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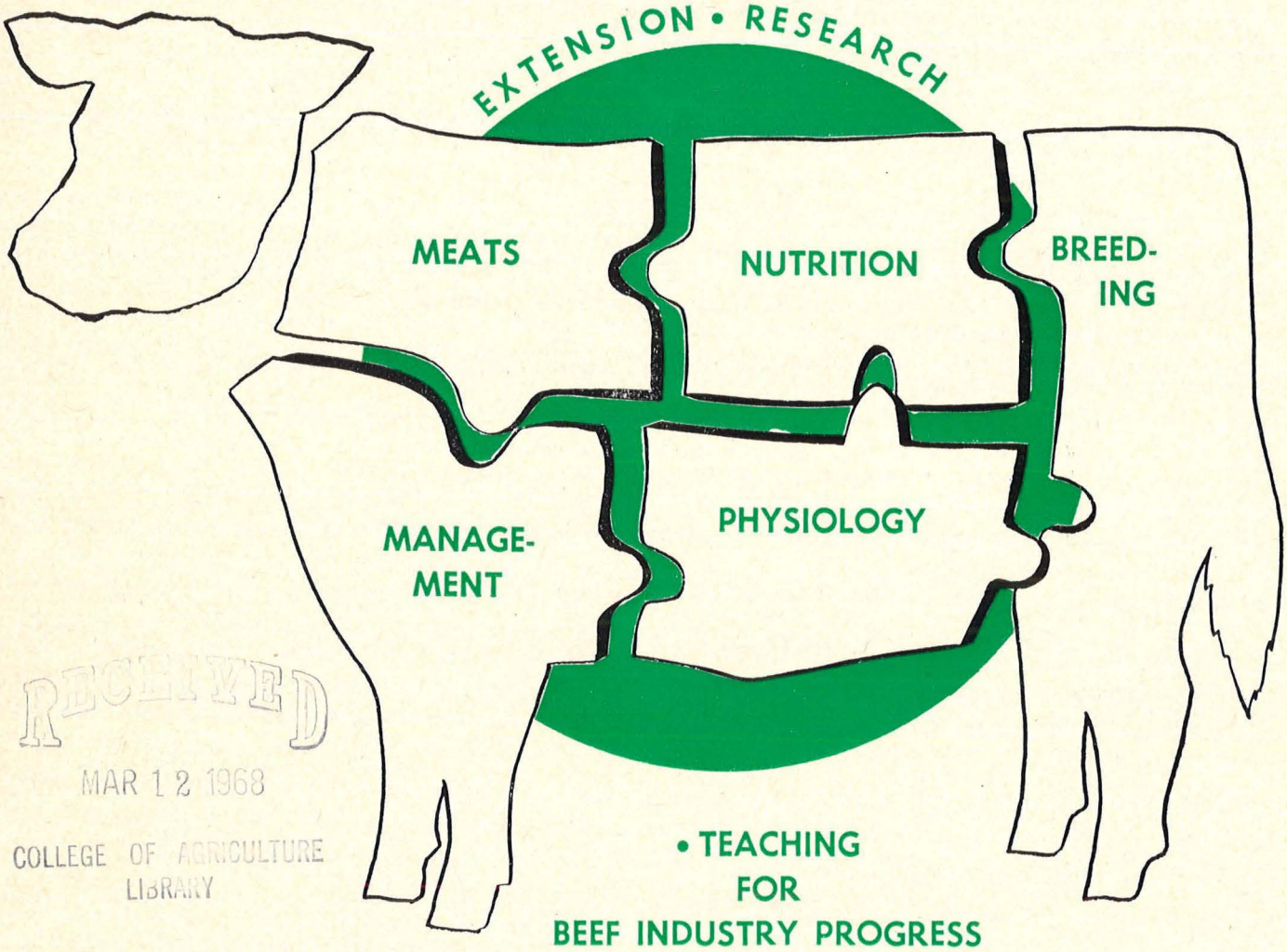
1968 NEBRASKA BEEF CATTLE PROGRESS REPORT



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Nebraska's Heritage, Future in Beef Production

By Frank H. Baker[1]

Beef is important to Nebraska's people; it is the basis for a very important industry in the state. This industry has grown by leaps and bounds in the recent past as beef has been consumed in larger and larger quantities by the American public.

Today annual beef consumption is above 100 pounds per person. This requires twice the annual beef production of 1947 to meet the demands of today's American consumers.

Nebraska beef industry in 1967 involved the use of an inventory of 6,432,000 cattle worth almost $1 billion.

Since 1930 (Table 1) cattle numbers in the state have doubled and value per animal tripled to produce a total inventory value 6 times that of 1930. When investment in land, facilities, packing plants, feed mills, markets, etc., are considered it becomes truly a multi-billion dollar industry.

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

Table 1. Importance of Nebraska's cattle industry; changes in inventory of cattle and calves 1930–1967.

	Number (1000's)	Value per head (dollars)	Total value (1000's dollars)
1930	3060	$ 55.00	168,300
1940	2904	41.20	119,645
1950	3843	124.00	476,532
1960	5072	131.00	664,432
1967	6432	152.00	977,664

Nebraska Ranks High

The yield of cash receipts from the beef industry for the single year of 1966 was greater than the total yield for the 10-year period of 1931-1940, i.e., $792 million in 1966 compared to $777 million for 1931-1940 (Figure 1).

In becoming a more important industry Nebraska's beef production has become a more important part of the entire agricultural community of the state.

Data in Figure 2 show that cash receipts from beef cattle have risen from a level of 25 to 35% of total agricultural receipts between 1930 and 1950 to a level of 40 to 50% during the 1960's.

In comparison to other states Nebraska ranks second in cattle feeding, second in beef calf production and third in total beef production. The number of cattle placed on feed in Nebraska feedlots in 1966 was 2,862,000 head or more than twice as many as in 1959.

Cattle Shipped Out

This great Nebraska beef production heritage provides a sound basis for continued future growth of the industry. It is estimated (Figure 3) that only ½ to ⅔ of the feed grain produced in Nebraska is currently being fed to livestock in the state. Similarly, it is estimated that about half a million cattle are shipped out of the state for feeding in other states (Figure 4). Thus, cattle and feed inputs for continued expansion of the feeding industry exist in the state today.

In addition to these current supplies of feed and cattle, future development of irrigation, improved crop varieties, fertilization practices and cultural practices will present

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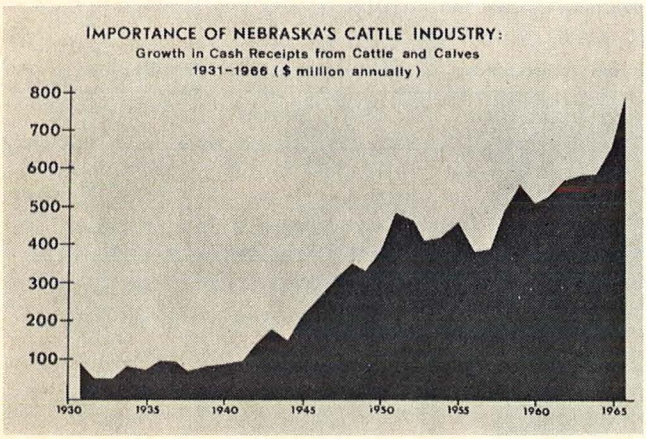


Figure 1. Importance of Nebraska's cattle industry, growth in cash receipts from cattle and calves, 1931-1966 ($ million annually).

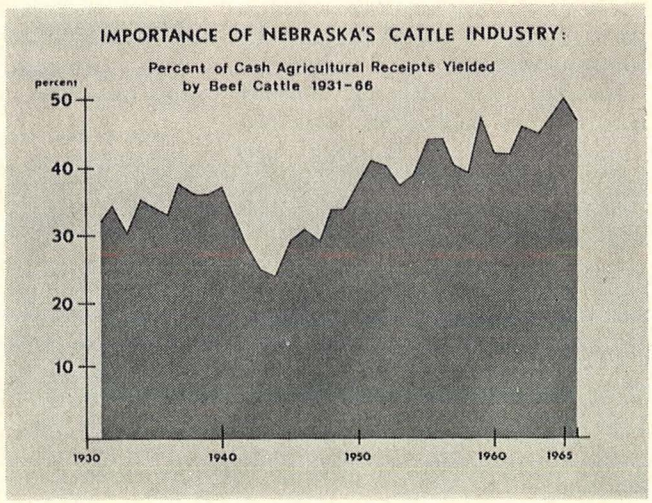


Figure 2. Importance of Nebraska's cattle industry, percent of cash agricultural receipts yielded by beef cattle 1931-1966.

Heritage, Future

(continued from page 3)

opportunities for even greater outputs of feed crops.

For example, water resource specialists suggest that irrigation, currently practiced on about 3 million acres, can be doubled through proper water resource development and water management.

Education, Research

A healthy future for any industry is based on the effective use of productive resources at a level of efficiency competitive with alternative uses for the resources and that permits a fair profit for the use of resources.

The cattle industry is no exception! Problems of the industry resulting from or as a product of low productive efficiency must be solved through education and research.

New technology that exists but has not been fully applied must be adapted to industry needs rapidly.

Problem-oriented research and other research related to needs of the beef industry must be initiated at an even greater rate in the future than in the past.

Outstanding Heritage

Data included in the accompanying progress reports are examples of research conducted in Nebraska with existing facilities and support. Additional research capability is possible as more fund support becomes available.

Current beef research commitments of the midwestern states are shown in Table 2. National beef cattle research investments represent less than .3% of cash receipts from the beef industry.

Research investments of other industries usually represent as much as 3% of their gross receipts or 10 times as much as that of the American beef industry.

Nebraska's beef production heritage is truly outstanding! Nebraska beef production future can also be truly outstanding but it will require outstanding action by Nebraskans!

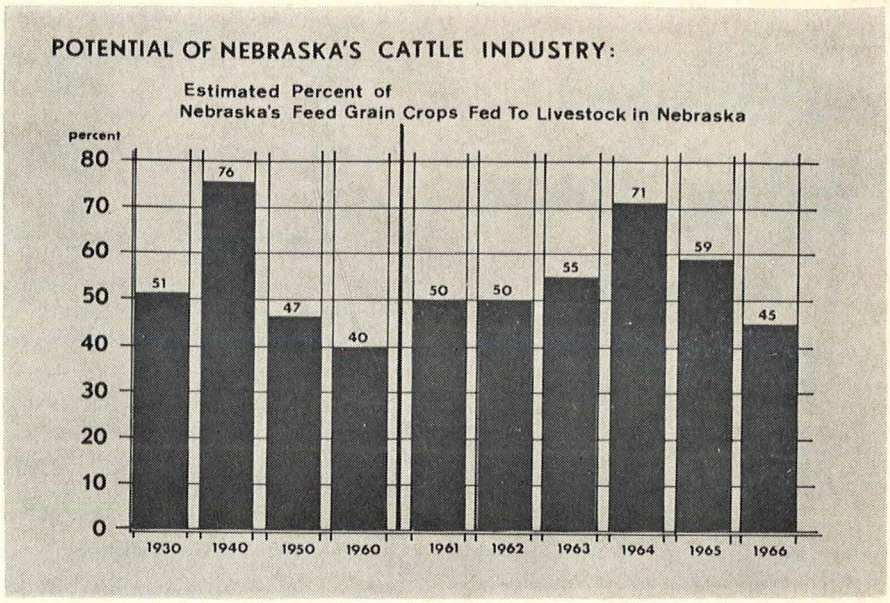


Figure 3. Potential of Nebraska's cattle industry, estimated percent of Nebraska's feed grain crops fed to livestock in Nebraska.

