STUDIES ON WINTER RATIONS FOR COMMERCIAL BEEF COWS

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

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The Story In Brief . . .

Two popular methods of wintering the commercial cow herd are: (A) Grazing yearlong on native grass and feeding a protein supplement during the winter period, and (B) Grazing for part of the year and feeding prairie hay and a protein supplement during the winter.

Two questions frequently arising concerning these systems are: (1) Is one of these systems more desirable than the other? and (2) What is the value of alfalfa hay relative to cottonseed cake as a winter protein supplement for cows grazing native grass yearlong?

The tests reported in this bulletin were undertaken to answer the above questions. Results of this research indicated that:

- Both systems of management were satisfactory. The yearly feed cost was slightly less for the cows grazed yearlong than for those fed prairie hay in the winter (Experiment I).

- When alfalfa hay was fed as the winter protein supplement in these two systems of management, the cows grazed yearlong produced heavier calves at a lower feed cost than cows fed prairie hay during the winter (Experiment II).

- Alfalfa hay may be fed profitably as a winter protein supplement to commercial cows grazing yearlong when the cost per pound is not more than one-third that of cottonseed cake (Experiment III).

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Winter feed is a major problem for Oklahoma farmers and ranchers maintaining a beef cow herd. The grasses of central and eastern Oklahoma (bluestem and associated grasses) are generally recognized as producing excellent summer grazing but relatively poor winter feed. As these grasses mature, their feeding value declines. By late fall they are a relatively poor source of protein, phosphorus, and carotene (provitamin A). Thus, it is generally agreed that cattle grazing native grasses yearlong should receive protein and mineral supplements during the winter period.

Various systems of management may be used by cattlemen who follow a cow-and-calf program. One widely used system is that of grazing yearlong on native grass pastures and feeding a protein supplement during the winter period. Another common program is that of grazing the native grass pastures for approximately seven months of the year, and feeding prairie hay and a protein supplement during the winter period. From the point of view of economy of production, as well as the response of the herd, a direct comparison of these two systems seemed desirable.

The study reported in this bulletin was undertaken to determine:

● The relative value of two systems of managing commercial beef cows: (A) Grazing yearlong and feeding cottonseed cake during

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the winter period; and (B) Grazing for part of the year and feeding prairie hay and cottonseed cake during the winter period (Experiment I).

- The relative value of these two systems of management with alfalfa hay replacing cottonseed cake as the protein supplement (Experiment II).

- The relative value of alfalfa hay and cottonseed cake as winter supplements for beef cows grazing yearlong (Experiment III).

HOW THE TESTS WERE MADE

The work reported in this bulletin covers a 9-year period, 1942-51. It was conducted at the Experimental Range unit of the Oklahoma Agricultural Experiment Station near Lake Carl Blackwell, west of Stillwater. The predominant grasses on the range are little bluestem, big bluestem, switch, and Indian. Some areas in each of the pastures have considerable buffalo and grama grass. Also, a small percentage of most pastures had previously been cultivated. In these areas, annual grasses and weedy plants are more common.

Grade Hereford cows were used in each experiment. The older and poorer producing cows were removed each year and young replacements added. Many of the cows used in the tests in the later years were produced in the experimental herd. Good quality purebred Hereford bulls were placed in the pastures with the cows on May 1 and removed at about September 1 of each year. With such a program, nearly all of the calves were born in February, March, and April. During the last five years of the test, the bulls were rotated among the pastures to minimize effects of possible variations in breeding efficiency.

Hay and cottonseed cake were fed every other day. The salt and/or mineral mixtures were fed free-choice. During the 1948-49 winter season, a small amount of prairie hay was fed to the cows grazing yearlong when snow covered the ground for an extended period.

Blood samples were obtained by venous puncture from at least one-half of the cows in each lot from 1944 to 1950. Samples of blood from some of the calves produced were collected from 1946 to 1950. During the 1944-45 and 1945-46 trials, blood samples from the cows were collected near the beginning and the end of the winter feeding period only. In later trials, samples were collected at monthly intervals.

Chemical analyses included, in various years, determinations of plasma carotene, vitamin A, calcium, phosphorus, and ascorbic acid. Inorganic phosphorus in the blood plasma was determined by the Youngberg and Youngberg (5) *, plasma calcium by the method of Clark and Collip (2), plasma carotene and vitamin A by the method of Kimble (3), and plasma ascorbic acid by the method of Mindlin and Butler (4). Feeds were analyzed essentially as described by the A.O.A.C. (1).

