calving. After 60 days they were placed on pasture for the summer.

Rations Fed

Ration 1 was fed to supply a suboptimum level of energy. Rations 2 and 3 were calculated to supply similar amounts of digestible energy. Energy level in these rations was considered near optimum for good production as determined in previous experiments.

The energy in Ration 2 was primarily from grain and that in Ration 3 primarily from hay. Digestible protein and energy were determined with calves in conventional digestion trials. Although digestible protein varied from 0.72 to 0.97 and 0.66 to 0.95 pounds per head per day in 1963–64 and 1964–65, respectively, all levels were adequate to meet requirements based on previous research at the Lincoln Station.

The digestion trials showed there was some difference in the energy intake between Ration 2 and 3 (Table 1). The difference of 0.9 megcal. and 1.2 megcal. per pound could have been large enough to influence production.

Heifers that received inadequate energy (Ration 1) gained 24 pounds during the 140-day experimental feeding period (Figure 1). Heifers that received Ration 2 and 3 gained 101 and 78 pounds, respectively, during the same period. Greater

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Table 1. Daily rations fed during both winters.

	Ration					
	1963-64[a]			1964-65[a]		
	1	2	3	1	2	3
Bromegrass hay, lbs.	10.76	5.84	12.99	11.65	3.86	16.73
Concentrate, lb.[b]	1.24	6.16	2.01	0.85	8.64	0.77
Crude protein						
Percent	11.12	13.56	8.94	9.91	9.08	8.96
Pounds/day	1.34	1.63	1.34	1.24	1.14	1.57
Digestible protein						
Percent	7.17	8.08	4.80	6.32	5.28	5.43
Pounds/day	0.86	0.97	0.72	0.79	0.66	0.95
Digestible energy						
Megcal./lb.	1.00	1.25	0.94	1.01	1.26	0.96
Megcal./day	12.0	15.0	14.1	12.7	15.7	16.9

[a] Amounts are for a 700 pound heifer in 1963-64. The heifers were fed an amount based on metabolic weight. All cows were fed the same amount in 1964-65.
[b] The concentrate contained soybean, corn, minerals and vitamin A. The concentrate in Ration 1 and 3 were mostly soybean whereas in Ration 2 it was mostly corn.

Table 2. Average calf and milk production and reproductive performance.

	Rations					
	1963-64			1964-65		
	1	2	3	1	2	3
Weight of calves, lbs.						
Birth weight, adjusted for sex	66	64	67	76	82	77
Adjusted 180 day weaning weight	335	356	355	327	384	366
Gain from birth to weaning	269	292	288	251	302	289
Milk production, lbs./24 hours						
30 days after calving	9.00	11.32	11.42	12.00	15.78	12.92
60 days after calving	8.52	10.95	11.02	10.16	15.50	12.96
Average reproductive performance[a]						
Days from calving to 1st heat	73	52	61	68	52	47
% conception on 1st service	17	67	0	0	71	71
No. services per conception	2.5	1.5	3.1	2.8	1.6	1.3
Days from calving to conception[b]	110	98	132	105	85	76
% settled 90 days	86[c]	89	100	83	100	100

[a] Daily heat checks were made with a marked sterilized bull prior to time the cows were placed with the fertile bull.
[b] Females were placed with a marked fertile bull 60 days post-calving in both years except for the heifers that calved prior to April 20, 1964. Their interval ranged from 60 to 90 days.
[c] Includes one heifer that never cycled and was never bred.

gains associated with Ration 2 as compared to Ration 3 were a reflection of the greater energy intake. Heifers fed the low level energy gained the most during the following summer.

In 1964–65 cows that received Ration 1 lost 55 pounds during the experimental period. Those that received Ration 2 and 3 gained 33 and 34 pounds, respectively, during the same period (Figure 1). There is more energy lost in the metabolism of a roughage ration than a concentrate ration, thus, the difference in metabolizable energy would not have been as great as the differences in digestible energy when comparing Ration 2 and 3 fed in 1964–65. By the same reasoning the difference in metabolizable energy of Ration 2 as compared to Ration 3 used in 1963–64 would have been greater than the digestible energy content.

Summer Weight Loss

There are two possible reasons why the cows lost weight during the summer: (1) there were several three-year-old heifers in each treatment that did not calve as two-year-olds. They were in excessively high condition going into the experiment in the fall. In general all of the cows were in high condition at that time; and (2) the pastures dried up in August and it was necessary to feed some hay. During that time the cows probably lost considerable weight.

The measure of heart girth circumference (a good measure of condition change) showed that the weight gain of the heifers that received Ration 2 was primarily condition (Figure 2). Their growth was less than those that received Ration 3. This is shown by increase in wither height.

In both experiments the females that received Rations 2 and 3 performed similarly and better than those that received Ration 1 (Table 2). The fact that adjusted calf weaning weight is influenced greatly by the milk production of the dam is shown in the results. The best milk production was from cows that received Ration 2; they also weaned the heaviest calves. The more rapid decline of milk production from the heifers and cows fed Ration 1 would indicate that milk production is influenced by pre-calving plane of nutrition as well as post-calving plane of nutrition. This has been shown in previous studies at the Lincoln Station.

Intervals from calving to first estrus were longer and conception rates lower in females fed Ration 1 as compared to those fed Rations 2 and 3. Although there was not a great difference in interval from calving to first heat when comparing females fed Ration 2 and 3, those that received the most digestible energy had the shortest interval regardless of the source of energy. The same relationship was present when comparing conception rates.