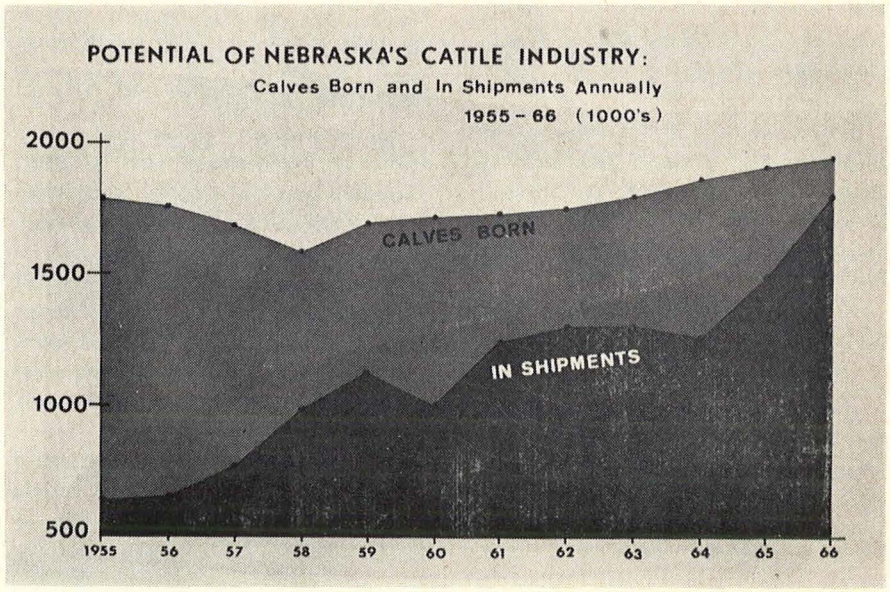


Figure 4. Potential of Nebraska's cattle industry, calves born and in shipments annually, 1965-1966.

Table 2. Beef cattle research commitments in midwestern states; scientific man years.[a]

	Cooperative State Expt. Station Positions	U.S.D.A. Positions in States	Total SMY's Per State
Nebraska	8.1	3.4	11.5
Illinois	10.2	0.4	10.6
Indiana	3.1	0.3	3.4
Iowa	8.2	21.6	29.8
Kansas	15.3	0	15.3
Michigan	4.1	1.4	5.5
Minnesota	2.4	5.0	7.4
Missouri	4.8	0.9	5.7
North Dakota	6.1	0	6.1
Ohio	3.7	3.7	3.7
South Dakota	16.0	0.3	16.3
Wisconsin	7.0	0	7.0
U. S. Total	344.1	168.3	514

[a] Information provided by Cooperative State Research Service USDA. A Scientific Man Year is estimated to represent an investment of $40,000 or more. These research commitments include Nutrition, Genetics, Physiology and all aspects of production efficiency plus pest and disease control, environmental stress, product quality or improvement and consumer protection.

An Ensiling Time

Urea Additions to Corn Silage

By Walter Woods,[1] Walter Tolman,[2] David Stenberg[3] and Lionel Harris[4]

In fattening trials at the Scotts Bluff Station, adding 10 pounds of urea per ton of chopped whole corn plant at the time it was put into the silo appeared to meet cattle protein needs as well or better than adding a comparable amount of urea to the ration at feeding time.

In wintering trials at the Northeast Station where calves were fed high silage rations, rate and efficiency of gain were practically the same for silage with urea added at ensiling or when fed.

However, cattle fed soybean meal as a supplement to untreated silage gained more rapidly and required less feed per cwt. gain than either ration containing urea as the sole source of supplemental protein equivalent. Dry matter loss during storage appeared to be lower for urea treated silage than control silage at both stations. The nitrogen loss in percentage of the total ensiled was approximately the same in urea treated and control silage. However, total losses of nitrogen were greater in urea treated silage because additions of urea increased amount of nitrogen stored.

Mixing Equipment Eliminated

Recent interest has developed in adding urea to silage at ensiling time primarily because it eliminates the need for elaborate mixing equipment that is needed when urea is added to the ration at feeding time. By the time urea is added to silage as it is unloaded into the silo and is removed for feeding, it appears to be distributed uniformly enough to avoid toxicity and palatability problems which occur when urea is not uniformly mixed.

When urea is added as the silage is made there is less flexibility in fitting the silage to a wide variety of feeding programs compared to using high urea supplements added at the time the ration is mixed. For example, silage with urea added at the rate of 10 pounds per ton may provide enough protein equivalent to balance fattening rations where liberal amounts of silage are fed but will not provide enough protein equivalent for low silage rations and may provide more non-protein nitrogen than can be most effectively utilized in high silage growing rations.

Protein Equivalent Up

Research at Ohio, Purdue, Minnesota and Illinois show that urea can effectively raise the protein equivalent of silage. Losses of urea, nitrogen and dry matter losses in the silo were not adequately evaluated in these tests, however.

Experiments were conducted at the Northeast and Scotts Bluff Stations in an attempt to answer the following questions:

1. What effect will urea have on performance when added at silo filling versus feeding time in growing and finishing rations?
2. What effect will urea have on dry matter and protein losses during the ensiling process?

At the Northeast Station, two lots of heifer calves fed corn silage to which urea was added at the rate of 8 pounds per ton at silo filling time were compared with heifers fed control silage supplemented with either soybean meal or urea added at feeding time. Approximately the same total protein equivalent (percentage of the ration) was included in each ration. Minerals and vitamins were added in adequate amounts to all rations.

Samples Taken

Alternate loads of chopped corn plant were weighed and treated with urea (262% protein equivalent) by sprinkling on top of the load before blowing into a sealed upright silo. No additions were made to the other loads which were weighed and stored in a similar silo. All material was weighed out of the silos as fed. Samples for chemical analyses were taken at harvest and routinely during the feeding period.

At the Scotts Bluff Station, steers were fed a finishing ration with silage limited to 12 pounds per head daily after they were on a full feed of concentrate. The treatments were:

1. Control corn silage with urea added at feeding time.
2. Corn silage to which urea was added at the rate of 10 pounds per ton at ensiling.
3. Corn-bean silage from corn and pole beans grown together.

(continued on next page)

Cattle used in the trial to evaluate urea additions to corn silage.

[1] Professor, Beef Nutrition, Department of Animal Science, University of Nebraska.
[2] Area Agricultural Extension Specialist (Animal Science), Northeast Station.
[3] Graduate Assistant, Department of Animal Science, University of Nebraska.
[4] Superintendent, Scotts Bluff Station.

Urea Additions

(continued from page 5)

Separate Harvest

The silage was stored in concrete stave silos. Urea was added to alternate loads before blowing into the silo. No additions were made to silage stored in the control silo.

In addition to silage, all steers were fed 1½ pounds of dehydrated alfalfa per head daily, a full feed of 75% ground shelled corn, 25% beet pulp mixture and a dicalcium phosphate salt mixture (equal parts by weight), free choice. Steers on the control silage were fed a high urea supplement to provide the equivalent amount of protein provided by the other two rations.

The results of the two experiments (of feeding silage to which urea has been added) are shown in Tables 1 and 2.

Table 1. Performance of heifer calves fed urea-treated corn silage.

	Urea treated corn silage	Corn silage + Urea	Corn silage + S. B. M.
No. head	26	26	26
Initial weight, lb.	415	419	410
Daily gain	1.45	1.48	1.66
Daily feed consumption, lb.			
Silage	28.6	30.1	29.8
Supplement	1.0	1.0	1.0
Feed required per cwt., lb.			
Silage as fed basis	1975	2027	1780
dry matter basis	697	693	609
Supplement	75	73	65

Table 2. Performance of fattening steers fed urea-treated corn silage.

	Urea treated corn silage	Corn silage + Urea	Corn-bean silage
No. head	16	16	16
Av. initial wt., lb.	737	743	732
Av. daily gain	3.20	2.97	3.03
Daily feed consumption, lb.[a]	22.7	23.4	22.7
Feed/cwt. gain, lb.[a]	710	790	748

[a] Dry matter basis

Higher Daily Gain

The urea-treated silage produced more favorable results in the fattening ration at Scotts Bluff than in the growing ration at the Northeast Station. In the fattening ration, urea treated corn silage produced a higher daily gain with less feed consumption than the corn silage supplemented with urea at feeding time. Corn-bean silage gave intermediate results.

Adding urea at feeding time in a supplement or putting it in the silo at ensiling time gave similar results in rate and efficiency of gain in high silage rations at the Northeast Station. Neither treatment resulted in performance comparable to supplemental protein in the form of soybean meal.

This as well as earlier data from this station indicates that urea should not be the sole source of supplemental protein for high corn silage rations to obtain maximum rate and efficiency of gain.

Random Samples

The effect of urea on dry matter loss from corn silage was determined by running dry matter determinations on random samples of corn silage as it was weighed into the silos and on random samples as it was weighed out of the silos. The results are shown in Table 3.

Dry matter losses were slightly greater for control corn silage than urea-treated corn silage at both locations. A larger dry matter loss occurred in the concrete stave silos than in the sealed structures.

The effect of urea additions on the nitrogen preservation during the ensiling process was determined at the Scotts Bluff Station. There was a loss in total pounds of protein for all treatments during the ensiling process. Adding urea increased the protein percentage of the urea-treated silage 3.3% over corn silage without added urea.

However, the total pounds of protein at feeding time in either the ensiled urea-treated material or the control silage was less than it contained at ensiling time. The protein loss for control corn silage was 22.4% during storage compared to 26.3% for urea treated silage.

Some Contamination

If this difference in protein loss is charged only to urea, 33.6% of the nitrogen added in the form of urea was lost from the time of filling the silo until feeding for the Scotts Bluff Station study.

Part of the samples of silage taken at silo filling time at the Northeast Station were lost because of contamination and prevented an adequate evaluation of nitrogen preservation under conditions there.

From these data it appears urea-treated corn silage is best utilized in a high grain, fattening ration when silage is the sole roughage source. When used in a high roughage, growing program, optimum gains would be obtained by additional supplementation with a natural protein, thus lowering the amount of urea needed in the corn silage. This would reduce the convenience of this practice.

Table 3. Percent dry matter loss.

	Dry Matter			
	Stored in silo	Removed from silo	Shrinkage	% loss
	Lb.	Lb.	Lb.	
Sealed structures at Northeast Station				
Untreated corn silage	81,918	78,780	3,138	3.8
Urea treated silage	83,256	82,233	1,023	1.2
Concrete stave structures at Scottsbluff Station				
Untreated corn silage	27,906	20,873	7,033	25.2
Urea treated silage	26,627	21,435	5,192	19.5
Corn-bean silage	26,276	22,271	4,005	15.2

Straightbred and crossbred cows with their crossbred calves in Phase 2 of the heterosis experiment involving Angus, Hereford and Shorthorn breeds.

Hybrid Vigor in Beef Cattle

By L. V. Cundiff,[1] K. E. Gregory,[1] R. M. Koch[2] and R. D. Humphrey[1]

Comprehensive analyses have been made on the data from the first phase of an extensive crossbreeding experiment conducted at the Fort Robinson Beef Cattle Research Station. This experiment involves Hereford, Angus and Shorthorn breeds.

In the first phase of the experiment, the three straightbreds and all reciprocal crosses among them were produced. Heterosis or hybrid vigor was evaluated by comparing crossbreds with the average of straightbreds for all major economic traits involved from conception through growth and onset of puberty for heifers and through growth and slaughter of the steers.

The effects of heterosis were significant for most of the traits evaluated. The results of these analyses are summarized in the 1966 and 1967 Beef Cattle Progress Reports.

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. The experimental design for the second phase of this experiment is given in Table 1. Straightbred cows of the three breeds are being compared with their crossbred half-sisters when both are bred to the same bulls to have crossbred calves.

Table 2 provides a summary of results of the heterosis effects on fertility traits through the 1967 breeding season and Table 3 provides information on the preweaning performance of calves out of both crossbred and straightbred cows through the 1967 calf crop.

Crossbreds Favored

For the five years (1963, 1964, 1965, 1966 and 1967) on which data have been collected, the advantage of the crossbred cows has been 17, 6, 10, –3 and 11%, respectively for calf crop weaned and 17, 32, 21, 23 and 28 lbs., respectively in weaning weight of calves at 205 days.