EXPERIMENT I

Yearlong grazing versus grazing seven months and feeding prairie hay during the winter period, with cottonseed cake as the winter protein supplement.

Procedure

Two groups of 20 grade Hereford cows were placed on this experiment in November 1942. The cows of Lot 1 were allowed to graze the native grass pastures yearlong, and were fed cottonseed cake during the winter period. Each cow was allowed 10 acres of grass which was mostly bluestem, and 2.25 acres which had previously been in cultivation.

The cows of Lot 2 were allowed to graze during the seven summer months, but were fed prairie hay and cottonseed cake in a 5-acre trap during the winter period. Each cow in this lot was allowed seven acres of bluestem grass and 1.6 acres of old fields during the summer months. These cows were allowed fewer acres of summer grass per head on the assumption that operators following such a management system would cut prairie hay from another area to provide winter feed. Such a system requires somewhat less total acreage per cow (summer grazing plus hay land) than does the yearlong grazing system. Throughout the year, both groups of cows were allowed free access to salt, and a mineral mixture composed of equal parts of salt, steamed bone meal, and ground limestone.

Results

Average production data for the four years are shown in Table I. For the 4-year period, the hay-fed cows came through the winter in better flesh than those grazed yearlong. The cows of Lot 1, grazed yearlong and fed 2.57 pounds of cottonseed cake per head daily during the

* Numerals in parantheses refer to *Literature Cited* section, page 12.

winter months, lost an average of four pounds per head from the start of winter feeding until the last weight obtained before calves were born. Similar cows in Lot 2, grazed seven months and fed 20.95 pounds of prairie hay and 1.33 pounds cottonseed cake per head daily for five months, gained an average of 48 pounds in this same period.

During the summer months, however, the cows of Lot 1 gained 111 pounds as compared to 90 pounds for those in Lot 2. During two years of this experiment, the total gain for the winter and summer season favored the hay-fed cows, and the other two years the advantage was in favor of the group grazed yearlong.

There was no significant difference in the average birth weight of the calves of the two groups. The calves produced by the hay-fed cows averaged seven pounds heavier at weaning than the calves from the cows grazed yearlong, a difference which is not considered significant. More calves were weaned by the cows fed hay during the winter, but nearly all of this difference in the 4-year average was apparently due to the breeding efficiency of the bull in the 1943-44 trial.

Under the conditions of this test, the yearly cost of feeding the cows was slightly less for those grazed yearlong than for those fed hay during the winter period.

During the last two years of the test (1944-45 and 1945-46), samples of blood were taken from one-half of the cows of each group at the beginning and at the end of the winter period and analyzed for plasma calcium, phosphorus, and carotene. The average analyses of these samples of blood are reported in Table II. Although some differences were noted in the average level of some blood constituents, the levels were all within normal limits.

Chemical analyses of the feeds used are given in Table III.

EXPERIMENT II

Yearlong grazing versus grazing seven months and feeding prairie hay during the winter period, with alfalfa hay as the winter protein supplement.

Procedure

During the 4-year period 1946-1950, two groups of 20 grade Hereford cows were used in this study. The cows of Lot 1 were grazed yearlong and fed an average of 8.17 pounds of alfalfa hay per head per day during the winter period. Lot 2 was grazed during the sum-

mer months, allowed access to fewer acres per head than the cows of Lot 1, and confined to a 10-acre trap during the winter period. During the winter phase, these cows were fed prairie hay free-choice, and an average of 4.71 pounds of alfalfa hay per head per day. The hay was fed every other day. The total daily intake of crude protein during the winter was approximately the same for the two groups.

Analyses of samples of blood from each group of cows were made at monthly intervals throughout the study. Blood samples were taken from 10 calves of each lot from March through August.

Results

Average production data are presented in Table IV. Chemical analyses of feeds are given in Table V. The cows in both groups lost weight from the beginning of the winter feeding period until the last weighing before any calves were born. The cows of Lot 1 lost an average of 15 pounds per cow to the time of calving. At the end of the summer phase, however, they were 39 pounds heavier than at the beginning of the winter phase. The cows of Lot 2 lost six pounds per cow to time of calving. The cows of this lot were 16 pounds lighter at the end of the summer grazing season than at the beginning of the winter period. In three of the four years, the yearly weight change was in favor of the cows grazed yearlong.