It appears that the quality of the ration can be increased at the expense of quantity for wintering

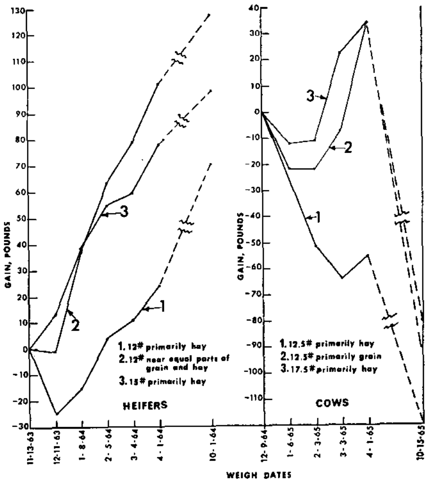


Figure 1. Average weight gains of heifers in 1963-64 and cows in 1964-65.

bred beef heifers and cows. The ratio of quantity of grain to roughage for supplying the energy in the ration will follow the ratio of digestible energy from the two sources.

For example, a ration of 15 pounds of hay with enough supplement to meet protein, mineral and vitamin requirements will compare with a ration of 6 pounds of hay and 6 pounds of grain with enough supplemental protein, mineral and vitamins to meet requirements. Six pounds of hay in each ration will be comparable. The 9 pounds of hay in the first ration times a digestibility factor of 50 gives 4.5 pounds of digestible energy. The 6 pounds of grain in the second ration times a digestibility factor of 80 gives 4.8 pounds of digestible energy. Thus, the two rations are comparable and as shown in this research will give comparable results in terms of calf production and reproduction.

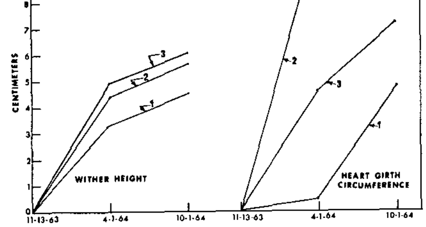
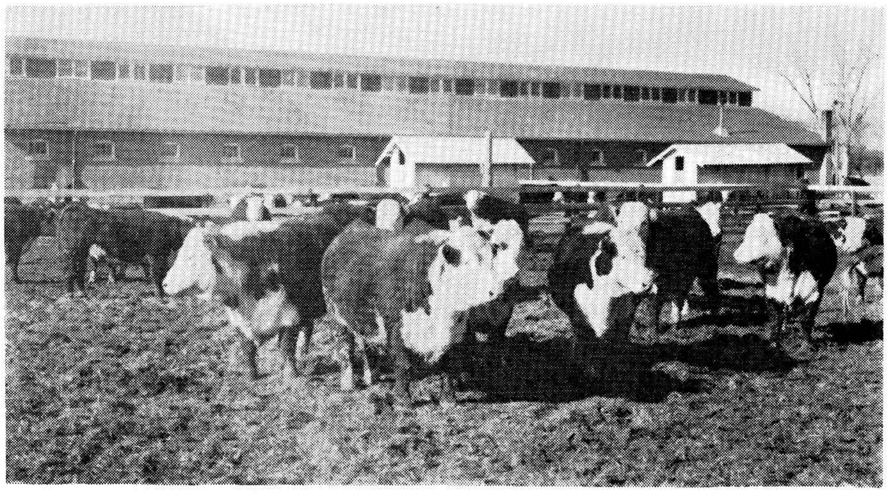


Figure 2. Average change in wither height and heart girth circumference of the heifers used in 1963-64.



Heifers being fed with self feeders at the Fort Robinson Experiment Station.

Thyroprotein in Cattle Rations

By D. C. Clanton,[1]
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The thyroid gland normally produces thyroxine, a hormone which is a regulator of body metabolism. If the thyroid gland produces too much thyroxine the animal becomes hyperthyroid. The animal will be nervous, excitable, and have a high metabolic rate. Those are the factors that contribute to poor performance. If an animal has a lower production of thyroxine, it is quiet, contented, has a lower basal metabolic rate, and is more apt to have good performance.

By feeding thyroxine, it may be possible to cause the thyroid gland to shrink, thus reducing the animal's secretion of thyroxine. After taking the thyroxine from the ration the shrunken thyroid gland may not produce optimum amounts of thyroxine. The hypothyroid condition which has been set up is ideal, theoretically at least, for large weight gains.

Experiments

Two experiments conducted during the summer and fall of 1963 showed that thyroprotein in the rations of yearling heifers interfered with weight gain and efficiency of feed conversion (Table 1). There were 25 heifers per treatment in the first experiment and 34 per treatment in the second.

The reduced performance was directly proportional to the level of thyroprotein fed. When thyroprotein was removed from the ration at about the mid-point of the experiments, the performance of the heifers was greatly improved. Those fed the lower levels of thyroprotein gained enough more than the controls during the last half of the experiments to have an accumulative performance as great and in one case greater than controls.

Levels used ranged from 1.5 to 13.5 grams per head per day. The basal ration in both experiments was 73.5% ground shelled corn, 25% LPC dried beet pulp and 1.5% premix. The premix contained soybean meal, salt, trace minerals, Vitamin A and thyroprotein. Stilbestrol was not used. Two pounds of alfalfa hay was fed per head per day in racks in both trials. All heifers were fed in self feeders.

As a result of the adverse effect on weight gains in the first experiment, the high levels of thyroprotein were not replicated in the second experiment. There are two possible reasons for the poor gains from the high levels: (1) hot weather and (2) physiological factors associated with the treatment of the heifers before the experiment. Some heifers were intact and some were ovarectomized to test the difference in physiological make-up.

The two classes of heifers were randomly assigned to each of the four treatments in the second ex-

Table 1. The effect of feeding varying levels of thyroprotein on the performance of heifers being finished for market (July 1963 to January 1964).