(continued on next page)

Table 1. 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 & reciprocal			S x (H x A)
H x S & reciprocal		A x (H x S)	
A x S & 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 2. Heterosis effects on fertility in Phase 2 of the experiment (Preliminary report of results).

	No. matings	Calving to first heat days	Settled on first service %	Pregnant %	Calves born %	Calves weaned %
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	85	80
Straightbreds	108	59.6	51.9	92.6	87	83
Difference	....	–4.0	+8.3	–6.1	–2	–3
1966—to calve as 4, 5, 6 and 7 year olds						
Crossbreds	130	47.6	55.4	93.1	92	88
Straightbreds	106	52.9	54.7	86.8	82	77
Difference	....	–5.3	+.7	+6.3	+10	+11
1967—to calve as 5, 6, 7 and 8 year olds						
Crossbreds	125	43.5	....	90.4	....	....
Straightbreds	102	49.4	....	83.3	....	....
Difference	....	–5.9	....	+7.1	....	....

[1] Animal Husbandry Research Division, ARS, USDA.
[2] Professor, Beef Breeding, Department of Animal Science, University of Nebraska.

Hybrid Vigor

(continued from page 7)

Approximately 8% more calves have been weaned by crossbred dams than by straightbred dams on the average for the first five years. Crossbred calves out of crossbred dams have on the average had 5% heavier weaning weights than crossbred calves out of straightbred dams.

When both of these traits are considered, a 17% advantage in favor of crossbred cows has been realized for pounds of calf weaned per cow exposed to a bull in the breeding pasture.

This does not take into account the 3% advantage in percent calf crop weaned and the 4.5% advantage in weaning weight of crossbred calves over straightbred calves indicated in the first phase of this experiment.

The results of heterosis effects on cow performance traits (fertility and mothering ability) should be regarded as preliminary because data are being collected for one more year in this phase of the experiment. At that time the data will be analyzed extensively.

Table 3. Weaning weight of calves, weaning scores of calves and estimated milk production of dams in Phase 2 of the experiment—1963, 1964, 1965, 1966 and 1967 (Preliminary report of results).

Dams	No.	Wn. wt.[a] 205-days lbs.	Wn. score[b] 205 days	Est. milk production 12-hour period[c] lbs.
		1963 calf crop		
Crossbreds	27	482	12.3	9.44
Straightbreds	24	465	11.6	8.97
Difference	....	+17	+.7	+.47
		1964 calf crop		
Crossbreds	97	484	13.0	7.87
Straightbreds	73	452	12.2	7.03
Difference	....	+32	+.8	+.84
		1965 calf crop		
Crossbreds	105	467	12.6	7.37
Straightbreds	74	446	12.2	6.70
Difference	....	+21	+.4	+.67
		1966 calf crop		
Crossbreds	106	480	12.8	.....
Straightbreds	89	457	12.3	.....
Difference	....	+23	+.5	.. ..
		1967 calf crop		
Crossbreds	114	488	13.1	.....
Straightbreds	82	460	12.7	.....
Difference	....	+28	+.4	.....

[a] Adjusted to mature equivalent dam basis—average of steers and heifers.
[b] Scores of 12, 13 and 14 = low, average and high choice, respectively.
[c] Calves average 2-3 months of age and dams were on summer range when estimates were made.

Quality Economically Important

Alfalfa Fed to Beef Cattle

By C. R. Luckett,[1] R. L. Ogden,[2] T. J. Klopfenstein[1] and W. R. Kehr[3]

The quantity of alfalfa to be fed to livestock, particularly beef cattle in Nebraska, each year is large enough so that quality is an important economic consideration. Changes in the quality of alfalfa are influenced primarily by two factors:

1. Changes in the leaf:stem ratio.
2. Changes in the fibrous components or cell-wall constituents of the stems, which are only partially digestible.

These two factors might be better described in more practical terms as less leafiness and more lignification of the cellulose and hemicellulose in the stems, as the plant matures. However, the reduction in quality of the hay contributed by these two factors may be minimized by good management practices.

Higher in Leaves

In a recent experiment, alfalfa forage cut at bud stage of maturity was higher in percent of leaves, in protein content and digestible nutrients than alfalfa harvested at 1/10 or full bloom. (Table 1).

Average annual dry matter yields were less from cutting at the bud stage than at later stages of maturity.

Number of cuttings was increased by harvesting at the bud stage of maturity compared to harvesting at 1/10 bloom or full bloom. Annual production of protein and other digestible nutrients (ton/acre) was similar for all stages of maturity from bud to full bloom (Table 2).

Harvesting alfalfa at full bloom resulted in dry matter yields similar to those obtained when alfalfa was harvested at 1/10 bloom. Protein and digestible nutrient contents were significantly lower in alfalfa cut at full bloom than at 1/10 bloom.

Higher Digestibility

Harvesting alfalfa at full bloom at the first cutting and at 1/10 bloom thereafter tended to take advantage of a large yield of forage that was relatively high in digestibility compared to forage from some of the later cuttings.

Over a three-year period, the full bloom-1/10 bloom cutting system yielded 94 and 96% as much protein and digestible nutrients (lb./acre) respectively, as the 1/10 bloom stage.

Similar values for the bud cutting system were 94 and 102%, respectively, for protein and digestible nutrients yields.

The leaf:stem ratio decreased as the system of management was based on more mature stages of growth.

[1] Research Associate, Department of Animal Science, University of Nebraska.
[2] Assistant Professor, Alfalfa Processing, Department of Biochemistry and Nutrition, University of Nebraska.
[3] Professor, Alfalfa, Department of Agronomy, University of Nebraska.

Table 1. Effects of maturity at cutting in nutrient content of alfalfa.

Item	Cutting systems			
	Bud	1/10	Full bloom 1/10	Full bloom
Percent protein	21.3	20.5	19.6	18.4
Percent DDM[a]	63.2	61.1	59.5	57.8
Percent leaves[b]	54.9	52.9	52.8	51.1

[a] Digestible dry matter, estimated from *In Vitro* technique.
[b] From the third year only.

Table 2. Effects of maturity at cutting on alfalfa yields.

	Cutting systems			
	Bud	1/10	Full bloom 1/10	Full bloom
Ave. no. of cuttings/yr.	5.0	4.3	4.0	3.7
Dry matter yields, tons/acre	4.18	4.39	4.32	4.35
Protein yields, tons/acre	.89	.90	.85	.80
DDM yields, tons/acre	2.64	2.68	2.57	2.51

Cost $7 a Ton

The importance of the leaf:stem ratio is amplified by the fact that leaves contain 75 to 80% of the protein and other digestible nutrients in the entire plant. A loss of leaves equal to 10% of the weight of the alfalfa would lower the amount of digestible nutrients 6 to 8 percentage units in alfalfa forage.

In terms of protein, it would require approximately 125 lb. of 44% soybean meal to replace that which would be lost per ton of forage with a 10% leaf loss. This would represent a cost of roughly $5 a ton for protein alone. When digestible nutrients are included, this loss would equal about 2 bu. of shelled corn worth about $2.

From Bud to Bloom

Five cutting systems were incorporated into this management study over a three-year period at Mead Field Laboratory, to study the influence of stage of maturity of alfalfa at harvest on forage yield and quality. Alfalfa was harvested at either the bud stage, 1/10 or full bloom in three systems.

In the other systems, one set of plots was harvested at full bloom at first cutting and all subsequent cuttings were made at 1/10 bloom.

Laboratory analysis revealed that the leaf fraction was not only quite high in digestible nutrients and protein content but that it was relatively constant in this respect, regardless of the stage of growth of the forage when harvested. Stems, however, were highly variable in digestibility and chemical composition, particularly cell-wall constituents.

Digestibility of the plant decreased as cell-wall constituents in the stems increased. Therefore, a variable such as leaf:stem ratio becomes very effective in influencing digestibility of alfalfa.

Swine and Poultry

The cell-wall constituent portion of the stems can be reduced by harvesting at more immature stages of growth. The importance of cell-wall constituents is easily seen in the rations of monogastric animals, swine and poultry, since they represent the fraction of the ration that is indigestible. However, in the ruminant animals, cattle and sheep, the cellulose and hemicellulose fractions are partially digested but the portions that are digestible are related to both the quantity of cell-wall constituents and the quantity of lignin within the cell-wall constituent fraction of the plant. Both cell-wall constituents and lignin contents increased with maturity in alfalfa.

Complete Digestibility

The possibility of separating alfalfa into leaf and stem fractions commercially has been considered by both researchers and alfalfa dehydrators. Should separation of alfalfa become economically feasible, the leaves would be readily acceptable in all types of livestock rations as a protein supplement.

From hand-separated samples of the cutting systems studied, it appears that the leaf fraction will contain 25 to 30% protein and 75 to 80% cell solubles, which could be completely digested by both monogastric and ruminant animals.

However, use of the stems would be limited to ruminant rations, primarily as low quality roughage containing roughly 10% protein. The nutritive value of the stems was more variable than that of the leaves and digestibilities of stems ranged from 45 to 65%, depending upon the stage of maturity and time of harvest. Dry matter digestibilities of the stem were lowest in mid-summer and highest in the spring and late summer.

At this time alfalfa forage quality may be improved primarily by three ways.

1. **Field Management.** Harvesting alfalfa prior to the accepted standard, 1/10 bloom, will increase overall forage quality at the expense of dry matter yield. Conserving leaves and minimizing losses from shattering is a must.

2. **Improvement Through Genetics or Plant Breeding.** Losses due to insects and plant diseases can be reduced through the use of disease and insect-resistant varieties. Research at the University of Nebraska and other universities has indicated that digestibility of alfalfa may be improved by selecting for lines that are high in leaf:stem ratios and protein or low in lignin. These desirable features could be incorporated into established or new varieties.

3. **Processing.** Alfalfa can be separated roughly into leaves and stems giving two products: a high protein leaf meal and a poor quality roughage. Research has shown that chemical treatment of alfalfa stems may remove partially the influence of lignification, thereby increasing the amount of hemicellulose and cellulose available to the ruminant.

Should these yearling steers go to grass or can they be placed in the feedlot? Picture taken in May following an average winter daily gain of 0.3 pounds.

Calves Wintered on Range

When to the Feedlot?

By D. C. Clanton[1]

Large numbers of beef calves are wintered in Nebraska on native range. Varying amounts of hay and protein concentrates are fed to supplement the range forage. Winter gains are low (usually .3 to .7 pound per head daily), generally because of the low plane of nutrition.

Rapid and relatively cheap gains while grazing native pasture the following summer have made this system of management possible.

Thus, the common practice has been for calves wintered in this manner to go to grass the following summer rather than to the feedlot.

The objective of the research reported here was to study the residual effect of low weight gains of calves wintered on native range on their performance in the feedlot when placed in the feedlot at different times.

[1] Professor, Animal Science, North Platte Station. Acknowledgment is extended to Guy N. Baker for supervision of the first experiment.

Experimental Procedure

In the first trial, ninety head of weanling steer calves divided into three groups of 30 head each were group fed every other day one of three supplements for 150 days (Dec. 11, 1963, to May 12, 1964) while grazing native winter range at the North Platte Station. The average daily gains of the three groups during that time were .55, .57 and .64.

A discussion of the winter phase of the study can be found in the 1966 Beef Cattle Progress Report.

On May 12, 1964, 10 steers from each winter treatment were selected at random and placed in the feedlot for finishing. The steers from each winter treatment group were fed separately to collect feed conversion data. The remainder of the steers (60 head) were placed on summer pasture with no supplemental feed.

On July 14, 1964, a second group of 10 steers from each winter treatment were selected at random and placed in the feedlot using the same procedures as used in May. The last steers were placed in the feedlot Sept. 29, 1964, again using the same procedures.