The average weaning weight of the calves in Lot 1 was 29 pounds greater than that of those in Lot 2. In three out of the four years, the average weaning weight per calf was in favor of the group of cows grazed yearlong.

The yearly cost of feeding the cows was less for those grazed yearlong than for those grazed seven months.

A summary of the blood constituents of the cows is shown in Table VI. Seasonal variation in plasma carotene and vitamin A was noted. Carotene plasma levels were high during periods of lush spring growth but declined as the grasses matured. During the winter, blood carotene and vitamin A levels were above the minimum, indicating adequate nutrition with respect to these nutrients. No major difference in carotene or vitamin A levels was induced by variation in quantity of alfalfa hay fed; the higher levels found in Lot 1 in March are attributed to the consumption of green forage which was present in the pastures.

Calcium and ascorbic acid levels of the plasma were within normal limits, suggesting an adequate nutritional status with respect to these nutrients.

The cows of Lot 1 were higher in plasma phosphorus than the cows of Lot 2 during most of the year, despite the fact that all had free access to a phosphorus-rich mineral mixture. The blood data showed that 4.71 pounds of alfalfa hay per day, plus prairie hay, did not provide sufficient phosphorus to maintain a blood level of phosphorus equal to that maintained by cows fed larger amounts of alfalfa hay. However, no evidence of phosphorus deficiency was noted among cows in Lot 1, which suggests that this system of management provided adequate phosphorus.

Plasma phosphorus, calcium, ascorbic acid, and vitamin A values (Table VII) were all within normal limits for the calves in these two treatments. A higher intake of alfalfa hay and access to pasture (Lot 1) was correlated with an increased carotene content of the blood of nursing calves during March and April.

EXPERIMENT III

Alfalfa hay versus cottonseed cake as winter supplements for beef cows grazed yearlong.

Procedure

Two groups of 20 grade Hereford cows were allowed to graze native grass pastures yearlong. During the winter period, one group of cows was fed 8.14 pounds of alfalfa hay per head daily as a protein supplement. The cows in the second group were fed an average of 2.58 pounds of cottonseed cake per head daily. The supplements were fed every other day. The total daily intake of crude protein supplied by the supplements during the winter months was approximately the same for the two groups.

During the first three years, all of the cows of each lot were bled at monthly intervals from November to May. Blood samples were also taken from 10 calves of each lot fromo March through August. From June to October, samples were collected from the 10 cows whose calves were bled during the summer months.

Results

The production data are summarized in Table VIII. Chemical analyses of the grasses and hays are given in Table IX.

Production of the cows in both lots was considered satisfactory. The cows fed cottonseed cake during the winter months lost seven pounds from the start of the winter feeding period until the last weighing be-

fore calves were born, as compared to a loss of 21 pounds for the same period for those fed alfalfa hay. However, the yearly gain of the cows was practically the same in both groups. The average weaning weight per calf was essentially the same in both groups. The total yearly feed cost per cow was less for those fed alfalfa hay than for those fed cottonseed cake.

The plasma phosphorus, carotene, and vitamin A content of the cows and calves are presented in Tables X and XI, respectively.

The plasma inorganic phosphorus of the cows of both lots was considered satisfactory for normal production, but at each winter bleeding the phosphorus level was highest in the plasma of the cows fed cottonseed cake. This is attributed to the high phosphorus content of this supplement.

Only slight differences in plasma carotene were found between lots. It might be expected that the plasma carotene of the cows fed alfalfa hay would be higher than that of those fed cottonseed cake because of the greater carotene content of the alfalfa hay. This was not the case, however. A possible explanation was the fact that the cows fed alfalfa hay did not graze as much as those fed cottonseed cake. The cows fed cottonseed cake were required to graze more extensively to maintain an adequate roughage intake. Observations indicated that they were eating larger amounts of the green, cool-weather grasses and other plants found in each of the pastures during most of the winter than the cows fed alfalfa hay.

Plasma phosphorus and vitamin A levels of calves were normal with no consistent difference between treatments. As in the case of the previous experiment, there was a tendency for the plasma carotene level to reflect a higher intake of this nutrient when alfalfa hay was fed despite a lower blood level in the cows. No differences observed are believed to be of importance in practical production.

