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Wintering Calves

in the

Nebraska Sandhills

The Agricultural Experiment Station, University of Nebraska College of Agriculture,
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Wintering Calves in the Nebraska Sandhills

E. M. BROUSE¹

INTRODUCTION

In the Sandhills area of Nebraska, which is principally a cattle producing section, there is little land suitable for tillage. Native grass is the chief source of income from the land. In the hills it is utilized for summer and winter grazing and in the valleys, for hay. The production of grass from year to year is relatively dependable. Even during the severe drought of the thirties, there was enough grass and hay to carry almost the usual number of cattle.

Grass of the Sandhills area, however, is low in protein and phosphorus. This is a serious shortcoming, especially when the grass is used as hay or winter range. Calves wintered on native grass or hay do not consume enough to meet their protein and phosphorus requirements. As a consequence their development is retarded. This was not important when calves were held on the ranch until they were three or four years old before being sold. Now, with many cattle being marketed off grass as yearlings, the winter ration for weanling calves becomes important because of its effect not only upon winter gains but upon total gains up to the time the calf is sold at an age of approximately 18 months. It is recognized that in general the more gain a calf makes during the winter, the less it will make the following summer on grass. Where cattle are to be marketed off grass as yearlings, the rancher's problem is to winter the calf so a maximum profit may be obtained for the combined winter and summer period. In order to get good results he will need answers to questions such as:

How much gain can be obtained from feeding prairie hay that contains 5 to 7 per cent protein?

What gains can be obtained from prairie hay *plus* a protein supplement fed at various rates?

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What is the relative value of:

High protein concentrates: cottonseed cake, soybean oil meal, linseed oil meal, tankage, and distillers dried grain and dried solubles

Farm grains: corn, rye, barley, and oats

Combination of grain plus cottonseed cake

Commercial pellets containing 12, 22, and 32 per cent protein

Legume hays: alfalfa and mixed clover

Mixed rations based on alfalfa meal, dehydrated alfalfa, oil meals, corn and urea?

How does a mineral supplement fed with prairie hay and many of the above mentioned protein supplements influence gain?

What is the effect of these winter rations on summer gain?

To answer these questions, wintering experiments with range calves were conducted at the Valentine Station from 1926 to 1948.

SUMMARY OF FINDINGS

1. Generally the more calves gained during the winter the less they gained on grass the following summer.

2. Calves wintered on prairie hay without a supplement made little or no gain.

3. A ration low in protein or phosphorus has a depressing effect on appetite. An adequate supply of these ingredients increased hay consumption as much as 25 per cent.

4. The combined winter and summer gain was most profitable where the ration was adjusted to produce from 0.75 to 1 pound of winter gain per head daily.

5. Feeding more than 1 pound of high protein supplement per head daily is not recommended unless the calves are to be sold in the spring or midsummer.

6. Feeding 0.5 pound cottonseed cake as a winter supplement resulted in 61 per cent as much combined winter and summer gain as feeding 1 pound.

7. Feeding 0.75 pound of cottonseed cake as a winter supplement resulted in 77 per cent as much combined winter and summer gain as feeding 1 pound.

8. There was no significant difference in the average total winter and summer gains between cottonseed cake and soybean oil meal when fed as winter supplements to calves.

9. Feeding soybean oil meal at the rates of 0.5 and 0.75 pound produced 94 and 95 per cent respectively as much total winter and summer gain as feeding 1 pound.

10. Total gain from feeding linseed oil meal was 5 pounds less than from soybean oil meal or 7 pounds less than from cottonseed oil meal.

11. A mixture of equal parts of cottonseed, soybean, and linseed oil meals produced gains equivalent to the average of the meals fed separately.

12. Two pounds of small grain fed as a winter supplement produced approximately as much total gain as 0.75 pound of cottonseed cake.

13. Two pounds of shelled corn produced 33 pounds less gain than 0.75 pound of cottonseed cake and usually would be unprofitable as a winter supplement under normal prices.