	First experiment July 23 to Nov. 6 Thyroprotein, gm./day[a]				Second experiment Sept. 26 to Jan. 7 Thyroprotein, gm./day[b]			
	0	4.5	9.0	13.5	0	1.5	3.0	4.5
Av. weights, lbs.								
Initial	735	734	733	730	764	780	776	765
Daily gain	2.46	2.53	2.25	2.30	2.86	2.80	2.66	2.56
Daily gain 1st part.	2.73	1.34	0.59	–0.16	3.26	2.88	1.93	1.65
Daily gain 2nd part.	2.29	3.39	3.44	4.05	2.24	2.65	3.87	4.06
Av. daily concentrate, lbs.	19.1	19.8	18.9	19.0	20.6	21.4	22.5	21.0
1st part.	17.6	17.6	16.5	16.0	19.3	21.1	21.6	20.2
2nd part.	20.4	21.8	21.1	21.8	22.8	22.2	23.9	22.4
Carcass data								
Yield[c]	59.88	60.04	59.21	59.54	60.48	59.86	60.29	60.01
Grade[d]	16.60	16.96	16.24	16.88	16.29	16.42	16.53	16.52
Rib eye area, sq. in.	11.33	10.94	11.12	11.08	12.03	11.55	11.90	12.25
Fat thickness, in.	0.84	0.83	0.77	0.82	0.81	0.75	0.79	0.71
Marbling[e]	10.60	10.36	10.12	10.32	10.51	10.56	10.65	10.76
Cutability (% lean meat)	49.85	49.63	50.26	50.06	50.20	50.17	50.31	50.90

[a] After 50 days (first phase) the thyroprotein was removed from all the rations and the control ration fed to all groups the last 56 days (second phase). For average daily gain the first phase was 44 days and the second 62 days.
[b] After 64 days (first part) the thyroprotein was removed from all the rations and the control ration fed to all groups the last 39 days (second part).
[c] Hot carcass weight divided by slaughter weight x 100.
[d] Carcass grade score 16 and 17 = low and average choice.
[e] Marbling score—the higher the number, the greater the marbling.

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periment to properly evaluate the effect of thyroprotein in relation to physiological status. The intact heifers in both the treated and control groups gained more than the ovarectomized heifers, thus, the affect did not appear to be associated with the physiological make-up of the animals.

An experiment with two replications testing the effect of feeding one level (3.0 grams per head per day) of thyroprotein for different lengths of time at the beginning of the feeding period was conducted in the fall of 1964 (Table 2). The four time intervals of feeding thyroprotein was zero (control), 14, 28 and 42 days. The 3.0 grams of thyroprotein provided 30 milligrams of thyroxine activity per day per head. The thyroprotein was prepared in a supplement with soybean meal, molasses, minerals and Vitamin A. Stilbestrol was not used. The basal concentrate ration in both replications was 70% ground milo, 25% LPC dried pulp and 5% supplement. The concentrate portion of the ration was fed in self feeders, alfalfa hay was fed in racks.

The heifers in the first replication were started on experiment September 2, 1964; those in the second replication were started one week later, September 9, 1964. Both groups were fed 91 days. The heifers were brought to full feed before the thyroprotein was placed in the rations. There were 35 heifers per treatment in the first replication and 23 per treatment in the second replication. Results are given in Table 2.

There was no apparent advantage in feeding the thyroprotein for any of the lengths of time studied. It was observed again that heifers which received the thyroprotein did not gain well while receiving the thyroprotein, but did recover and either caught up or came close to catching up with the controls by the end of the feeding period. There was little difference in efficiency of gain or carcass measures.

An experiment conducted during the winter of 1961–62 at the

(continued on next page)

Table 2. The effect of feeding 3 grams thyroprotein per head per day for different lengths of time on the performance of heifers being finished for market (91 days—September to December 1964).

	First replication Days fed thyroprotein				Second replication Days fed thyroprotein			
	0	14	28	42	0	14	28	42
Av. weights, lbs.								
Initial	772	768	754	761	724	736	742	730
Daily gain	2.41	2.30	2.10	2.21	2.74	2.80	2.66	2.81
Av. daily intake, lbs.								
Concentrate	24.1	22.5	22.8	22.7	24.5	22.3	21.7	22.4
Alfalfa	2.1	2.2	2.2	2.2	2.7	2.7	2.6	2.6
Av. concentrate/lb. of gain	10.1	9.9	11.0	10.3	8.9	8.0	8.2	8.0
Carcass data								
Yield[a]	61.01	61.72	61.36	60.58	60.93	59.24	61.93	59.10
Grade[b]	15.94	15.68	15.67	15.51	15.60	15.67	14.50	15.50
Rib eye area, sq. in.	10.96	11.00	10.99	11.27	11.01	11.09	10.94	11.07
Fat thickness, in.	0.72	0.74	0.68	0.66	0.65	0.66	0.68	0.67
Marbling[c]	10.11	10.47	10.09	10.00	10.00	9.95	9.82	9.87
Cutability (% lean meat)	50.22	50.34	51.00	51.09	51.16	50.98	48.97	50.90

[a] Hot carcass weight divided by final feed lot weight x 100.
[b] Carcass grade score 14 and 15 = average and high good; 16 = low choice.
[c] Marbling score—the higher the number the greater the marbling.

Table 3. The effect of feeding varying levels of thyroprotein on the performance of steers being finished for market (Scotts Bluff Station—1961-62).

	Herefords Thyroprotein, gm./day			Holsteins Thyroprotein, gm./day		
	0	1.5	3.0	0	1.5	3.0
Avg. weights, lbs.						
Initial	724	732	735	722	716	725
Daily gain	2.70	2.46	2.60	2.62	2.56	2.58
Feed per cwt. gain, lbs.						
Concentrate	645	703	676	664	671	679
Corn silage	1010	996	1027	1145	1178	1068
Carcass data						
Yield[a]	62.2	62.4	62.7	57.8	57.6	58.2
Grade[b]	17.2	16.4	16.9	10.7	8.8	11.2
Rib eye area, sq. in.	11.67	11.52	11.98	11.29	11.82	11.71
Fat thickness, in.	0.83	0.75	0.73	0.71	0.64	0.60

[a] Hot carcass weight divided by slaughter weight x 100.
[b] Carcass grade score: 16, 17, 18 = low, average and high choice; 9 = high commercial and 10, 11, 12 = low, medium and high standard.

Table 4. The effect of feeding thyroprotein on the performance of steers being finished for market (Scotts Bluff Station—1962-63).