SUMMARY

This study compared the following two management systems:

(1) Commercial beef cows grazed on native grass pastures yearlong and fed cottonseed cake during the winter months; and

(2) Cows grazed for seven months and fed prairie hay and cottonseed cake during the winter months.

Both systems proved satisfactory.

A variation of the two systems was made to determine the value of alfalfa hay as a protein supplement for replacing cottonseed cake. A system in which cows were grazed yearlong and fed alfalfa hay during the winter months was more desirable than a system of grazing cows seven months and feeding alfalfa hay and prairie hay in a trap during the winter months. The advantage of the former system was primarily in terms of economy of production both in the cost of feed and in the lower labor required by yearlong grazing.

No attempt was made to evaluate the carrying capacity of the pastures used in the different systems of management. However, the system in which cows were allowed to graze only during the summer months required somewhat less total acreage per cow (summer grazing plus hay land) than a yearlong grazing system.

Approximately eight pounds of alfalfa hay satisfactorily replaced 2½ pounds of cottonseed cake as the winter protein supplement for commercial cows grazed yearlong on native grass pastures. The feeding of alfalfa hay required more labor, but the winter feed cost was less than when cottonseed cake was fed. When labor costs and grazing acreage required are not considered, alfalfa hay may profitably be fed if the cost per pound is not more than one-third that of cottonseed cake. The value of alfalfa hay relative to cottonseed cake is further increased, since fewer acres of grassland per cow are required.

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Table I.—Summary of Production Data; Experiment I. Average of Four Seasons. (1942-43 through 1945-46)

	Lot 1 Grazed yearlong. Fed Cottonseed cake for five months	Lot 2 Grazed 7 months. Fed prairie hay and Cottonseed cake for five months
Average number of cows	20	20
Average weight per cow (lbs.)		
Beginning winter period	1049	1046
Before calving	1045	1096
End of winter period	937	976
End of summer period	1048	1066
Change to calving	—4	48
Change during winter[1]	—112	—70
Gain per year	—1	20
Average date		
Winter period started	Nov. 8	Nov. 8
Last weight before calving	Feb. 26	Feb. 26
Birth of calves	March 27	March 19
End of winter period	Apr. 13	Apr. 13
End of summer period	Nov. 8	Nov. 8
Average birth weight per calf (lbs.)	70.5	71.8
Average number of calves born	15.5	17.2
Average number of calves weaned	14.2	15.7
Average weaning weight per calf (lbs.)	405	412
Average daily ration (lbs.)		
Winter:		
Native grass pasture	12.25 acres[2]	1.45 acres[2]
Cottonseed cake	2.57	1.33
Prairie hay	----	20.95
Salt and mineral mixture[3]	ad lib	ad lib
Summer:		
Native grass pasture	12.25 acres[2]	8.6 acres[2]
Salt and mineral mixture[3]	ad lib	ad lib
Yearly feed cost per cow[4] (dollars)	20.98	22.17

[1] The cows were weighed when winter feeding was discontinued. Although the change in weight during the winter period is reported in Experiments I, II, and III of this bulletin, this weight loss has little significance when comparing rations because of variation between lots in numbers of cows which had calved by the time of weighing and variation in length of time since calving and therefore in time of lactation while on winter feed.

[2] Lot 1 grazed yearlong on 10 acres of pasture. Lot 2 grazed 7 acres of pasture during the summer plus 1.45 acres of meadow for hay. The old fields were not evaluated because of their low productivity.

[3] Salt, ad lib, and mixture of equal parts salt, steamed bone meal, and ground limestone, ad lib.

[4] Average feed prices in the four year period were: 43% protein cottonseed cake, $52.92 per ton; bluestem grass, $1.01 per acre; and cost of making hay $5.38 per ton.

Table II.—Blood Constituents of Cows, Experiment I; 1944-45, 1945-46

(Units per 100 ml. plasma)

Date	Phosphorus (mg.)		Calcium (mg.)		Carotene (mcg.)	
	Lot 1*	Lot 2**	Lot 1	Lot 2	Lot 1	Lot 2
Nov. 20, 1944	3.45	3.79	10.9	10.6	429	470
Mar. 23, 1945	6.06	4.01	10.4	10.8	666	283
Oct. 22, 1945	3.08	3.25	10.9	11.1	295	459
Apr. 3, 1946	4.47	4.20	10.5	10.4	1125	576

* Grazed yearlong.
** Grazed 7 months, hay 5 months.