The finished steers were slaughtered on Dec. 8, 1964; Feb. 16 and March 12, 1965 in the same order in which they were started on feed. The steers were slaughtered when it was estimated a large percentage of them would make the choice grade.

Weight gains and feed consumption during the finishing period and carcass grades were recorded.

The same procedures were followed the second year of the study except 120 calves, divided into four groups of 40 head each, were group fed different supplements during the winter. The average daily gains of the groups ranged from .27 to .34 pounds per head per day between Dec. 14, 1965 and May 4, 1966.

In the first trial (Table 1) a complete mixed ration of corn, supplement and corn cobs was used, whereas in the second trial (Table 2) corn silage was used as the roughage instead of corn cobs.

Table 1. Performance of yearling steers as influenced by going to feedlot at different times following wintering on native grass (1964-65).

	Date Going In Feedlot		
	May 12	July 14	Sept. 29
Steers/treatment	30	30	30
Days in feedlot	210	217	164
Avg. weights, lb.[a]			
Initial (May 12, 1963)	598	600	601
Daily gain on pasture	..	1.80	1.36
Going in feedlot	598	713	791
Daily gain in feedlot	2.68	2.07	2.45
Final	1164	1162	1192
Avg. feed consumed per lb. gain, lb.	8.73	11.06	9.65
Carcass grade[b]	16.0	15.6	15.5

[a] The average daily gain for all calves from Dec. 11, 1963 to May 12, 1964 was 0.59 pounds.
[b] Carcass grade of 15 = high good and 16 = low choice.

Table 2. Performance of yearling steers as influenced by going to feedlot at different times following wintering on native grass (1966-67).

	Date Going In Feedlot		
	May 4	July 20	Sept. 15
Steers/treatment	40	40	40
Days in feedlot	168	133	112
Avg. weights, lb.[a]			
Initial (May 4, 1966)	495	507	498
Daily gain on pasture	..	1.73	1.64
Going in feedlot	495	640	718
Daily gain in feedlot[b]	3.69	4.06	3.94
Final	1115	1180	1159
Avg. feed consumed, lbs.			
Daily			
Concentrate	20.1	20.5	20.3
Silage	10.9	11.8	14.5
Per lb. of gain[b]			
Concentrate	5.45	5.04	5.16
Silage	2.96	2.90	3.68
Carcass date			
Yield[c]	63.2	60.4	59.2
Grade[d]	16.2	16.3	17.1
Rib eye area, sq. in.	11.7	11.9	11.7
Fat thickness, in.	0.80	0.61	0.62

[a] The average daily gain for all calves from Dec. 14, 1965, to May 4, 1966, was 0.30 pounds.
[b] Initial weights were following an overnight shrink while final weights were full weights. This contributes some to the high daily gains and feed efficiency.
[c] Hot carcass weight divided by final feedlot weight x 100.
[d] Carcass grade of 16 = low choice and 17 = average choice.

Because winter gains were so similar within each year, residual effects are not considered in this report.

Results and Discussion

Steers that went directly to the feedlot from the winter pasture performed the best in the feedlot the first year (Table 1) and the poorest the second year (Table 2).

Yearly variation in climate and range forage may be the major reason for the difference in performance. The fact that the calves the first winter gained .59 pound per day and the calves the second winter gained only .30 pound per day may also be involved in the difference in feedlot performance. At any rate a definite interaction between year and time of going in the feedlot was shown.

In the first experiment steers that were on summer pasture for 63 days before going in the feedlot did not perform as well in the feedlot as the steers going to the feedlot in May or September. These steers went off feed in October and it was not possible to get them back to a full feed of grain.

The cause of this was not determined, however, it was not likely the result of experimental treatments. A mild outbreak of infection or disease was suspected.

More Outside Fat

The year variation in carcass grades was similiar to the year variation in the feedlot performance. The more complete carcass information collected the second year shows that the younger cattle, those going directly to the feedlot, contained approximately .2 inch more outside fat than the steers going to summer pasture before going to the feedlot, yet graded less (Table 2).

This would indicate the carcasses of the younger cattle had less marbling. This may be a disadvantage in starting the lighter cattle on feed without first going to summer grass for at least a couple of months. In marketing younger slaughter cattle it would appear desirable to sell them on a carcass basis because they yielded more than the other groups (Table 2).

This type of study should be conducted over several years to eliminate the affect of variation in seasons. It appears that the time of going to the feedlot following wintering on range should be governed more by the availability and cost of summer pasture and the anticipated market conditions for different weights of cattle rather than differences in feedlot efficiency.

Urea: Corn Silage Supplement

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

Urea is an effective source of protein in cattle fattening rations when carefully mixed into rations adequate in energy, minerals and vitamins.

The level of energy in the ration is important in urea utilization. The level of readily available energy in corn silage as the sole source of feed does not appear adequate for maximum calf performance when it is supplemented with urea as the only source of supplemental protein equivalent.

The use of urea to supply all the supplemental protein for a corn silage ration fed to calves did not support the performance obtained from soybean meal or combinations of soybean meal and urea.

The optimum level of urea for a high corn silage ration was indicated to be not more than ⅓ of the supplemental protein needed in the ration as measured by rate of gain and feed required per unit gain.

Sprinkled and Mixed

The value of urea as part, or all, of the supplemental protein to a corn silage ration was studied in three trials with calves. Soybean meal was compared to urea. The supplements were sprinkled over the silage and mixed into it. These rations were full fed once daily.

In one additional trial the objective was to determine the influence of different levels of corn upon performance of calves fed corn silage and supplemented with either urea or soybean meal.

The composition of the supplements is shown in Table 1.

(continued on next page)

[1] Professor, Beef Nutrition, Department of Animal Science, University of Nebraska.
[2] Area Agricultural Extension Specialist (Animal Science), Northeast Station.

Urea Supplement

(continued from page 11)

In the first three trials the objective was to compare four supplements shown in Table 1 as supplements to a full feed of corn silage for calves.

In the fourth trial the soybean meal supplement and urea base supplement were compared when either 0, 3 or 6 pounds of corn were fed with them.

Not Primary Source

Results of the first three trials are given in Table 2. There was a trend for rate of gain to decline and feed required per unit gain to increase as level of urea in the supplement increased.

It appears that urea should not be used as the primary source of nitrogen for supplementing corn silage when no additional grain is fed for obtaining maximum rate and efficiency of gain. Based on these results up to ⅓ of the supplemental protein could be used or more if the cost of the supplement was sufficiently reduced as compared to the oil meal supplement.

Table 3 gives the results on a percentage comparison of the different levels of urea to the soybean meal levels. In this test it would appear that the cost of the ⅓ urea supplement in relation to the soybean meal supplement would have to be about 27% less to give an equal feed cost per pound of gain.

Only Slight Drops

This would vary because of cost of supplement and silage but since both supplement and silage required per 100 pounds of gain was increased it would decrease the cost of the supplement more than just the increased amount of supplement required. Going to higher levels of urea only brought slight reductions in cost of supplement.

It would appear that in many situations, because of economics in formulation of urea supplements, using the higher levels may come closer to meeting the cost reductions indicated rather than the supplements with the lower levels.

It is a common practice to add some corn to a silage ration and because additional energy might increase the utilization of urea, the effect of added corn was studied.

Results of this trial are shown in Table 4. The ration supplemented with urea did not support performance to the extent that supplementing with soybean meal did.

The addition of corn increased daily gain and decreased silage consumption but did not completely overcome the lower rate of gain by steers fed all urea based supplement. It would appear from this study that additional grain improves the performance on urea supplements but that a sufficient level was not added to completely meet the energy needed for the animal for best urea utilization.

Table 3. Percentage change from soybean meal supplemented ration.

	Amount of supplemental protein from		
Soybean meal Urea	66% 34%	34% 66%	0 100%
Daily gain	−5.8	−11.1	−12.1
Silage required/100 lb. gain	+8.0	+8.3	+10.2
Supplement required/100 lb. gain	+5.6	+11.1	+13.9
Supplement cost reduction necessary to maintain equal feed cost[a]	27	32	38

[a] This is a relative value to show the percent reduction in cost of the urea based supplements as compared to the soybean meal supplement to give the same feed costs per pound of gain. This was based on $10 corn silage and $100 ton for soybean meal supplement. No attempt was made in this comparison to evaluate fixed costs effect. Because of the cost relationship in formulating the higher urea supplements it may be that the higher levels of urea are more likely to be competitive rather than the lower levels.

Table 4. Corn additions to silage rations.[a]

	Supplemental protein from					
	Urea			Soybean Meal		
	0	3 lb. corn	6 lb. corn	0	3 lb. corn	6 lb. corn
No. head	22	22	22	22	22	22
Initial weight, lb.	469	481	476	470	469	469
Daily gain, lb.	1.66	1.83	1.96	1.95	1.94	2.12
Daily feed consumption, lb.						
Corn silage	32.6	27.5	21.6	34.8	27.3	21.0
Corn	.....	3.0	6.0	.....	3.0	6.0
Supplement	1.25	1.25	1.25	1.25	1.25	1.25
Feed/100 lb. gain, lb.						
Corn silage	1970	1500	1103	1792	1404	990
Concentrate	75	230	366	64	216	338

[a] Length of trial 105 days.

Table 1. Composition of supplements.

	Amount of supplemental protein from			
Soybean meal Urea	100% 0	66% 34%	34% 66%	0 100%
	%	%	%	%
Soybean meal	94.60	62.80	28.20	
Ground corn	.....	26.50	55.50	78.05
Urea (262)	.....	4.75	9.50	14.40
Dicalcium phosphate	4.00	4.55	4.95	5.00
Monosodium phosphate	.....	.....	0.45	1.15
Trace mineral premix	0.25	0.25	0.25	0.25
Vitamin A (30,000 IU/gm)	0.15	0.15	0.15	0.15
Salt	1.00	1.00	1.00	1.00

Table 2. Performance of calves fed corn silage supplemented with urea.

	Amount of supplemental protein from			
Soybean meal Urea	100% 0	66% 34%	34% 66%	0 100%
No. cattle	140	137	145	143
Initial weight, lb.	463	464	454	457
Daily gain, lb.	1.73	1.63	1.54	1.52
Daily feed consumption, lb.				
Corn silage	35.3	35.9	34.4	34.7
Supplement	1.25	1.25	1.25	1.25
Feed required/100 lb. gain, lb.				
Corn silage	2070	2236	2242	2281
Supplement	72	76	80	82

Feeding Oyster Shell to Beef Cattle

By Walter Woods[1] and Harry LaTousch[2]

Research work with oyster shell as a roughage substitute in high grain finishing rations has indicated that:

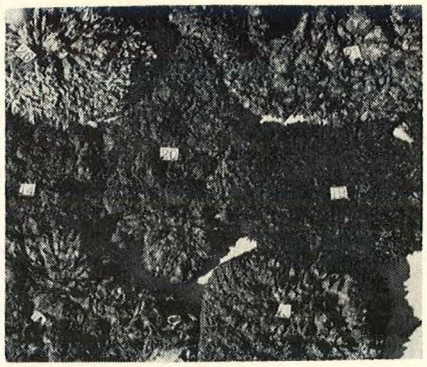
1. Gains tend to be less for oyster shell fed cattle than cattle fed rations containing 15% roughage.
2. Gains are similar when the level of concentrate intake is the same for cattle fed oyster shell rations and cattle fed conventional roughage rations or all concentrate rations.
3. Including oyster shell in the ration tends to increase rate of gain compared to an all concentrate ration when feed consumption is not controlled at same level of intake.
4. Feeding oyster shell at the 2½% level does not prevent matting of rumen papillae.
5. Efficiency of feed conversion is increased by substituting shell for roughage in the ration.

Two experiments were conducted in addition to those reported in the 1967 Beef Cattle Progress Report. In the first trial feed consumption was self fed after the cattle reached full feed. The treatments compared were

1. 15% roughage ration.
2. 2½% oyster shell ration supplemented with either added potassium or Vitamin E.
3. An all-concentrate ration.