	No thyroprotein	Thyroprotein, 4.5 gm./day
Avg. weights, lb.		
Initial	786	776
Daily gain	3.01	3.10
Feed per cwt. gain, lb.		
Concentrate	664	646
Corn silage	875	870
Carcass data		
Yield[a]	58.73	58.49
Grade[b]	14.3	14.9
Rib eye area, sq. in.	11.26	11.74
Fat thickness, in.	0.66	0.77

[a] Hot carcass weight divided by slaughter weight x 100.
[b] Carcass grade score: 14 and 15 = average and high good.

Table 5. Digestion coefficients expressed in percent and nitrogen retention expressed in grams per day in steers fed thyroprotein.

Nutrients	No thyroprotein		Thyroprotein during first 17 days	
	First trial	Second trial	First trial	Second trial
Dry matter	74.2	74.6	75.7	77.3
Energy	73.3	72.1	74.7	74.1
Protein	69.6	61.2	71.3	64.7
Nitrogen retention	52.6	38.1	58.2	42.6

Thyroprotein

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Scotts Bluff Experiment Station showed a slight but non-significant depression in weight gain in yearling steers fed 1.5 or 3.0 grams of thyroprotein per head per day during a 165 day feeding period (Table 3). The steers received a daily ration of corn silage, 0.5 pounds of soybean meal, two pounds dehydrated alfalfa and a full feed of a mixture of equal parts cracked corn and dried beet pulp.

A second experiment conducted at the Scotts Bluff Station during the winter of 1962–63 showed a slight but non-significant increase in weight gain in mixed Hereford and Holstein yearling steers fed 4.5 grams of thyroprotein per head per day during a 140 day feeding period (Table 4). The ration was the same used the previous year.

Improved Digestibility

The results of digestion and metabolism trials using yearling steers fed rations comparable to those used in the performance trials showed improved digestibility of dry matter, energy and protein in the steers fed thyroprotein (Table 5). In the first trial four steers received 3 grams of thyroprotein per head per day for 17 days and four steers received no thyroprotein. Following this trial, thyroprotein was removed from the ration and a second 17-day trial was conducted with both groups of steers. Digestion was measured during the last seven days of each trial.

These data indicate that if there is a benefit from feeding thyroprotein to cattle being finished for market it is cancelled by the decreased performance during the time of feeding the thyroprotein. The fact that thyroprotein fed at Scotts Bluff did not alter performance whereas it did when fed at Fort Robinson was probably the result of the difference in temperature. However, it is possible there could be a sex affect. The effect of temperature and sex should be studied.

Influence of Gelatinized Corn On Beef Animal Performance

By Benjamin Wilson[1] and
Walter Woods[2]

Previous research has indicated that gelatinized corn, when incorporated at a high level into a concentrate ration, depressed feed consumption and daily gains, but the cattle maintained efficiency of feed conversion. These performance traits are thought to be a result of elevated ruminal lactate levels which are associated with readily fermentable carbohydrates. An individual feeding trial was conducted to measure animal performance when varying levels of gelatinized corn were substituted for cracked corn. Adding up to 45% gelatinized corn in a fattening ration tended to increase gains and efficiency of feed conversion by steers.

The steers were fed individually *ad libitum* a complete mixed ration composed of 75% concentrate and 25% roughage. Each steer was fed twice a day for 2-hour intervals in the morning and in mid-afternoon. When not eating, the cattle were in a common pen with access to salt and water. The trial was 139 days in length. The treatments were 0, 15, 30 and 45% gelatinized corn added to replace cracked corn in the basal ration. The gelatinized corn was commercially produced at a temperature of 350° F. and extruded from the die at 400 to 500 PSI of pressure.

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Performance data from the trial are given in Table 1. The level of gelatinized corn had very little effect on rate of gain; however, the incorporation of gelatinized corn into the ration tended to increase gains over that of the control ration. The average increase in gain for steers fed the gelatinized corn rations as compared to the controls was 6%.

When the cracked corn was replaced by gelatinized corn, average daily feed consumption was slightly higher for the 15 and 30% gelatinized corn rations. The efficiency of feed conversion tended to increase slightly for the steers fed the gelatinized corn, but the efficiency was not appreciably affected by the level of gelatinized corn.

In addition to the performance trial, a fermentation trial was conducted simultaneously to measure ruminal lactate formation. This trial indicated that as the level of gelatinized corn increased, the ruminal lactate levels increased. Apparently, the high ruminal lactate levels in the steers fed the 30 and 45% levels of gelatinized corn did not appreciably influence feedlot performance.

Research results indicate that further study is required to determine the influence of gelatinization upon starch utilization by steers.

Table 1. Performance of steers fed various levels of gelatinized corn.

	Control	Level of gelatinized corn[a]		
		15%	30%	45%
No. steers	6	6	6	6
Initial wt., lb.	627	608	608	613
Average daily gain, lb.	2.97	3.18	3.16	3.11
Daily feed consumption, lb.	22.4	22.7	23.0	22.3
Feed/cwt. gain, lb.	756	714	734	720

[a] Percent of cracked corn replaced with gelatinized corn.

Energy Source and Urea Use

By Walter Woods,[1] Guy Baker,[2] Murray Danielson[2] and Manuel Casas[3]

The efficient utilization of urea by rumen microorganisms for protein synthesis depends upon a source of energy at the time the ammonia is being liberated from urea. One characteristic of urea that limits its use in rations is the rapid production of ammonia. Without optimum conditions for synthesis a reduction in efficiency may occur.

Since research has indicated that gelatinized corn is fermented at a faster rate than regular corn, it was thought that gelatinized corn might be a more effective carrier for urea in a protein supplement.

Nitrogen-balance trials with steers indicated that increased protein synthesis occurred when gelatinized corn replaced cracked corn as a carrier for urea. The performance data reported in this study indicated that in certain situations, particularly in corn silage rations, there appeared to be a benefit from using gelatinized corn in combination with urea. However, there were other studies that indicated no apparent effect whether ground corn or gelatinized corn was used as the carrier for the urea.