Table III.—Feed Analyses, Experiment I. (1942-1946)

	Percent dry Matter	Percent composition of dry matter							
		Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Ca	P	Carotene[1]
Prairie hay									
1945	91.57	6.76	3.42	2.46	33.35	54.01	.497	.047	27.2
1944	93.66	7.38	4.78	2.45	35.55	49.82	.587	.083	24.2
1943	93.65	7.85	4.86	3.62	35.09	48.58	.588	.066	----
1942	92.52	6.49	4.43	2.41	34.04	52.18	.422	.078	----
Average	92.85	7.24	4.37	2.74	34.52	51.13	.512	.069	25.6
Native grass									
March 14, 1946	----	6.11	2.20	1.71	36.30	53.68	.285	.020	Trace
March 7, 1945	----	6.70	2.30	2.07	34.71	54.22	.391	.021	Trace
February 15, 1944	----	6.87	2.72	3.00	38.75	48.66	.415	.030	None
February 16, 1943	----	9.17	2.94	1.79	33.66	52.44	.432	.038	None
Average	----	7.22	2.54	2.14	35.86	52.24	.381	.027	None
Cottonseed cake									
1945	92.38	7.77	44.38	7.01	9.10	31.74	.206	1.254	None
1944	92.06	6.07	46.74	6.03	10.43	30.73	.226	.954	None
1943	91.21	6.71	43.92	6.80	11.35	31.22	.227	.822	None
1942	91.34	6.90	45.87	9.35	9.86	27.91	----	----	None
Average	91.75	6.87	45.23	7.29	10.18	30.43	.220	1.013	None

[1] Parts per million.

Table IV.—Summary of Production Data; Experiment II. Average of Four Seasons. (1946-47 through 1949-50)

	Lot 1	Lot 2
	Grazed yearlong. Fed alfalfa hay for 5 months	Grazed 7 months. Fed prairie hay and alfalfa hay for five months
Average number of cows	20[1]	20
Average weight per cow (lbs.)		
Beginning winter period	1001	975
Before calving	986	969
End of winter period	849	817
End of summer period	1040	959
Change to calving	—15	—6
Change during winter	—152	—158
Change per year	39	—16
Average date		
Winter period started	Nov. 3	Nov. 3
Last weight before calving	Feb. 4	Feb. 4
Birth of calves	Mar. 8	Mar. 8
End of winter period	Apr. 14	Apr. 14
End of summer period	Oct. 24	Oct. 24
Average birth weight per calf (lbs.)	75	70
Average number of calves born	19.5	20.0
Average number of calves weaned	18.5	17.8[2]
Average weaning weight per calf (lbs.)	456	427
Average daily ration (lbs.)		
Winter:		
Native grass pasture	12.25 acres[3]	----
Prairie hay[4]	----	15.95
Alfalfa hay	8.17	4.71
Salt and mineral mixture[5]	ad lib	ad lib
Summer:		
Native grass pasture	12.25 acres[3]	8.6 acres[3]
Salt and mineral mixture[5]	ad lib	ad lib
Yearly feed cost per cow[6] (dollars)	35.03	40.49

[1] One cow died during the 1948-49 season.

[2] In the 1947-48 season, six calves in this lot were either born dead or died soon after birth. It was not determined whether these losses were due to the ration fed or the unseasonably cold weather prevailing at the time of birth. Calves born in this lot before and after the period of cold weather were normal. However, calves dropped in Lot 1 during the cold period were strong and vigorous.

[3] Lot 1 grazed yearlong on 12.25 acres of pasture, 2.25 acres of which were old fields. During the summer the cows of Lot 2 were allowed 8.6 acres of pasture, of which 1.6 acres were old fields.

[4] Prairie hay fed to Lot 1 only when the ground was covered with snow for an extended period. The average daily consumption of prairie hay for the season was 0.91 lbs.

[5] Salt and 1-1-1 (Salt, bone meal, ground limestone) during 1946-47 and summer of 1950. 2-1 (Salt and bone meal) during 1948-49 and winter of 1949-50. 3-1 (Salt, bone meal) during 1947-48.

[6] Average feed prices for the four-year period were: Grazing yearlong, $20.30 per cow; grazing 7 months, $12.42 per cow; prairie hay, $14.75 per ton; alfalfa hay, $21.38 per ton.