In addition, a larger size oyster shell was compared to hen size in one set of comparisons.

Results of this study are given in Table 1. Average daily gains for steers fed oyster shell containing rations were lower than steers fed rations containing 15% roughage. It would appear that this decrease was because of lower concentrate consumption in that steers fed oyster shell rations consumed on the average about .5 lb. less concentrate per day than those fed the 15% roughage ration.



Examples of rumens taken from cattle fed various types of rations. Note clumping of papillae that occurred.

The addition of potassium or Vitamin E to the oyster shell ration did not increase animal performance. Although gains were lower, it is not understood why the addition of a combination of potassium and Vitamin E would reduce gains.

Feeding of oyster shell reduced the amount of feed required per 100 pounds of gain. This reduction appeared to result primarily from the substitution of oyster shell for roughage. Feeding a larger size oyster shell did not change the pattern of performance.

Gains Are Slower

Cattle fed the all-concentrate ration did not gain as rapidly as the average for the cattle fed oyster shell and appeared to require slightly more feed per 100 pounds of gain.

(continued on next page)

Table 1. Performance of cattle fed oyster shell rations.[a]

	15% Roughage	2½% Oyster shell				All concentrate
		0	+ Potassium[b]	+ Potassium[b] + Vitamin E	Large Shell[c]	
No. steers	13[d]	14	14	14	14	14
Initial weight, lb.	736	718	723	690	734	734
Adjusted daily gain,[e] lb.	3.38	3.27	3.23	2.84	3.06	2.87
Daily feed intake, lb.	25.6	21.9	23.0	20.2	21.7	20.9
Feed required/ 100 lb. gain, lb.	724	636	672	668	669	682
Dressing %[f]	57.3	57.5	56.6	56.3	56.7	56.5
Carcass grade[g]	16.5	16.9	16.0	15.6	16.7	16.0
Condemned livers[h]	0	1	3	7	4	4

[a] The length of the trial was 118 days.
[b] Potassium added to raise level in ration by .15% and Vitamin E added to supply 10 IU per steer per day.
[c] Oyster shell used was a size slightly larger than the hen size used in the other treatments.
[d] Animal removed from experiment because of refusal to eat the ration.
[e] Daily gain adjusted to equal yield basis.
[f] Based on weight at end of experiment and hot carcass weights shrunk 2½%.
[g] Federal carcass grade score, 16 = high good, 17 = low choice.
[h] Condemned livers for abscessed conditions.

Table 2. Performance of cattle fed oyster shell ration when concentrate intake controlled.[a]

	15% roughage	2½% Oyster shell		15% Roughage[c] then 2½% Shell	All concentrate
		0	+ Potassium[b]		
No. steers	16	16	16	15[d]	15[e]
Initial wt., lb.	654	659	658	664	659
Adjusted daily gain, lb.[f]	2.99	2.86	2.77	2.89	2.83
Daily feed consumption, lb.	21.3	18.6	18.6	19.4	18.2
Feed required/100 lb. gain, lb.	711	651	673	672	645
Dressing %[g]	59.6	59.9	59.2	59.8	59.5
Carcass grade[h]	16.9	17.0	17.0	16.9	16.8
Condemned livers	0	2	3	2	3

[a] Length of trial was 157 days.
[b] Potassium added to raise level in ration by 0.15%.
[c] The 15% roughage ration was fed for first 56 days, then cattle were switched to 2½% oyster shell ration.
[d] One steer died after shifting to shell because of bloat. Bloat occurred for all treatments and cattle had to be let down to avoid loss.
[e] One steer removed from trial because of poor performance and refusal to consume ration.
[f] Gains adjusted to equal yield basis.
[g] Based on weight off experiment and hot carcass weight shrunk 2½%.
[h] Federal grade score, high good = 16, low choice = 17.

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[2] Graduate Assistant, Department of Animal Science, University of Nebraska.

Feeding Oyster Shell

(continued from page 13)

Liver condemnation was higher for the higher concentrated rations compared to the 15% roughage ration.

The results of Trial 2 are shown in Table 2 where cattle were restricted to an equal concentrate intake for all treatments. Gains were not significantly different. However, oyster shell and all-concentrate ration gains tended to be slightly lower. Feed required per 100 pounds of gain favored the more concentrated rations. Liver condemnations increased as level of concentration in the ration increased.

Roughage Reduced

In the two trials reported, feeding of 2½% oyster shell in place of 15% roughage in a fattening ration reduced the amount of roughage required per 100 lb. of gain, i.e., 16 pounds of shell substituted for approximately 106 pounds of roughage.

The benefit for including oyster shell in the ration as a substitute for roughage would be in the reduction in the cost of supplying the roughage in the ration as compared to the cost of the amount of oyster shell required. One additional factor that must be mentioned is that the slightly decreased rate of gain would increase the fixed cost per pound of gain slightly.

Research Needed

Preliminary observation was that the addition of oyster shell when compared to all concentrate rations might increase rate of gain on a free choice feeding basis but when concentrate intake was controlled gains were not significantly different than the all-concentrate rations.

More research is needed to clarify the effect of oyster shell on the management of cattle fed high concentrate rations. It would appear that further research is required to be able to find the factors necessary to get an optimum rate of gain on oyster shell containing rations.

Table 1. Daily rations fed in Experiment 1.

Treatment	1	2	3	4	5
Grain mixture[a]	←		full-feed		→
Beet top silage	.....	½ roughage	.....	all roughage	.....
Corn silage	all roughage	½ roughage	.....	.....	.....
Alfalfa hay, lb.	.....	.....	.....	2.0	.....
Dehydrated alfalfa, lb.	2.0	2.0	2.0	2.0	2.0
Soybean meal, lb.	0.50	0.25	0.50		.....

[a] The grain mix was 50% corn and 50% beet pulp pellets for 30 days, 55% corn and 45% beet pulp pellets for 35 days, and 60% corn and 40% beet pulp pellets for the remainder of the test. Salt was fed free choice.

In Finishing Rations

Beet Top Silage

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

Feeding a mixture of beet top and corn silage resulted in more rapid gains than beet top silage (wilted or unwilted) as the only source of roughage in finishing rations at the Scotts Bluff Station.

Alfalfa hay fed as a supplemental roughage did not contribute to more rapid and efficient gains but did reduce the laxative effect of beet top silage.

Neither did feeding supplemental protein improve rate and efficiency of gain when added to finishing rations containing beet top silage as the only roughage.

While weight gains of steers fed corn silage have been superior to those fed beet top silage, beet tops can be used satisfactorily as the sole source of roughage in a finishing ration.

Experiments Conducted

Three experiments have been conducted (1963-64, 1964-65, 1965-66) to study the effect of using other roughages such as alfalfa hay and corn silage, and to study the effect of using supplemental protein with beet top silage in finishing rations for yearling steers.

Although chemical analysis indicates that beet top silage contains enough protein to meet the requirements of cattle being finished for market, it was possible that the protein was being poorly utilized.

Each of the experiments utilized 80 head of yearling steers randomly assigned to ten different pens. Five different rations were fed in each experiment. Thus, each ration was replicated in two lots.

The rations in each experiment are shown in Tables 1 and 2. All steers were implanted with 24 milligrams of stilbestrol at the onset of the experiment.

In Experiment 1, beet top silage was made by harvesting and chopping unwilted beet tops. The tops were stored in piles and covered with black plastic.

In Experiment 2 and 3, both un-

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[2] Superintendent, Scotts Bluff Station.

Table 2. Daily rations fed in Experiments 2 and 3.

Treatment	1	2	3	4	5
Grain mixture[a]	←		full-feed		→
Unwilted beet top silage	.....	½ roughage	.....	all roughage	.....
Wilted beet top silage	.....	.....	½ roughage	.....	all roughage
Corn silage	all roughage	½ roughage	½ roughage	.....	.....
Dehydrated alfalfa, lb.	2.0	2.0	2.0	2.0	2.0
Soybean meal, lb.	0.5	0.25	0.25	.....	.....

[a] Grain mixture was 60% corn and 40% dried beet pulp for 28 days; then 75% corn and 25% dried beet pulp. A salt-bonemeal mixture was fed free choice.

Table 3. Feed value of beet top silage, supplemented with alfalfa hay or corn silage and soybean meal (Experiment 1).

	Corn silage Soybean meal	Beet top silage Corn silage Soybean meal	Beet top silage Soybean meal	Beet top silage Alfalfa hay	Beet top silage
Number of steers	16	16	16	16	16
Avg. weights, lb.					
Initial	744	738	753	746	758
Final	1176	1156	1127	1119	1130
Daily gain	3.44	3.32	2.96	2.96	2.95
Avg. daily feed consumption, lb.					
Grain mix	15.8	15.8	15.8	15.8	15.6
Beet top silage	.....	17.1	37.8	32.2	37.9
Corn silage	22.0	16.8	.....	.....	.....
Soybean meal	0.50	0.25	0.50	.....	.....
Alfalfa hay	.....	.....	.....	2.0	.....
Dehydrated alfalfa	2.0	2.0	2.0	2.0	2.0
Carcass grade[a]	15.8	15.9	15.0	14.5	15.3

[a] 14, 15 and 16 = average good, high good and low choice, respectively.

wilted and wilted beet tops were harvested and fed.

Laxative Effect Cut

When about equal parts of corn silage and beet top silage were fed, gain and feed conversion were nearly comparable to those cattle fed corn silage as the only roughage (Table 3).

Even though there was no increase in gain or feed efficiency when alfalfa hay was fed as the supplemental roughage, it did reduce the laxative effect of beet top silage. This was also reduced when corn silage was fed with beet tops.

Supplementing beet top silage with ½ pound of soybean meal per head per day did not improve the performance of the steers.

In Experiments 2 and 3 it was again shown that beet top silage, either wilted or unwilted, fed as the sole source of roughage, was not as satisfactory as corn silage in a finishing ration (Table 4).

However, when about equal parts of corn silage and either wilted or unwilted beet top silage was used as the roughage, gains were comparable to those of steers receiving corn silage as the basal roughage ration. The relative grades of the carcasses from the different treatments took the same relationship as the weight gains.

High Ash Content

The unwilted beet top silage used in these studies ranged from 77 to 80% moisture, whereas the wilted silage ranged from 55 to 60% moisture. Beet top silage is high in ash (mineral) content, which no doubt contributes to its laxative effect.

A reasonable conclusion as to why beet top silage fed alone is not as satisfactory as when fed in combinations with corn silage may be that the high ash or mineral content limits the consumption of the tops by the steers. Although not accurately measured there is some evidence of this shown in Table 4. The total dry matter intake from forage was not as great when the beet top silage was fed alone as when it was fed in combination with the corn silage.

Although weight gains of steers fed the beet top silage were not as great as those from steers fed corn silage, the gains were respectable.

Trench, Upright Silos

Thus it is recommended that beet farmers handle their beet tops carefully because they do have great economic value for a roughage in cattle finishing rations.

Unwilted beet top silage produces good results but there are advantages in wilting tops before ensiling them. Moisture loss from tops in the windrow makes it easier to handle the forage. Wilted beet tops can be stored in trench or upright silos.

Production of wilted beet top silage is attractive to the average beet grower because he can harvest both roots and tops with the same labor crew. At proper intervals he can stop the harvest of roots to chop and ensile his windrowed tops.

How To Make Silage

Top the beets and make neat windrows containing tops from four to six rows of beets. Be careful not to drive trucks or beet root

(continued on next page)

Table 4. Feed value of wilted and unwilted beet top silage fed with and without corn silage (Experiment 2 and 3).