Further research is required to determine those conditions necessary in the rumen for optimum protein synthesis by the rumen microorganisms that will give consistent increases in animal performance.

Trials

Table 1 gives results of a trial conducted at the North Platte Station in which steers were fed a corn silage ration. The treatments were soybean meal or urea as sources of supplemental protein. The urea rations contained either 1, 2 or 3 pounds of corn from either ground-shelled corn or gelatinized corn as the carrier for the urea. The gelatinized corn was commercially produced at 350° F. and extruded from the die at 400 to 500 PSI of pressure.

Each ration in this study and subsequent studies was formulated to be adequate in minerals, Vitamin A and stilbestrol (in the fattening rations). The results indicated that supplying the supplemental protein from urea reduced performance when ground corn was the carrier for urea as compared to soybean meal. The same tendency applied for gelatinized corn. However, there appeared to be an increase in weight gain or daily performance when gelatinized corn served as the carrier. This difference, however, was not large and needs further evaluation.

Table 2 gives results of a second study conducted at the North Platte Experiment Station in which steers were fed a ration of a full feed of ground corn, 10 lbs. of corn silage and a source of supplemental protein either from soybean meal or urea.

The soybean meal supplement was compared to supplements containing ½ urea and ½ soybean meal supplying the supplemental protein or a supplement based primarily upon urea. For each of the rations containing urea, various levels of gelatinized corn were fed. For each of the urea containing rations either 0, ½, or 1 lb. of gelatinized corn was fed. The remainder of the supplements was from ground corn.

Urea as the source of supplemental protein supported performance similar to that of soybean meal. In rations where the low level of urea was fed, the addition of ½ or 1 lb. of gelatinized corn increased average daily gain and decreased the feed required per 100

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Table 1. Performance of steers fed corn silage supplement with urea and gelatinized corn.

	Soybean meal	Regular corn				Gelatinized corn			
		1 lb.	2 lb.	3 lb.	avg.	1 lb.	2 lb.	3 lb.	avg.
Number of steers	20	20	20	20	60	20	20	20	60
Initial wt., lb.	386	392	393	395	393	391	390	392	391
Final wt., lb.	642	608	601	630	613	622	624	642	629
Total gain, lb.	259	216	207	235	219	230	233	250	238
Av. daily gain, lb.	1.85	1.54	1.49	1.67	1.56	1.64	1.67	1.79	1.70
Daily feed consumption, lb.									
Corn silage	33.5	33.2	33.1	31.7	32.7	33.1	32.5	30.0	31.9
Supplement	2.2	1.6	2.2	3.1	2.3	1.6	2.2	3.1	2.3
Feed/cwt. gain, lb.									
Corn silage	1812	2160	2241	1888	2096	2010	1946	1681	1879
Supplement	117	104	148	187	146	97	130	174	134

Table 2. Performance of steers fed urea with gelatinized corn as part of the supplement.

	Protein from:						
	Soybean meal	½ Urea + ½ Soybean meal			Urea		
		½ lb. corn	½ lb. gel. corn	1.0 lb. gel. corn	½ lb. corn	½ lb. gel. corn	1.0 lb. gel. corn
No. steers	20	20	20	20	20	20	20
Initial weight, lb.	792	796	784	791	781	781	789
Daily gain, lb.	2.48	2.50	2.69	2.63	2.65	2.66	2.61
Daily feed consumption, lb.							
Ground corn	19.1	19.5	19.8	18.9	18.7	20.1	19.1
Corn silage[a]	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Supplement	1.25	1.25	1.25	1.75	1.25	1.25	1.75
Total	30.35	30.75	31.05	30.65	29.95	31.35	30.85
Feed/cwt. gain, lb.	1223	1226	1153	1164	1131	1177	1179

[a] Corn silage on an as fed basis and in feed required per cwt. gain corn silage is on as fed basis.

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Energy, Urea

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lb. gain. With increased level of urea in the supplement the feeding of gelatinized corn did not increase average daily gain as was noted with the lower level of urea feeding. Why, on a high-grain ration, the use of cracked corn or gelatinized corn as part of the supplement might influence the performance of cattle in different ways at each level of urea intake is not understood.

To define the influence of the rate of grain fermentation on urea utilization the study reported in Table 3 was conducted at the Lincoln Experiment Station. Calves were individually fed a ration of bromegrass hay and supplemented with soybean meal or urea. Urea was supplied in either 1 or 2 lbs. of ground corn or gelatinized corn. The results indicated that the steers fed urea and the 1 lb. or 2 lbs. of cracked corn or the 1 lb. of gelatinized corn performed inferior to those fed the soybean meal. However, it appeared that the 2 lbs. of the gelatinized grain gave similar performance to those fed soybean meal. There was a difference in energy intake which could influence the performance of the ration; however, increased protein utilization probably was an important factor.

Table 4 gives results of a second trial conducted at the Lincoln Experiment Station in which urea or soybean meal was used to supplement a high corn ration with a roughage from cobs and bromegrass hay. The experiment compared the performance of a urea supplement, a soybean meal supplement and a urea supplement supplying only ½ the level of urea that was thought to be needed to balance the ration. The latter treatment was to place increased stress on protein utilization. Performance data indicated that the urea supplements were supporting similar performance to the soybean meal supplement and that the gelatinized corn had minor effects on performance.

Table 5 gives the performance of individually fed steers on a fattening ration composed of about 80% concentrate and 20% roughage. This study was to determine if there was a level optimum for gelatinized corn when urea was included in the ration as the sole source of supplemental protein. Although this study would not differentiate between the influence on protein utilization or on energy utilization, the levels of gelatinized corn fed were 0, 5, 10 and 15% in a ration where all supplemental nitrogen came from urea.

The average daily gain of the steers did not appear to give a consistent pattern. There seemed to be a difference between performance of the groups; not necessarily relaed to treatment. However, there was a tendency as the level of gelatinized corn increased in the ration that the feed required per 100 lb. of gain increased.