Table V.—Feed Analyses; Experiment II. (1946-1950)

	Percent dry Matter	Percent composition of dry matter							
		Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Ca	P	Carotene[1]
Alfalfa hay	93.34	7.95	15.79	2.57	30.08	43.61	1.34	0.19	24
Prairie hay	94.13	7.50	4.20	2.16	34.78	51.36	0.47	0.06	13
Bone meal	96.08	91.70	----	----	----	----	32.73	15.30	----
Ground limestone	99.67	----	----	----	----	----	36.18	----	----
Grass[2]									
November	----	5.01	2.53	1.74	40.02	50.70	0.253	0.046	14
January[3]	----	5.92	2.57	1.57	40.86	49.08	0.309	0.039	Trace
May	----	6.39	9.68	2.40	32.02	49.51	0.308	0.126	407
July[3]	----	6.33	6.39	2.75	33.82	50.71	0.257	0.093	251
August	----	6.21	5.06	2.23	35.42	51.08	0.246	0.078	112
October[3]	----	5.18	3.23	1.62	37.24	52.73	0.244	0.048	16

[1] Parts per million.

[2] Averages, by species, of the four predominant grasses: big bluestem, little bluestem, Indian, and switch. During most of the years, monthly analyses were made on three individual samples of each species which were collected from different areas of the pasture.

[3] Three years only.

Table VI.—Blood Constituents of Cows by Lots; Experiment II, 1946-1950.
(Units per 100 ml. plasma)

Month	Phosphorus (mg.) 4 years		Carotene (mcg.) 4 years		Vitamin A (mcg.) 4 years		Ascorbic Acid (mg.) 2 years		Calcium (mg.) 2 years	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Nov.	3.4	3.3	359*	405	28.2*	27.5*	332	305	10.6	10.5
Dec.	4.1	3.1	216	182	29.9*	28.0*	179	261	10.3	10.6
Jan.	3.9	3.0	155	150	30.2	26.8	210	236	10.3	10.6
Feb.	3.5	2.7	153	153	24.0	23.6	330	363	10.7	10.8
Mar.	4.2	2.8	145	117	24.0	19.7	191	231	10.7	11.2
Apr.	4.0	3.3	528	307	18.0	21.6	259	282	10.6	10.8
May	5.4**	3.7**	1097**	1055**	29.4**	24.6**	246†	272†	10.4†	10.7†
June	4.2	3.5	1088	1035	25.1	21.5	424	446	10.7	10.8
July	3.2	2.5	808	816	32.5	29.4	224	220	10.7	11.2
Aug.	4.0	3.1	950	978	44.9	38.0	451	395	10.2	10.7
Sept.	4.0	3.6	575	621	35.9	31.7	175	186	11.1	11.3
Oct.	3.7	2.9	443	462	27.9	25.5	239	302	12.2	12.8

* Three years.
** Two years.
† One year.

Table VII.—Blood Constituents of Calves by Lots; Experiment II, 1946-1950.

(Units per 100 ml. plasma)

Month	Phosphorus (mg.) 4 years		Carotene (mcg.) 4 years		Vitamin A (mcg.) 4 years		Ascorbic Acid (mg.) 2 years		Calcium (mg.) 2 years	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
March	8.1	8.0	16	12	18.1	16.9	322	349	13.1	12.5
April	7.9	7.9	129	77	14.9	12.8	258	250	10.6	11.3
May	8.5*	8.0*	394*	390*	20.4*	23.6*	230**	233**	11.9**	11.1**
June	8.1	8.2	543	518	21.2	20.7	542	580	11.5	11.0
July	7.6	7.3	739	723	34.0	36.3	311	381	11.1	11.3
August	7.3	6.8	629	549	26.7	26.2	395	515	10.4	11.0

* Three years.
** One year.