	Corn silage	Corn silage Unwilted beet top silage	Corn silage Wilted beet top silage	Unwilted beet top silage	Wilted beet top silage
		Experiment 2			
Avg. weights, lb.					
Initial	800	804	801	792	797
Final	1203	1219	1196	1152	1156
Daily gain	3.10	3.19	3.03	2.76	2.76
Avg. daily feed consumption, lb.					
Grain mix	15.6	15.4	15.3	15.3	15.4
Corn silage	26.4	17.4	15.3	.....	.....
Wilted beet tops	.....	.....	15.0	.....	23.6
Unwilted beet tops	.....	18.8	.....	31.4	.....
Dehydrated alfalfa	2.0	2.0	2.0	2.0	2.0
Carcass grade[a]	16.6	16.6	16.4	15.8	16.8
		Experiment 3			
Avg. weights, lb.					
Initial	720	733	750	716	735
Final	1129	1126	1124	1091	1099
Daily gain	2.92	2.81	2.67	2.68	2.61
Avg. daily feed consumption, lb.					
Grain mix	15.6	15.8	15.4	15.4	15.8
Corn silage	22.6	16.4	14.3	.....	.....
Wilted beet tops	.....	.....	14.2	.....	26.0
Unwilted beet tops	.....	18.4	.....	32.1	.....
Dehydrated alfalfa	2.0	2.0	2.0	2.0	2.0
Carcass grade[a]	16.4	16.8	16.8	16.8	16.4

[a] 15 and 16 = high good and low choice, respectively.

Beet Top Silage

(continued from page 15)

harvest machines over the windrowed tops.

Allow tops to wilt in the windrow until they contain 60 to 65% moisture. Fresh green tops contain from 75 to 80%. The rate of moisture loss from tops in the windrow depends on the weather and the type of top growth at harvest.

Small, mature, light green tops will wilt much faster than large, dark green tops. In most instances, beet tops in the windrow are ready to harvest for wilted silage 4 to 8 days after you top the beets.

Keep Out Air

Chop tops from the windrow and ensile them in trenches, bunker or upright silos or in stacks. Cover the exposed forage with black plastic to keep out air. Good beet top silage can be made without preservatives. The sugar in the crown provides carbohydrates for rapid fermentation.

If tops become too dry (below 50% moisture) in the windrow, chop them and add water as they are ensiled. Packing will also aid in producing good silage from dry tops.

Another common practice is to put corn silage in a trench silo and then harvest beet tops and place them on top of the corn silage in the same trench. Thus while feeding the silage each day a mixed ration of corn silage and beet top silage is automatically fed. This type of mixture should approach the mixture used in Experiments 2 and 3.

Controlling Ovulation in the Beef Heifer

By D. R. Zimmerman,[1] L. Slyter,[2] R. Parker[3] and J. N. Wiltbank[4]

Estrus synchronization or heat grouping has received the major emphasis in essentially all reproductive cycle control procedures developed for cattle.

These procedures usually employ a treatment that inhibits heat and ovulation (usually the administration of a progestogen in the feed, a substance possessing many of the characteristics of progesterone, the natural occurring pregnancy hormone that inhibits heat and ovulation during gestation) for a period approximately equal to the length of one estrus cycle (18-20 days).

Cycling females initiate a new reproductive cycle a few days after the treatment is terminated. Most of the females treated in this manner (80-100%) show heat, ovulate, and can be inseminated during a 3-5 day period. This treatment is successful in grouping heat periods of cycling females but often produces a subnormal conception rate at first post-treatment heat.

Timing Important

Improper timing of the insemination may be one possible cause of the lowered conception rate. Insemination in most synchronization trials has been timed approximately 12 hours after the onset of heat. This timing produces the best conception rate in untreated cattle but it is not known whether or not this timing is optimal for synchronized cattle; ovulation may not occur at the normal time, 12-14 hours after the end of heat. Proper timing of insemination is critical to fertility because of the short fertile lifespan of the ovum or egg.

The regulation of ovulation to a narrow, predictable time following termination of the synchronization treatment would make it possible to inseminate all animals at a specific pre-selected time. Fertility might be enhanced because it would be possible to inseminate all females at the best time.

The practical advantages of such a procedure would be many. Large numbers of females could be inseminated at one time. This would greatly facilitate the use of artificial insemination in beef cattle as the need for heat checks would be eliminated. Insemination could be scheduled on one day and could be done with less labor and cost. Management would be simplified because the females could be handled as a group for insemination.

Potential Valuable

The potential value of such a procedure for beef cattle and the promising results of this approach obtained with sheep and swine led to experiments summarized here.

Synchronized reproductive cycles from 77 beef females (predominantly one- and two-year-old heifers) were studied in the summer of 1965 at the Fort Robinson Beef Cattle Research Station, Crawford, Nebraska. In addition, 30 heifers were used in a fertility study.

All females received a synchronization treatment consisting of nine (9) daily feedings of a progestogen[5,6] and an intramuscular injection of 5 mg. of estradiol valerate[6] given on the second day of progestogen treatment.

The progestogen was premixed in corn oil and added to the concentrate portion of the ration at the rate of 15 mg. per pound. All females were fed 5 lb. of concentrate once daily except in the latter part of the study when the feed intake was increased to 6 lb. in order to increase the level of progestogen consumed. This was necessary because some ovulations were observed during treatment in the early part of the study.

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[5] Acetophenone derivative of 16, 17 dihydroxyprogesterone, E. R. Squibb & Sons, New Brunswick, New Jersey.

[6] The progestogen, estradiol valerate and estradiol benzoate were kindly furnished by Dr. Don Rankin, E. R. Squibb & Sons.

The ovulation control treatment consisted of a single intramuscular injection of estradiol benzoate (EB, 2 or 5 mg.) at 24, 36, or 48 hours or human chorionic gonadotrophin (HCG, 1500 I.U.) at 48 hours following the last progestogen feeding (Table 1).

End Points Measured

The end points measured in this study were: the length of estrus and time of estrus and ovulation following treatment. All animals were checked twice daily for estrus during progestogen treatment and every four hours following the last progestogen feeding with sterilized bulls. The animals observed in estrus post-treatment were also checked every four hours to determine the end of estrus. Bulls used during the post-treatment heat checks were aproned to prevent copulation. An animal was called in estrus if she would stand to be mounted.

Routine rectal palpations were made the day the animals went on treatment, once during progestogen treatment and every four hours from the start of estrus until ovulation. The size of the ovaries and the size and position of all significant ovarian structures (follicles and corpora lutea $\geq$ 8 mm.) were recorded at each palpation. Laparotomies were performed on all animals that ovulated or that were thought to have ovulated to establish the time of ovulation. These were performed at four-hour intervals following the palpation periods.

Post-treatment observation of heifers in the breeding trial consisted of determining the occurrence of estrus and pregnancy diagnoses. Of the 30 heifers on this trial, 20 were yearlings and 10 were two-year-olds. Twenty-eight of these heifers had been on a progesterone treatment previous to assignment to the breeding trial. All heifers on this trial were artificially inseminated 60 and 72 hours following the last progestogen feeding or 24 and 36 hours following EB injection.

Ovulation Study

The effectiveness of human chorionic gonadotrophin (HCG) and estradiol benzoate (EB) as ovulation control treatments was compared in Trial 1. Although the averages of the various intervals studied were similar, a greater percentage of the heifers treated with EB responded by showing heat and ovulating, and the variation in their response was less than for the HCG treated heifers.

All heifers injected with EB ovulated within a 4 hour period as compared to 75% ovulation response in a 11 hour period for the heifers on the HCG treatment. The interval from last feeding to ovulation averaged 88.5 and 81.0 hours for the EB and HCG treatments, respectively. The interval was less variable for the EB treatment (S.D. 1.6 vs. 7.0 hours).

Because of the encouraging results with estradiol benzoate in Trial 1, Trial 2 was designed to study the influence of dose and time of injection of EB on the control of ovulation.

The estradiol benzoate treatment used in Trial 2 resulted in 67.8% of the synchronized animals ovulating in the 72 hour observation period following the estradiol benzoate injection. The highest ovulation response was obtained in the group given 2 mg. of estradiol benzoate 36 hours after the last progestogen feeding. In this group, 81.2% of the synchronized heifers ovulated in the 72 hour period. Two mg. EB given 48 or 24 hours post-progestogen treatment resulted in 64.5 and 66.7% ovulation response, respectively. Five mg. EB given 48 hours post-progestogen resulted in a 50% ovulation response.

The mean interval from last feeding to ovulation was approximately 7 hours longer for those animals injected 48 hours post-progestogen feeding than for those injected 24 or 36 hours following progestogen feeding. The pooled value for this interval was (86.5 $\pm$ 7.8 hours).

This indicates that ⅔ of the animals that ovulated did so in a 15.6 hour period or that approximately 96% of them ovulated in a 31.2 hour period. If ova shed from these ovulations are physiologically normal, ovulation synchronization of this degree may improve poor conception rates obtained in many previous synchronization trials.

Synchronization of ovulation in this range (96% in less than 32 hours) offers the possibility of insemination at a fixed time following synchronization treatment rather than following estrus.

Breeding Trial

Nineteen of the 30 heifers in the breeding trial exhibited estrus the second morning (approximately 48 hours) following last progestogen feeding. Two more heifers were in estrus approximately 72 and 84 hours post-feeding; a total of 21 were in estrus in a 36 hour period.

Eleven of the 30 heifers bred were pregnant when palpated 35 days post-insemination. This represents 37% pregnancy of the total animals treated or 52% pregnancy of those heifers that were in estrus following progestogen feeding. All heifers diagnosed pregnant had been in estrus following progestogen feeding.

The proper level of progestogen and estrogen for effective ovulation synchronization and the optimum insemination interval for these levels of hormones needs further investigation under normal ranch conditions.

Table 1. Distribution of heifers by trial and ovulation control treatment.[a]

Trial	HCG 48 hr.	EB-2 24 hr.	EB-2 36 hr.	EB-2 48 hr.	EB-5 48 hr.
1	5	...	...	5	...
2	...	8	21	44	10
3	...	...	30[b]	...	...

[a] Treatments indicated were administered 24, 36, and 48 hours following last progestogen feeding. HCG, Human Chorionic Gonadotrophin; EB-2, estradiol benzoate, 2 mg.; EB-5, estradiol benzoate, 5 mg.; Control, not injected.

[b] Fertility trial. Heifers were artificially inseminated 60 and 72 hours following the last progestogen feeding.

Crambe Meal, Protein Supplement

By D. C. Clanton[1] and
J. L. Lambert[2]

Crambe abyssinica, a relatively new plant introduction belonging to the mustard family, is emerging as a potential oilseed crop.

Crambe seed contains an oil high in erucic acid, a product useful for manufacturing nylon, plastics, rubber, and other products.

Crambe meal, seed residue remaining after oil extractions, contains up to 35 percent protein. Crambe seed is characterized by the presence of thioglucosides and other antigrowth factors that reduce feed value and palatability. A heat and sodium carbonate cooking process has been developed by the USDA Northern Regional Research Laboratory at Peoria, Illinois that significantly improves nutritive value of the meal and its acceptability to animals.

Crambe seed can be processed so that the meal contains the hulls which encase the seed or the hulls can be removed in the processing. In addition to the protein content the meal is a good source of calcium and phosphorus. A typical analyses of a processed meal is:

	Protein	Calcium	Phosphorus
Crambe meal with hulls, %	**27**	**1.3**	**0.9**
Crambe meal partially hulled, %	**35**	**1.1**	**1.2**

During the past four years studies have been conducted to determine the merit of using the meal as a protein supplement in beef cattle rations.

As a result of the trials it has been established that at least half of the supplemental protein in beef cattle finishing rations can be from properly processed crambe meal.

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Experiments

The first experiment, conducted in 1964 at the Lincoln Station, showed that heat treated crambe meal was not a desirable source of protein for beef cattle because it was not palatable. However, it was good quality protein as efficiency of performance was acceptable (Table 1).

In this experiment the basal ration was 20% corn cobs, 62% ground corn, 7.5% dried molasses and the balance was supplement with appropriate minerals, vitamins and additives included.