More Work Needed

The studies reported suggest that further research is needed to define those factors influencing energy and protein utilization when urea is the source of supplemental protein. It appears that the source and type of ration influences the results obtained. The performance of cattle appeared to be increased under certain conditions when gelatinized corn was used as the source of the energy in the urea supplement as compared to cracked corn. However, there were other studies in which this relationship was not found.

Table 3. Performance of calves fed urea supplements to bromegrass hay.

	Supplemental protein[a] from				
	Soybean meal	Urea +			
		1 lb. corn	2 lb. corn	1 lb. gel. corn	2 lb. gel. corn
No. steers[b]	447	463	458	462	444
Av. daily gain, lb.	.70	.51	.54	.50	.69
Daily feed consumption, lb.					
Bromegrass hay	9.2	9.0	8.6	9.4	8.7
Supplement	1.25	1.25	2.25	1.25	2.25
Total	10.45	10.25	10.85	10.65	10.95
Feed/100 lb. gain, lb.					
Bromegrass hay	1366	2461	1622	2629	1270
Supplement	182	323	426	350	328
Total	1549	2788	2048	2979	1595

[a] Each supplement contained in addition to the protein and energy sources indicated adequate supplemental minerals and vitamins.
[b] Steers individually fed for 104 days.

Table 4. Performance of cattle fed gelatinized corn as carrier for urea.

	Protein source from:				
	Soybean meal	Urea		½ level of urea	
		Corn	Gel. corn	Corn	Gel. corn
No. steers	20	19	20	20	20
Initial weight, lb.	604	601	607	604	606
Daily gain, lb.	2.74	2.88	2.79	2.82	2.69
Average daily feed consumption					
Ground ear corn	8.6	8.8	8.6	8.7	8.7
Ground shelled corn	9.7	9.2	9.7	9.4	9.4
Bromegrass hay	1.8	1.8	1.8	1.8	1.8
Supplement	1.5	1.5	1.5	1.5	1.5
Total	21.6	21.3	21.6	21.4	21.4
Feed/100 lb. gain, lb.	791	737	772	760	795

Table 5. Performance of steers[a] fed a fattening ration supplemented with urea and different levels of gelatinized corn.

	Level of gelatinized corn, %			
	0	5	10	15
No. steers	6	6	6	6
Initial weight, lb.	514	518	515	516
Daily gain, lb.	2.74	2.89	2.51	2.63
Daily feed consumption, lb.	18.7	19.7	18.8	18.0
Feed/100 lb. gain	687	682	751	765

[a] Steers individually fed.

Cattle receiving rations containing Tranimul and Stilbestrol.

Tranimul, Stilbestrol in Rations

By Walter Woods[1] and Walter Rowden[1]

Research with stilbestrol has shown consistent benefits in increasing rate of gain and efficiency of gain when fed to fattening beef cattle. There is a continued search to find ways of improving performance of cattle by combining other additives with stilbestrol.

This research was to determine the influence of Tranimul (a tranquilizer) upon performance of fattening steers. The results indicated a benefit in gain in addition to that obtained from stilbestrol. The effect on efficiency of feed conversion in the absence of stilbestrol was negative, however, in presence of stilbestrol there appeared to be a small increase in efficiency of feed conversion.

Trials

In Trial 1 steers were fed a full feed of sorghum grain, limited feed of alfalfa hay and .5 lb. supplement. Two lots of 55 steers each received either 0, 5, 10 or 100 mg. for 10 days and then 10 mg. of Tranimul for the remainder of the trial. The supplement contained supplemental Vitamin A, minerals and stilbestrol. The steers were fed the rations 140 days.

In Trial 2, Tranimul and stilbestrol were fed singularly and in combination to two lots of 40 steers. The Tranimul and stilbestrol were fed at the rate of 10 mg. each per steer per day. The steers were given a full feed of a grain mixture of 75% sorghum grain and 25% corn. A limited feed of alfalfa hay was fed with 1 lb. of dehydrated alfalfa and .5 lb. of supplement per day. The supplement for all lots contained a source of supplemental minerals and Vitamin A. The steers were fed an average of 157 days.

Results

Performance of the steers fed in Trial 1 is shown in Table 1. The steers fed Tranimul gained faster than those on the control ration. The increase in gain was about 7% above the controls. There was little difference in the gains for the steers fed 5, 10 or 100 mg. for 10 days and then 10 mg. of Tranimul for the remainder of the trial. The feed required per 100 lb. of gain was decreased slightly by feeding Tranimul. The control steers required 1,079 lb. of feed for producing 100 lb. of gain. The average feed per 100 lb. of gain for all lots receiving 10 mg. of Tranimul appeared to be slightly lower than those receiving 5 mg. level. All steers fed 10 mg. of Tranimul required an average of 1,043 lbs. of feed to produce 100 lb. of gain, which represents a decrease of 3.3% as compared to the control.

Since all lots received stilbestrol

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Table 1. Influence of Tranimul on performance of fattening steers.

	Levels of Tranimul				
	0	5 mg.	10 mg.	100 mg. then 10 mg.[a]	All 10 mg.[b]
No. steers	110	106	110	107	217
Initial weight, lb.	695	700	706	707	706
Final weight, lb.	998	1023	1030	1036	1033
Total gain, lb.	303	323	324	328	326
Av. daily gain, lb.	2.16	2.31	2.31	2.34	2.32
Daily feed consumption, lb.					
Sorghum grain	17.6	18.8	18.5	18.3	18.4
Alfalfa hay	5.2	5.4	5.4	5.4	5.4
Supplement	0.5	0.5	0.5	0.5	0.5
Total	23.3	24.7	24.4	24.2	24.3
Feed required/100 pound gain					
Sorghum grain	814	813	801	781	791
Alfalfa hay	242	235	233	230	231
Supplement	23	22	22	21	21
Total	1079	1070	1056	1032	1043

[a] 100 mg. of Tranimul fed per steer per day for first 10 days and the 10 mg. per steer per day for remainder of test.
[b] Aveage of steers receiving 10 mg. and 100 mg. then 10 mg.