Table VIII.—Summary of Production Data; Experiment III, Average of Four Seasons. (1947-48 through 1950-51)

	Lot 1 Grazed yearlong. Fed alfalfa hay	Lot 2 Grazed yearlong. Fed cottonseed cake
Average number of cows	20[1]	19[2]
Average weight per cow (lbs.)		
Beginning winter period	1016	1011
Before calving	995	1004
End of winter period	855	881
End of summer period	1067	1059
Change to calving	—21	—7
Change during winter	—161	—130
Gain per year	51	48
Average date		
Winter period started	Nov. 6	Nov. 6
Last weight before calving	Feb. 4	Feb. 4
Birth of calves	March 8	March 6
End of winter period	Apr. 19	Apr. 19
End of summer period	Oct. 16	Oct. 16
Average birth weight per calf (lbs.)	75	75
Average number of calves born	19.5	20.0
Average number of calves weaned	18.2	19.0
Average weaning weight per calf (lbs.)	461	466
Average daily ration (lbs.)		
Winter[3]:		
Native grass pasture	12.25 acres	12.25 acres
Alfalfa hay	8.14	----
Cottonseed cake	----	258
Salt and mineral mixture[4]	ad lib	ad lib
Summer:		
Native grass pasture	12.25 acres	12.25 acres
Salt and mineral mixture[4]	ad lib	ad lib
Yearly feed cost per cow[5] (dollars)	34.66	40.08

[1] One cow died during the 1948-49 season.

[2] Four cows died: one during 1947-48, one during 1948-49, and two during 1950-51.

[3] Prairie hay fed only when snow covered the ground for an extended period during the 1948-49 season.

[4] Mineral mixture was 3-1 (3 parts salt and 1 part bone meal) during 1947-48. 2-1 (Salt and bone meal) during 1948-49 and 1949-50 winter season. Salt and 1-1-1 (Salt, bone meal, ground limestone) during summer of 1950 and 1950-51 season.

[5] Averge feed prices were: Grazing yearlong, $20.30 per cow; alfalfa hay $19.75 per ton; cottonseed cake, $85.00 per ton.

Table IX.—Feed Analyses; Experiment III. (1947-1951)

	Percent dry Matter	Percent composition of dry matter							
		Ash	Crude protein	Ether extract	Crude fiber	N-free extract	Ca	P	Carotene[1]
Alfalfa hay	93.03	8.05	16.13	2.45	30.18	43.19	1.24	.20	21
Cottonseed cake	93.00	6.41	43.16	5.36	11.60	33.47	.23	.98	---
Bone meal	96.15	91.46	----	----	----	----	32.54	15.41	---
Ground limestone	99.64	99.54	----	----	----	----	37.09	----	---
Grass[2]									
November	----	5.06	2.67	1.73	39.19	51.35	.25	.04	14
January[3]	----	5.74	2.52	1.70	40.42	49.62	.28	.03	Trace
May	----	6.38	8.63	2.30	31.72	50.97	.28	.12	401[4]
July	----	6.18	6.23	2.70	33.78	51.11	.27	.09	251[4]
August	----	6.21	5.23	2.33	36.15	50.08	.26	.08	109
October	----	5.32	3.48	1.80	37.04	52.36	.25	.05	24

[1] Parts per million.

[2] Averages, by species, of the four predominant grasses: big bluestem, little bluestem, switch, and Indian. During most of the years, monthly analyses were made on three individual samples of each species which were collected from different areas of the pasture.

[3] Two years only.

[4] Three years only.

Table X.—Blood Constituents of Cows by Lots; Experiment III. Three-year Average.
(Units per 100 ml. plasma)

Month	Phosphorus (mg.)		Carotene (mcg.)		Vitamin A (mcg.)	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Nov.	3.4	4.2	359	371	28.2	26.9
Dec.	4.1	5.7	179	160	29.9	30.1
Jan.	3.8	5.8	124	163	29.4	29.2
Feb.	3.3	5.9	115	117	25.2	20.7
Mar.	4.3	6.1	127	190	23.5	15.9
Apr.	4.1	4.5	571	797	16.3	12.5
June	4.7	4.8	1066	1046	23.8	21.4
July	3.1	4.0	770	794	33.0	24.8
Aug.	4.2	4.3	1056	1079	47.2	38.2
Sept.	3.8	4.6	650	654	37.4	29.3
Oct.	4.0	4.1	519	509	28.1	26.2

Table XI.—Blood Constituents of Calves by Lots; Experiment III. Three-year Average.
(Units per 100 ml. plasma)

Month	Phosphorus (mg.)		Carotene (mcg.)		Vitamin A (mcg.)	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
March	7.8	7.6	14	10	17.4	16.8
April	7.9	8.4	161	127	15.9	16.2
May*	8.9	9.0	426	409	22.2	24.8
June	8.6	9.7	542	539	20.0	22.6
July	7.8	7.7	745	708	37.5	40.8
August	7.5	7.8	647	627	25.2	30.5

* Two years.


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