Four levels (0, ⅓, ⅔ and all of the supplemented protein) were fed with soybean meal making up the balance. Each was replicated without and with the crambe hulls that would accompany the amount of crambe meal fed had they not been separated in processing.

When hulls were added to the ration, that same amount of corn cobs was removed so roughage level was constant. The rations contained about 11% protein, 0.34% phosphorus and 0.72% calcium.

The second experiment, conducted in 1965, was the same basic design as the first except it was a growth study instead of a finishing study (Table 2). The same raw crambe meal used in the first trial was used except it was ammoniated to see if palatability could be improved. The acceptability of the crambe meal was increased but not to a desirable level.

A 3rd experiment, conducted in 1965, showed that crambe hulls were not satisfactory as a roughage in cattle finishing rations and again crambe meal was not palatable.

Palatability Trials

As a result of the first three experiments it appeared the largest

Table 1. The average performance of steers individually fed rations containing varying levels of crambe meal with and without crambe hulls (196 days, 1964).

	Supplemental protein from crambe meal, %							
	No hulls				Crambe hulls			
	0	33	67	100	0	33	67	100
Steers per treatment	5	5	5	5	5	5	5	5
Avg. wt., lb.								
Initial	551	549	568	531	545	508	536	547
Final	1060	1036	990	901	1042	1000	1000	917
Daily gain	2.60	2.48	2.15	1.89	2.53	2.51	2.36	1.89
Avg. feed consumed, lb.								
Daily	19.8	19.9	18.2	13.2	19.8	16.9	15.8	13.5
Per lb. of gain	7.9	8.1	8.1	6.9	7.6	6.8	6.5	6.7
Avg. slaughter data								
Carcass grade[a]	15.8	16.0	15.4	15.0	15.4	16.2	16.0	14.8
Thyroid weight, gm.	18.0	13.2	16.0	15.8	12.1	16.3	14.2	15.5

[a] Carcass grade of 16 = low choice, 15 and 14 = high and average good.

Table 2. The average performance of steer calves individually fed rations containing varying levels of crambe meal with brome grass hay in a growth trial (113 days, 1965).

	Supplemental protein from crambe meal, %			
	0	33	67	100
Steers per treatment	5	5	5	5
Average wts., lbs.				
Initial	453	453	444	452
Final	549	546	531	510
Daily gain				
No corn fed (56 days)	0.81	0.58	0.61	0.26
Corn fed (57 days)	0.89	1.07	0.93	0.78
113 days	0.85	0.82	0.77	0.51
Average daily feed consumed, lbs.				
1st 56 days				
Hay	8.66	8.66	8.36	8.78
Supplement	1.50	1.39	0.91	0.30
2nd 57 days				
Hay	10.84	10.45	9.54	10.01
Supplement	3.00	3.00	3.00	2.74

objection to the use of crambe meal as a protein supplement was its lack of acceptance by the animals. Thus, a series of palatability trials were conducted using crambe meal processed in different manners. Complete rations containing crambe meal processed in different manners were made available to steers and they were allowed to choose their own ration. Five trials were conducted (Table 3).

From the palatability trials, it appeared that the carbonate and heat treatments were improving the palatability most, thus two group feeding experiments were conducted at the North Platte Station in 1966 and 1967 to evaluate crambe meal treated with heat and carbonate or heat alone when used as one-half or all of the supplemental protein in finishing rations.

Results of the two experiments are shown in Tables 4 and 5. The basal ration used in 1966 was corn silage, ground corn and supplement. All of the crambe meal contained hulls. In 1967 the basal ration was alfalfa haylage, corn cobs, ground corn and supplement. As shown in Table 5 part of the crambe meal had been partially dehulled. The concentrate portion of the ration contained 15% corn cobs, 75% ground corn and 10% supplement.

The two group feeding experiments have shown that at least one-half of the supplemental protein can come from crambe meal if it is treated with heat and carbonate or heat alone and that it makes little difference if hulls have been removed from crambe meal.

If all the supplemental protein comes from crambe meal, a slight reduction in feed consumption can be expected. This will be accompanied by a slight reduction in weight gain, however, the efficiency of gain is reduced very little.

There has been no harmful affects on the health of the animals as a result of feeding crambe. The carcass data indicate it has little influence on carcass quality that would not be a direct result of the animal performance.

Table 3. Average daily consumption of rations containing crambe meal treated different ways, lb. (1965).

Treatment used on crambe meal	Trials				
	A	B	C	D	E
Heat treated, Ammonia treated for 60 min.	1.43	...	...	...	...
Heat treated, Ammonia treated for 20 min.	9.77	...	3.58	...	...
Heat-carbonate treated	9.84	...	1.87	10.3[a]	11.7[a]
Heat treated	3.47	...	...	...	...
Heat-carbonate treated plus 2% salt	...	12.42	2.20	...	...
Heat treated, Ammonia treated for 60 min. and includes hulls	...	2.03	...	...	...
Heat-sodium hydroxide treated	...	8.27	5.06	...	...
Heat treated, Ammonia treated for 60 min., under pressure	...	1.85	...	...	...
Heat treated under pressure	...	...	6.55	...	10.8
Soybean meal[b]	...	...	...	13.4	...

[a] This meal was in a different form than that fed in the A and C trials.
[b] This was not a treatment used on the crambe meal but was the soybean meal used as a feed source of supplemental protein.

Table 4. Average performance and feed consumption of steers group fed rations containing supplemental protein from different sources (124 days, 1966).

	Source of supplemental protein				
	Soybean meal	½ soybean meal and ½ heat-carbonate treated crambe meal	½ soybean meal and ½ heat treated crambe meal	All heat-carbonate treated crambe meal	All heat treated crambe meal
Steers per treatment[a]	16	16	16	16	15
Avg. weights, lb.					
Initial	721	723	724	703	727
Daily gain	3.06	3.08	2.92	2.80	2.70
Avg. feed consumed, lb.					
Daily					
Concentrate	19.1	19.6	18.4	18.4	18.6
Silage	6.0	6.3	6.4	7.0	6.7
Per lb. of gain					
Concentrate	6.24	6.36	6.30	6.57	6.89
Silage	1.96	2.04	2.19	2.35	2.55
Carcass data					
Yield[b]	63.93	63.42	64.07	62.94	63.80
Grade[c]	16.75	16.69	16.69	16.50	16.40
Rib eye area, sq. in.	11.96	11.96	11.37	11.34	11.74
Fat thickness, in.	0.80	0.72	0.82	0.75	0.76

[a] Average of two replications. One steer was removed from the group receiving heat treated crambe because of urinary calculi.
[b] Hot carcass weight divided by final feedlot weight x 100.
[c] Carcass grade of 16 = low choice, 17 = average choice.

Table 5. Average performance and feed consumption of steers group fed rations containing supplemental protein from different sources (112 days, 1967).

	Source of supplemental protein				
		All heat treated crambe meal		All heat-carbonate treated crambe meal	
	Soybean meal	Partially hulled	With hulls	Partially hulled	With hulls
Steers per treatment[a]	16	16	16	16	15
Avg. weights, lb.					
Initial	848	848	851	854	850
Daily gain	2.95	2.74	2.71	2.78	2.71
Avg. feed consumed, lb.					
Daily					
Concentrate	20.8	20.2	19.8	20.2	20.2
Silage	6.7	6.7	6.7	6.7	6.7
Per lb. of gain					
Concentrate	7.05	7.37	7.31	7.27	7.45
Silage	2.27	2.45	2.47	2.41	2.47
Carcass data					
Yield[b]	60.4	59.2	59.2	58.7	58.5
Grade[c]	16.5	16.8	16.8	16.7	16.9
Rib eye area, sq. in.	13.11	12.33	12.53	11.94	12.29
Fat thickness, in.	0.74	0.73	0.72	0.86	0.76

[a] Average of two replications. One steer was removed from the group receiving heat-carbonate treated crambe meal with hulls because of sickness.
[b] Hot carcass weight divided by final feedlot weight x 100.
[c] Carcass grade 15 = high good, 16 = low choice.

Table 1. Performance of heifers fed three hay levels.[a]

	Amount of hay fed/day		
	1½ lb.	3 lb.	4½ lb.
No. head	26	26	26
Initial weight, lb.	589	591	591
Daily gain, lb.	2.42	2.40	2.24
Daily feed consumption			
Corn	17.1	16.4	14.8
Hay[b]	1.5	3.0	4.5
Supplement	0.5	0.5	0.5
Feed per 100 lb. gain, lb.			
Concentrate	730	708	688
Hay	78	234	204
Total	808	843	893

[a] Average length of trial was 126 days.

Table 2. Performance of steers fed all concentrate and roughage containing rations.[a]

	15% roughage			All concentrate		
	11% protein	14% protein	Av.	11% protein	14% protein	Av.
No. head	49	50	99	50	50	100
Initial weight, lb.	692	699	696	693	696	694
Adj. daily gain, lb.[b]	3.10	2.98	3.04	2.95	3.15	3.05
Daily feed consumption, lb.	24.5	24.7	24.6	21.8	22.4	22.1
Feed required/100 lb. gain, lb.	779	832	805	751	724	737
Dressing %[c]	58.3	58.7	58.5	58.9	59.0	58.9
Carcass grade[d]	16.8	17.0	16.9	17.1	17.1	17.1
Condemned livers	7	7	14	28	28	56

[a] Length of trial was 120 days.
[b] Daily gain adjusted to equal dressing percent.
[c] Based on live weight at end of experiment.
[d] 16 = high good, 17 = low choice.

Table 3. Protein and roughage levels in finishing rations.[a]

	3 lb. haylage				6 lb. haylage			
	0	+.75 lb. SBM	+1.5 lb. SBM	Av.	0	+.75 lb. SBM	+1.5 lb. SBM	Av.
No. head	22	22	22	66	22	22	22	66
Initial weight, lb.	690	687	689	689	695	690	687	691
Daily gain, lb.	2.91	2.81	2.86	2.86	2.52	2.58	2.64	2.58
Daily feed consumption, lb.								
Corn	18.6	17.2	16.8	17.5	15.7	15.8	14.6	15.4
Haylage[b]	3.2	3.2	3.2	3.2	6.2	6.2	6.2	6.2
Supplement[c]	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Soybean meal	...	.75	1.5	.75	...	.75	1.5	.75
Feed required/100 lb. gain, lb.								
Concentrate	658	652	650	653	633	661	628	641
Haylage	128	128	128	128	251	245	239	245
Total	785	784	782	784	884	906	868	886

[a] Average length of trial was 125 days.
[b] Haylage contained 32% moisture.
[c] The supplement fed was primarily a corn base carrier for minerals, vitamin A and stilbestrol and antibiotics.

Table 4. Performance of steers fed all concentrate rations.[a]

	15% roughage[b]	All concentrate[b]	15% roughage to equal all concentrate[c]
No. steers	16	15	15
Initial weight, lb.	654	659	656
Adjusted daily gain, lb.	2.99	2.83	2.72
Daily feed consumption, lb.	21.3	18.2	19.4
Feed per 100 lb. gain, lb.	711	645	715
Carcass grade score[d]	16.9	16.8	17.0
Dressing percent[e]	59.6	59.5	59.3

[a] Length of feeding trial was 159 days.
[b] The all concentrate ration was fed at a controlled level of concentrate to equal the concentrate consumed by those fed 15% roughage ration.
[c] This ration was fed to equal the estimated net energy intake of the all concentrate ration.
[d] Score averaged—high good 16, low choice 17.
[e] Based on live weights at end of experiment.

Roughage Level in

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

Live weight gain was not influenced as much in beef cattle fed varying levels of roughage in high grain finishing rations as was the feed required per pound of gain.

Feed required to produce a unit of gain favored the lower roughage and higher concentrate rations. In cases where the roughage level fed was higher there was reduction in grain consumption. The lowest level of roughage in the ration where the cattle maintained feed consumption produced the most efficient gains.