Table 2. Influence of Tranimul and Stilbestrol singularly and in combination upon performance of fattening steers.[a]

	Basal	Basal +		
		Stilbestrol[b]	Tranimul[b]	Stilbestrol + Tranimul
No. steers	78	79	77	78
Initial weight, lb.	588	596	601	584
Final weight, lb.	953	988	978	1016
Av. daily gain, lb.	2.32	2.50	2.39	2.73
Daily feed consumption				
Sorghum grain—corn[c]	16.2	17.0	17.2	17.4
Supplement	.5	.5	.5	.5
Dehydrated alfalfa	1.0	1.0	1.0	1.0
Alfalfa hay	4.9	4.9	4.9	4.9
Total	22.7	23.4	23.6	23.8
Feed/100 lb. gain, lb.	976	938	987	874

[a] Length of trial was 157 days.
[b] Stilbestrol and Tranimul fed at rate of 10 mg. per steer per day.
[c] Sorghum grain and corn were mixed in 75:25 proportions.

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Tranimul

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in Trial 1, the objective of Trial 2 was to determine the response by the steers to Tranimul in the absence and presence of stilbestrol. The results are reported in Table 2. The feeding of 10 mg. of stilbestrol increased gains over the controls by 7.8% and decreased feed required for 100 lb. of gain by 3.9% as compared to controls. This increase in gain and decrease in feed required per 100 lb. of gain because of stilbestrol feeding is lower than that reported in a number of other studies. The feeding of 10 mg. Tranimul increased gains as compared to controls by 3% and increased the feed required per 100 lb. of gain by 1.1%.

The combination of Tranimul and stilbestrol increased gains by 17.6% and decreased the feed per 100 lb. of gain by 10.4% as compared to controls. It appears from this trial there could be an additive effect between Tranimul and stilbestrol. Actually, in this study the response to the combination was greater than from the added effect of both compounds.

A response to stilbestrol feeding is expected by fattening cattle. It appears that Tranimul may offer some promise in increasing weight gains and feed conversion in beef cattle, in addition to that obtained from stilbestrol. Tranimul is presently in the investigational stage and is not cleared for feeding to beef cattle by the Federal Food and Drug Administration.

Antibiotic Tylosin and Performance

By Walter Woods,[1] Walter Rowden[1] and Walter Tolman[2]

Administering compounds to cattle on pasture may be difficult when supplements or grains are not fed. The research reported here investigated the effect upon performance when cattle on pasture were given a bolus containing the antibiotic Tylosin. The bolus was prepared so that the release of the antibiotic would be sustained about 40 days. The results of two year's research indicated that supplying antibiotics to cattle on pasture by this means did not increase weight gains.

In the first year's study, at the Field Laboratory, steers grazing bromegrass pastures or alfalfa-bromegrass pastures were treated twice at 42-day intervals. The treatments were control, 3 grams of Tylosin in a bolus, two of the 3 gram Tylosin boluses, 6 grams of Tylosin in a bolus and two of the 6 gram Tylosin boluses. The steers were on trial for an 88-day period.

In the second year's study, at the Field Laboratory, steers grazing brome-alfalfa pastures were treated every 42 days with the boluses. The treatments were control, 1 bolus containing 5.6 grams of Tylosin given every 42 days and 2 boluses containing 5.6 grams of Tylosin every 42 days. The steers were on test for 134 days.

At the Northeast Nebraska Experiment Station, heifers on bromegrass pastures were given the same treatments as the steers in the second year's study at the Field Laboratory. The heifers were fed .5 pounds of corn per day for 42 days and then placed on a full feed of corn for the remainder of the time they were on pasture. The heifers were on the test for 126 days.

The performance of the steers during the first year's study at the Field Laboratory was considered to be poor and the results are shown in Table 1. The reason for this was not known except excessive rain occurred in the period of the test and the cattle experienced considerable stress from flies and mosquitos. Supplying an antibiotic in a bolus had no consistent effect on the liveweight gain of the steers. An indication of increased gains was noted when two of the boluses containing 3 grams of Tylosin were administered. However, the other treatments performed similarly to the controls.

In the second year's study the performance of the control cattle was similar to those given the antibiotic treatments. There was a slight tendency for the higher level of antibiotic to lower the daily gains of the steers and heifers.

In this study the administration of a bolus to slowly release an antibiotic (Tylosin) over a period of time to cattle on pasture did not consistently influence animal performance. Further research is required to determine if the lack of response was because of method of administration; that normally cattle under these conditions do not respond to antibiotics; the antibiotics used; or other factors affecting the response from antibiotic administration.

Table 1. Performance of steers on pasture given boluses containing Tylosin.[a]

Treatment/level of Tylosin	No. steers	Initial weight	Daily gain
Control	79	588	.56
3 gm. bolus	84	586	.53
Two 3-gm. boluses	74	578	.70
6 gm. bolus	86	594	.53
Two 6-gm. boluses	75	595	.59

[a] Administered every 42 days.

Table 2. Performance of cattle on pasture given boluses containing Tylosin.

Treatment	No. animals	Initial weight	Daily gain
Control—Steers	88	471	1.85
Control—Heifers	20	539	1.99
Average			1.92
1 bolus[a]—Steers	87	463	1.84
1 bolus —Heifers	20	541	2.01
Average			1.92
2 boluses[a]—Steers	89	468	1.75
2 boluses —Heifers	20	538	1.91
Average			1.83

[a] Bolus contained 5.6 grams of Tylosin administered every 42 days.

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[2] Department of Animal Science, Northeast Experiment Station.

Experiments in Progress

Beef Carcass Evaluation

A study of the effect of sex on production traits has been in progress since 1962. The objectives of this study are to evaluate sex effects on growth and carcass traits and to determine if sires rank the same in growth and carcass traits on their bull, steer and heifer progeny. Analysis of the first three years data is underway. The results will be summarized and published.