14. One pound of corn plus 0.5 pound cottonseed cake produced 7 pounds less total gain per head than 0.75 pound of cottonseed cake; however, 1 pound of oats plus 0.5 pound cottonseed cake produced 16 pounds and a similar combination of rye and cottonseed cake produced 28 pounds more gain than 0.75 pound of cottonseed cake.

15. Commercial pellets containing 12 and 22 per cent protein produced 89 and 90 per cent respectively as much total winter and summer gains as cottonseed cake when fed as winter supplements. The total gains produced from feeding the 32 per cent protein pellets were comparable to those from feeding soybean oil meal at the rates of 0.50, 0.75 or 1 pound when supplemented with 0.08, 0.06, and 0.04 pound of steamed bone meal respectively.

16. Four and one-half pounds of alfalfa hay was equivalent to 0.75 pound of cottonseed cake in producing net gain. However, hay consumption was greater in the alfalfa lot.

17. Unless alfalfa hay costs about the same as prairie hay, it usually will be unprofitable to feed it as the only roughage for wintering calves.

18. Feeding mixed clover hay produced a total gain equivalent to feeding 0.75 pound of cottonseed cake and prairie hay.

19. A phosphorus carrier fed with 1 pound of cottonseed or soybean oil meal as a supplement to Sandhills prairie hay usually increased the winter gain over either meal alone but by the end of the grazing season the additional total gain was seldom significant.

20. Supplementing 0.5 pound of soybean oil meal with a phosphate carrier produced gains equal to feeding 1 pound of soybean oil meal alone.

21. Supplementing soybean oil meal with ground limestone depressed the gains.

22. A phosphorus carrier added to mixtures of soybean oil meal, corn, and urea; dehydrated alfalfa, corn, and urea; or corn and urea increased winter and total gains.

23. The practicability of using urea as a substitute for part of the crude protein in a wintering ration in this area was demonstrated.

24. There was no great difference in the results obtained from the various supplements where they supplied approximately the same daily intake of nitrogen and phosphorus.

THE TRIALS

The calves in these experiments were high-grade Herefords purchased at weaning time from Sandhills ranchers. Steer calves were used until 1935, then for two years both steers and heifers were used. After 1937 only heifers were purchased.

At the beginning of each wintering test the calves were divided as uniformly as possible into lots of ten. For initial and final weights the average of three consecutive days' weights was used. One-day weights were also taken at 28- or 30-day intervals during both the wintering and grazing periods.

The wintering quarters consisted of pens 24 by 120 feet with a manger at the north end. A windbreak 7 feet high extended along the end of the pens 10 feet back from the manger and down the east and west sides for 50 feet. This afforded the only winter protection for the calves.

The calves were fed morning and evening all the hay they would clean up. Unpalatable material was taken from the mangers daily and weighed out. The supplements were fed in bunks preceding the morning feed of hay. Water and salt were available at all times except that in freezing weather water was available only during the day.

During the second week of May all lots of calves were turned together on Sandhills summer range. They watered at a creek which was within a mile of the farthest portion of the pasture. Salt was supplied in block form.

Prairie Hay as a Winter Ration

Prairie hay without a supplement was fed from 1926 until 1931 and then discontinued until the winter of 1947-48. Results for five trials with prairie hay are shown in table 1. Winter gains were quite consistent from year to year except in 1927-28 when the calves weighed less in the spring than at weaning time. Two of the ten calves made a slight gain but the others lost 8 to 27 pounds each. During the winter of 1947-48 calves wintered without a supplement gained an average of 4 pounds and the following winter calves similarly fed gained 21 pounds per head.

Protein Concentrates as Supplements to Prairie Hay

Cottonseed cake. This was the first protein supplement used in the Sandhills. In 1925, the year prior to the beginning of this series of experiments, three carloads of cottonseed cake were shipped to Valentine. By 1940 the annual consumption of protein supplements in this locality had increased to 70 carloads. Now the feeding of a protein supplement has become a general practice on most Sandhills ranches.