Feeding all concentrate rations did not cause particular managment problems, however, in one test gains tended to be lower than where 15% roughage was fed. Considering both rate of gain, efficiency of feed conversion and ease of managment, it appears that 10-15% roughage in the ration gave the most consistent results.

Adding Protein

Protein supplementation of roughage containing rations was not beneficial at levels above 11%, however, the results tended to favor higher protein levels in an all concentrate ration. This observation on all concentrate rations requires further checking to see if this occurs consistently and what is the desired level of protein.

Table 1 gives the results from feeding three levels of haylage in a high grain ration to heifers. Results indicated gains to be lower going from 1½ pounds to 4.5 pounds of hay per animal per day. In this case, daily corn consumption was decreased. The total feed required per pound of gain favored the lower roughage rations.

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High Grain Rations

In this comparison, 42 pounds of corn was replaced by 126 pounds of hay in producing 100 pounds of gain.

Table 2 gives the results of feeding a 15% roughage ration as compared to an all concentrate ration at two protein levels to steers. The steers on the all concentrate ration were adjusted by lowering the hay level in the ration.

On the average, across protein levels, gains were similar between steers fed the two roughage levels, however, the feed required per 100 pounds of gain favored the all concentrate ration. Yield and grade were similar between treatments but liver condemnation was increased by 4 times for the all concentrate fed group.

Higher protein levels in the ration gave slightly different results, tending to depress performance in the 15% roughage ration and to increase performance in all concentrate rations. It appears from this and the results shown in Table 3 that 11% protein in the ration is sufficient where some roughage is fed. The required level of protein for all concentrate rations requires further investigation.

Haylage Levels

Table 3 gives the results from two levels of haylage and 3 protein levels for finishing rations. Three pounds of haylage in a finishing ration gave consistently increased gains and efficiency of feed conversion as compared to 6 pounds of haylage included in the ration. Adding either .75 or 1½ pounds of soybean meal to increase the protein level in these rations did not give increased animal performance.

Table 4 compares cattle fed the same amount of concentrate as an all concentrate ration and as a 15% roughage ration. One additional treatment compared all concentrate ration and a ration containing 15% roughage when fed on equal estimated net energy basis.

Gains favored the 15% roughage ration but efficiency of feed conversion favored cattle fed the all concentrate ration. The feeding of the 15% roughage ration at an equal estimated net energy of the all concentrate ration resulted in slightly lower gain and increased feed required per unit of gain.

These data indicate that in high concentrate rations from an energy utilization viewpoint alfalfa hay had a lower energy value than standard composition tables usually indicate.

Results of these studies suggest that for optimum efficiency of finishing rations the roughage level needs to be kept as low as the cattle can be kept effectively on feed. Protein levels higher than 11% did not increase animal performance where the ration contained roughage. Further studies are required to determine the protein level optimum for all concentrate rations. Feeding all concentrate rations favored an increased liver condemnation.

High Grain Rations and Calcium

By Larry Varner[1] and Walter Woods[2]

High grain rations may be low or borderline in the amount of calcium required by beef cattle unless calcium is added to the ration. This is particularly true where nonlegume roughages are fed.

The optimum level of calcium in rations containing 15% ground corn cobs as the roughage source appeared to be between 0.28 and 0.37% in the total ration.

The addition of calcium to a high grain ration to raise the calcium level above 0.37% did not result in increased weight gain and efficiency of feed conversion by steers. Carcass characteristics were not found to be influenced by calcium level in the ration.

Other trials have not shown the consistent pattern given here, using other roughage sources. This could probably be accounted for by level of calcium in basal ration ingredients, and calcium content in water.

Two Trials

Results of two individual feeding trials to determine the performance of cattle fed rations calculated to contain either .18, .28, .38 or .48% calcium are shown in Table 1. By chemical analyses the rations contained 0.18, 0.28, 0.37 and 0.45% calcium respectively. The ration contained 85% concentrate and 15% roughage (corn cobs).

Results are averaged for both trials for presentation. Gains were significantly increased by raising the calcium level from .18% to .28%. Gains were slightly though not significantly increased by raising the calcium level from .28% to .37%. In these data .45% calcium lowered gains as compared to the .37% level.

(continued on next page)

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Table 1. Levels of calcium in rations for finishing steers.

	Calculated levels of calcium			
	.18%	.28%	.38%	.48%
Analyzed levels of calcium, %	.18	.28	.37	.45
No. head	12	12	12	12
Initial weight, lb.	740	739	742	757
Average daily gain, lb.	2.41	2.74	2.82	2.63
Av. feed consumption/day, lb.	18.9	20.2	20.4	19.6
Feed required/100 lb. gain, lb.	784	736	722	746
Carcass grade score[a]	16.3	16.3	16.7	16.3
Fat thickness, in.	.67	.62	.66	.61
Rib eye area, sq. in.	11.40	11.60	11.70	11.4

[a] Carcass grade score assigned, 16 = high good, 17 = low choice.

Calcium in Rations

(continued from page 21)

Feed required per unit gain was decreased as calcium level in the ration increased from 0.18 to 0.28 and 0.37%. However, the 0.45% calcium level tended to give a pattern intermediate between the 0.18 and 0.37% levels as far as feed required per 100 pounds of gain.

Other research previously conducted using corn silage or alfalfa hay as the roughage has not given as consistent a pattern. Gains tended to be similar between 0.2 and 0.4% calcium in the ration.

Gains Increased

Results of the individual feeding trials showed gains to be increased by the calcium levels from 0.18 to 0.28% in the finishing ration for cattle. No significant difference was found between 0.28 and 0.37% calcium levels.

Efficiency of feed conversion favored the 0.28% and 0.37% calcium levels. The levels indicated to be optimum are not materially different than commonly recommended and data support the need to formulate finishing rations to contain at least .28% calcium.

Experiments in Progress

Adjusting Cattle to Urea Supplements

An experiment is being conducted at the Field Laboratory to determine if the kind of protein fed during the initial period cattle are in the feedlot aids in the adjustment to high urea supplements.

Urea Supplements of Corn Silage

These experiments are being conducted to determine if the effectiveness of urea as a supplement to a high corn silage ration can be increased.

At the Northeast Station the effectiveness of ensiling corn with added urea is being studied. Also the effect of added levels of grain is being investigated to determine the level of corn required to increase the efficiency of urea utilization.

Combination of urea and protein in a liquid supplement is being investigated at the Field Laboratory as a supplement to corn silage for calves.

Factors Influencing Roughage Utilization

The influence of processing upon the utilization of low quality roughages and other high cellulose products by beef cattle and sheep is being investigated at the Lincoln Station. Both high grain and high roughage rations are being fed to determine if processing of the roughage influences its feeding value.

Roughage Substitutes and All Concentrate Rations

All concentrate rations and rations containing oyster shell and clay grits are being compared to roughage containing rations for beef cattle at the Lincoln Station.

Silage Preservatives

The influence of Aspergillus oryzae and Bacillus subtilis additions to corn silage upon silage preservation and feeding value is being studied at the Scottsbluff Station.

Dry Roughage Additions to Beet Top Silage

The addition of dry roughage to a full feed of beet top silage for calves is being studied at the Scottsbluff Station.

Completed Mixed vs. Feeding of Separate Ingredients

The value of feeding a complete mixed ration as compared to feeding the grain, roughage, and supplement separate to beef cattle is being studied at the North Platte Station.

High Sugar Corn

The production per acre, ensiling losses and feeding value of several varieties of corn is being compared at the North Platte Station. One of the varieties in the test is a high sugar corn.

Urea in Range Supplements

The utilization of urea under range conditions is being investigated at the North Platte Station. Supplements containing different levels of urea are being compared as to their effectiveness in supplying supplemental protein to cattle grazing range grass.

Range Forage Utilization

A study is under way at the North Platte Station to determine the effect of supplemental program upon quantity and quality of range forage consumed as well as supplement effect upon digestibility of the forage.

Native Upland Hay

The effect of stage of maturity and method of harvesting upon *in vitro* digestibility of native upland hay is being investigated at the North Platte Station.

Factors Affecting Nitrogen Utilization

Factors (such as source of nitrogen, method of administration and source of energy) are being investigated in digestion and metabolism trials to determine if the efficiency of supplemental protein can be increased in beef cattle. This research at the Lincoln Station is investigating the effect of method of feeding and different sources of nonprotein nitrogen upon its utilization by cattle.

Effect of Pre-calving Energy Intake on Post-calving Endocrine Function and Energy Retention of Two-year-old Heifers.

Work is continuing at Lincoln to determine the cause of the prolonged intervals from calving to first heat in heifers fed a low level of energy prior to calving.

Supplements for Pregnant Yearling Heifers Grazing Native Winter Range

The influence of two levels of energy supplementation (1½ lb. 40% protein vs. 3 lb. 20% protein) on the post-calving reproductive performance of two-year-old heifers is being studied at Mead. In addition at the North Platte Station 2 lb. 20% protein, 1 lb. 40% protein and ½ lb. 40% protein supplement are being compared as supplements to grass hay rations for bred heifers.

The Effect of Sex on Production and Carcass Traits

The project in progress has as its objectives: the effects of sex, (bull versus steer), on carcass quality; level of energy on carcass quality and composition; chronological age on carcass desirability; the relationship between chronological and physiological age; and to determine the degree and importance of interactions among sex, level of energy and age with particular attention to the differences in the quality of beef from bulls and steers fed to have the same degree of marbling at the same chronological age.

Seventy-two bulls and seventy-two steers will be slaughtered. Sixteen of each sex will be slaughtered at twelve, fifteen, eighteen, and twenty-four months of age. Each age group will be composed of steers and bulls fed at two levels of energy. They will be fed eight head to the lot by sex; one half of each lot from a different source. One lot of bulls and one lot of steers will be fed on each of the two levels of energy. Two lots, one lot of eight steers and one lot of eight bulls, will be slaughtered at nine months of age. Each lot will be fed on a different level of energy.

Production data and quantitative carcass measures will be obtained. Carcass quality will be measured by marbling score, maturity score, grade, and tenderness measured with the Warner-Bratzler shear. Chemical evaluation, histological studies, and palatability, measured by a taste panel, will also be made. This work will be in cooperation with the Market Quality Research Division, ARS, U.S.D.A.

Beef Cattle Selection Experiments

At Fort Robinson a breeding experiment is being conducted to determine changes in production when cattle are selected for (1) weaning weight, (2) yearling weight, and (3) a combination of yearling weight and thicker muscling.

Three lines of cattle originating from the same foundation stock were established in 1960. Since 1960 all replacement bulls and heifers have been selected within each line on the criteria outlined above. Each line has about 150 cows. Six bulls are used each year. Two bulls and 25 heifers are selected to add to each line every year. These criteria of selection (weaning weight, yearling weight, muscling and yearling weight) were chosen because:

(1) *Weaning and yearling ages* represent important ages for marketing cattle.

(2) *Pre-weaning and post-weaning* growth represent distinct production phases.

(3) *We need to know* the correlated response in feed efficiency, longevity, carcass merit and rate of maturity when selection for early growth rate is emphasized.

(4) *The traits, easily measured,* represent simple objectives.

(5) *Previous research indicates* these traits are heritable and should respond to selection.

The experiment is long term in nature and will likely take 20 years to have adequate evaluation.

Animal Science

Animal science is the art and science of animal agriculture whereby meat and fiber are produced for America's millions. Today Animal Science requires a knowledge of all biological sciences, botany, zoology, bacteriology, genetics and physiology. It also requires a knowledge of mathematics, chemistry, and physics as well as the agricultural sciences dealing with forages, feed grains, insects, animal health, nutrition, breeding and meats.

The person who likes sciences will find Animal Science challenging. Many Animal Science positions require considerable contact with people. For those who would rather work by themselves, there are positions in laboratories and offices. So, whether you prefer the outdoors or the indoors, the market place, the laboratory, or the classroom, there is a place for you in Animal Science if you like livestock.