Sixty head of male calves from the same breeding herd are now on feed and will be slaughtered this summer (1966). The same live and carcass traits will be measured. In addition, the effect of stilbestrol on bulls and steers will be studied. A study of lipids in the blood will be made periodically while on feed and in the intramuscular and subcutaneous fat in the carcass.

Urea Levels

Calves are being wintered at the Northeast Experiment Station on corn silage rations with different levels of the supplemental protein coming from urea. The influence of adding sulfur to urea supplements is also being investigated.

Roughage Additions to Silage Rations

The benefit of utilizing the nutrient composition of alfalfa is being investigated at the North Platte Experiment Station. Various levels of alfalfa hay with and without a complete supplement are being fed with a corn silage ration.

Dehydrated Alfalfa

The influence of the dehydrated alfalfa on protein utilization is being investigated at the Lincoln Station. Soybean meal and urea are being investigated as sources of protein.

Effect of a Feed Additive

The influence of feeding and implanting stilbestrol in combination upon performance of fattening steers is being investigated at the Field Laboratory at Mead. Implantation of stilbestrol is being made at different times in the feeding period.

Silage Preservatives

The influence of limestone and other materials on fermentation in the silo is being investigated at the Lincoln Station using miniature silos. Both alfalfa and corn silages are involved in the study. The influence of the additives on nutrient preservation is being measured.

Calcium

The level of calcium required in fattening rations for beef cattle is being investigated at the North Platte Station. The roughage sources are corn silage and alfalfa hay. The levels of calcium being fed are .3, .4 and .5% of the ration.

Milo

In Vitro studies are being conducted investigating the availability of starch from various sources of sorghum grain to rumen bacteria. The artificial rumen is being used as a screening technique to aid in the evaluation of different grains.

Improving the Nutritive Value of Stemmy Fractions of Dehydrated Alfalfa

A three and a half year study has been started to develop procedures to increase the digestibility of the stemmy fractions of dehydrated alfalfa. Various chemical, physical and biological treatments will be used.

Endocrine Function and Energy Retention of the Post-Partum Beef Female as Influenced by Pre-Partum Energy Intake

Objectives of this project are:

1. To determine gonadal and gonadotrophic hormone levels at calving and at four post-partum stages in two-year-old beef females fed high and low levels of energy for 140 days prior to calving.
2. To determine energy retention in the post-partum two-year-old beef heifer as influenced by pre-partum energy intake.
3. To determine relationships between endocrine function, energy retention and the interval from calving to first estrus.

The Effect of Energy Intake on the Performance of Two-Year-Old Heifers

At the Fort Robinson Station two groups (50 head in each) of bred yearling heifers are being wintered on native range. One group is receiving 1 pound of a 40% protein supplement daily. The other is receiving 4 pounds of a 10% protein supplement daily. At calving time one-half of the heifers in each of the groups on winter range will be switched to the other level of supplement. Growth of the heifers, calf production and reproductive performance will be measured.

Supplements for Calves Grazing Native Winter Range

Heifer calves are being individually fed varying levels of protein and energy in different combinations while grazing native winter range at the Fort Robinson Research Station. Following the winter feeding experiment the heifers will be bred to measure the treatment effect on reproduction. A comparable study utilizing the group feeding procedure is being conducted at the North Platte Experiment Station using steer calves. Following the winter phase in this study one-third of each winter treatment group will go in the feedlot during May, another third during July and the remaining third in September. The last two-thirds will remain on summer pasture without supplement until they go in the feedlot. The different methods of wintering, summering and/or finishing will be evaluated in terms of an overall program.

Wilted vs. Unwilted Beet Tops in Cattle Rations

At the Scotts Bluff Experiment Station various methods of handl-

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ing beet top silage in wintering and finishing rations are being studied. Wilted and unwilted beet top silage fed alone, in combination with each other and with corn silage are being compared as the roughage in finishing rations. Two groups of calves are being wintered on either wilted or unwilted beet top silage and a third group is being wintered on beet top pasture. Comparable acreage of beets handled each way will allow for an economical evaluation of the handling methods in terms of feed value.

The Development of Laboratory Methods for Determining Range Forage Quality

On the Scotts Bluff Experiment Station range a study is in progress to develop laboratory methods for determining range forage quality. Esophogeal fistulated cattle are being used to determine what forage the animals eat and digestion trials to determine how well they utilize the forage. The determined nutritive value of the forage will be related to various chemical components to determine if there are any that may be used to predict nutritive value.

The Value of Crambe By-Products in Beef Cattle Rations

A plant, "Crambe abyssinica," which produces seed with large amounts of oils, is adapted to Nebraska soil and climate conditions. The meal resulting from the extraction of oil in the processing of the crop shows promise as a protein supplement in beef cattle rations. Growth and finishing trials are in progress at the Lincoln Experiment Station to determine the level of supplemental protein that may be furnished from Crambe meal.

Evaluating Milk Production of Beef Cattle

For three years the Animal Science Department has been developing procedures for estimating milk production of beef cattle. During the past year, a study was conducted with 24 Angus cows to evaluate the effects of oxytocin on estimating milk production. Six observations were made on each cow during the first eight weeks of lactation.

Each week one-third of the cows received no oxytocin during the milking procedure. Another third received oxytocin before the calf nursed the cow. The remaining third received an oxytocin injection after the calf nursed. The purpose of this experiment was to determine whether the time of administration of oxytocin would influence the amount of milk nursed by the calf or the total amount of milk that could be withdrawn from the cow after completion of nursing.

There was a significant treatment effect favoring the administration of oxytocin before nursing. There was no change in the standard deviation of either calf consumption or milk production. It appeared that oxytocin injection was not required to get an estimate of relative levels of milk production of different cows. Further work will be done in this area.

During 1965 more than 130 cows in the heterosis experiment and approximately 60 heifers in the selection experiment were used to estimate milk production. These data will be studied carefully to determine: 1. the effects of heterosis on milking ability of beef cows and 2. to evaluate the relationships between calf size, growth rate and the milking characteristics of the cow.