TABLE 1.—Wintering calves on prairie hay—five trials.

	Prairie hay, ad libitum					
	1926-27	1927-28	1928-29	1929-30	1930-31	Average
Number of animals	10	10	10	10	10	10
Days in winter period	150	170	170	180	180	170
Av. initial weight, lbs.	323	420	419	391	488	408
Av. final weight, lbs.	348	407	452	433	526	433
Av. winter gain, lbs.	25	-13	33	42	38	25
Av. daily winter gain, lbs. ...	.16	-.07	.19	.23	.21	.15
Feed consumed per head, lbs.						
Prairie hay	1370	1550	1920	1965	2215	1804
Days on grass	140	150	150	150	150	148
Av. final weight, lbs.	600	670	722	696	772	692
Av. summer gain, lbs.	252	263	270	263	246	259
Av. daily summer gain, lbs. ...	1.80	1.75	1.80	1.75	1.63	1.74
Total grain per head, lbs. ...	277	250	303	305	284	284
Feed per cwt. gain, total period						
Prairie hay, lbs.	494	620	634	644	780	634
Pasture, days	51	60	50	49	53	53

TABLE 2.—Comparative value of feeding prairie hay vs. prairie hay plus 0.5 pound cottonseed cake daily to wintering calves—two trials.

	Prairie hay, ad libitum no supplement			Prairie hay, ad libitum ½ lb. cottonseed cake per head daily		
	1927-28	1928-29	Average	1927-28	1928-29	Average
Number of animals	10	10	10	10	10	10
Days in winter period	170	170	170	170	170	170
Av. initial weight, lbs.	420	419	420	415	422	418
Av. final weight, lbs.	407	452	530	525	562	543
Av. winter gain, lbs.	-13	33	10	110	140	125
Av. daily winter gain, lbs. ...	-.07	.19	.06	.65	.82	.73
Feed consumed per head, lbs.						
Prairie hay	1550	1920	1735	1955	2365	2160
Cottonseed cake				85	85	85
Days on grass	150	150	150	150	150	150
Av. final weight, lbs.	670	722	696	750	799	774
Av. summer gain, lbs.	263	270	266	225	237	231
Av. daily summer gain, lbs. ...	1.75	1.80	1.77	1.50	1.58	1.54
Total gain per head	250	303	276	335	377	356
Additional gain, lbs.				85	74	80
Feed per cwt. gain, total period						
Prairie hay, lbs.	620	634	627	584	627	607
Cottonseed cake, lbs.				25	23	24
Pasture, days	60	50	54	45	40	42

In the first trial cottonseed cake was fed at the rates of 1 and 1.5 pounds per head daily. Subsequent trials included rates of 0.50 and 0.75 pound. Since the various rates were not fed the same years, the data are presented by comparing the results from feeding the supplement with those from feeding only prairie hay the same period.

Prairie hay vs. prairie hay plus 0.5 pound cottonseed cake: The value of feeding a protein supplement with prairie hay is shown in table 2. The prairie hay consumption was increased approximately 25 per cent by feeding 0.5 pound cottonseed cake per day. The average extra winter gain of 115 pounds which resulted from feeding 85 pounds of cottonseed cake should be attributed partly to the 425 pounds of additional hay consumed. On most Sandhills ranches hay is plentiful and the increased consumption through feeding a protein supplement offers an opportunity to convert more hay into beef without increasing the number of cattle.

The calves wintered on prairie hay without a supplement made larger gains on grass because they carried less flesh at the beginning of the grazing season. They averaged 35 pounds more summer gain and showed a gain for the year of 276 pounds which was 80 pounds less than the calves fed 0.5 pound cottonseed cake per head daily during the winter. The 85 pounds of cake fed during the wintering period plus the 425 pounds of additional hay resulted in 80 pounds additional gain.

Prairie hay vs. prairie hay plus 0.75 pound of cottonseed cake: Table 3 shows that as an average of three trials, calves wintered on prairie hay plus 0.75 pound cottonseed cake per head daily showed 88 pounds more combined winter and summer gain when taken off grass the following fall. The data provide a direct comparison between the practice of feeding 0.5 pound and 0.75 pound cottonseed cake in only one year, 1928-29. Tables 2 and 3 show that increasing the protein supplement 0.25 pound per day resulted in a net increase in gain off grass of 20 pounds per head.

Prairie hay vs. prairie hay plus 1 pound of cottonseed cake: Table 4 shows that the average daily gain (three trials) of calves fed prairie hay and 1 pound of cottonseed cake per head daily during the wintering period was 1.10 pounds per head. This was 12 times as much as the gain made by calves fed prairie hay without any supplement. The value of feeding 1 pound of cottonseed cake in severe weather was demonstrated in the 1927-28 trial. The calves without supplement lost an average of 13 pounds each; whereas, those fed cake made an average gain of 176 pounds which approximated the three-year average.

TABLE 3.—Feeding prairie hay vs. prairie hay plus 0.75 pound cottonseed cake daily to wintering calves—three trials.

	Prairie hay, ad libitum no supplement				Prairie hay, ad libitum, ¾ lb. cottonseed cake per head daily			
	1928-29	1929-30	1930-31	Average	1928-29	1929-30	1930-31	Average
Number of animals.....	10	10	10	10	10	10	10	10
Days in winter period.....	170	180	180	177	170	180	180	177
Av. initial weight, lbs.....	419	391	488	433	422	390	487	433
Av. final weight, lbs.....	452	433	526	470	576	568	645	596
Av. winter gain, lbs.....	33	42	38	37	154	178	158	163
Av. daily winter gain, lbs.....	.19	.23	.21	.21	.90	.99	.88	.92
Feed consumed per head, lbs.								
Prairie hay.....	1920	1965	2215	2033	2465	2145	2680	2430
Cottonseed cake.....					135	135	135	135
Days in summer period.....	150	150	150	150	150	150	150	150
Av. final weight, lbs.....	722	696	772	730	819	779	855	818
Av. summer gain, lbs.....	270	263	246	260	243	211	211	222
Av. daily summer gain, lbs.....	1.80	1.75	1.63	1.73	1.62	1.40	1.40	1.48
Total gain per head, lbs.....	303	305	284	297	397	389	369	385
Additional gain, lbs.....					94	84	85	88
Feed per cwt. gain, total period								
Prairie hay, lbs.....	634	644	780	684	621	551	726	631
Cottonseed cake, lbs.....					34	39	37	35
Pasture, days.....	50	49	53	50	38	39	41	39

TABLE 4.—Feeding prairie hay vs. prairie hay plus 1 pound cottonseed cake to wintering calves—three trials.

	Prairie hay, ad libitum, no supplement				Prairie hay, ad libitum plus 1 lb. cottonseed cake per head daily			
	1926-27	1927-28	1928-29	Average	1926-27	1927-28	1928-29	Average
Number of animals.....	10	10	10	10	10	10	10	10
Days in winter period.....	150	170	170	163	150	170	170	163
Av. initial weight, lbs.....	323	420	419	387	323	410	422	385
Av. final weight, lbs.....	348	407	452	402	497	586	610	564
Av. winter gain, lbs.....	25	-13	33	15	175	176	188	179
Av. daily winter gain, lbs.....	.16	-.07	.19	.09	1.16	1.03	1.04	1.10
Feed consumed per head, lbs.								
Prairie hay.....	1370	1550	1920	1613	1815	2125	2520	2153
Cottonseed cake.....					150	170	170	163
Days in summer period.....	140	150	150	147	140	150	150	147
Av. final weight, lbs.....	600	670	722	664	705	782	842	776
Av. summer gain, lbs.....	252	263	270	262	207	196	232	212
Av. daily summer gain, lbs.....	1.80	1.75	1.80	1.78	1.47	1.30	1.54	1.45
Total gain per head, lbs.....	277	250	303	277	382	372	420	391
Additional gain, lbs.....					105	122	117	115
Feed per cwt. gain, total period								
Prairie hay, lbs.....	494	620	634	583	475	571	600	550
Cottonseed cake, lbs.....					39	46	40	42
Pasture, days.....	51	60	50	53	37	40	36	37

TABLE 5.—Feeding 1 pound vs. 1.5 pound cottonseed cake, both fed with prairie hay, to wintering calves—two trials.

	Prairie hay, ad libitum 1.0 pound cottonseed cake per head daily			Prairie hay, ad libitum 1.5 pounds cottonseed cake per head daily		
	1926-27	1927-28	Average	1926-27	1927-28	Average
Number of animals.....	10	10	10	10	10	10
Days in winter period.....	150	170	160	150	170	160
Av. initial weight, lbs.....	323	410	366	323	404	363
Av. final weight, lbs.....	497	586	541	514	583	548
Av. winter gain, lbs.....	175	176	175	191	179	185
Av. daily winter gain, lbs. ...	1.16	1.03	1.09	1.27	1.05	1.16
Feed consumed per head, lbs.						
Prairie hay.....	1815	2125	1970	1695	2005	1850
Cottonseed cake.....	150	170	160	225	255	240
Days in summer period.....	140	150	145	140	150	145
Av. final weight, lbs.....	705	782	743	696	782	738
Av. summer gain, lbs.....	207	196	201	182	199	190
Av. daily summer gain, lbs.	1.47	1.30	1.39	1.30	1.32	1.31
Total gain per head, lbs. ...	382	372	377	373	378	375
Additional gain, lbs.....				-9	6	-3
Feed per cwt. gain, total period						
Prairie hay, lbs.....	475	571	522	454	530	493
Cottonseed cake, lbs.....	39	46	42	60	67	64
Pasture, days.....	37	40	38	38	40	39

Prairie hay vs. prairie hay plus 1.5 pounds cottonseed cake: Two direct comparisons between feeding 1 pound and 1.5 pounds of cottonseed cake per head daily are available. Data for these trials are presented in table 5. The calves fed 1.5 pounds of cake during the winter made slightly larger winter gains but failed to hold this advantage in the summer. In these trials there was no advantage in feeding 1.5 pounds of cake in comparison with feeding 1 pound.

Soybean oil meal. Soybean oil meal has long been a popular protein supplement in dairying and cattle-feeding sections. It was not until the pelleting process was developed that soybean oil meal became a competitor of cottonseed cake in the range area.

Tables 6 and 7 present the data for nine trials with cottonseed cake and eleven with soybean oil meal. These data are based on comparable trials. There was more variation in the winter gains from feeding cottonseed cake than from feeding soybean oil meal. The calves wintered on cottonseed cake consumed an average of 0.22 pound more hay per head daily and gained 20 pounds more per head than calves wintered on soybean oil meal, but made less summer gain. However, there was only 6 pounds per head difference in average total gain for the nine years. The difference in favor of the cottonseed cake for the first five years was 13 pounds.

TABLE 6.—Feeding 1 pound of cottonseed cake daily as a supplement to prairie hay to wintering calves—nine trials.

	Prairie hay, ad libitum 1 pound cottonseed cake									
	1935-36	1936-37	1937-38	1938-39	1939-40	1941-42	1942-43	1943-44	1944-45	Average
Number of animals	9	10	10	9	10	9	10	9	10	10
Days in winter period	168	168	168	168	168	168	168	168	168	168
Av. initial weight, lbs.	352	383	441	420	430	414	360	373	359	392
Av. final weight, lbs.	486	569	627	570	597	546	541	517	518	552
Av. winter gain, lbs.	134	186	186	150	167	132	181	144	159	160
Av. daily winter gain, lbs. ....	.80	1.10	1.10	.89	.99	.78	1.08	.86	.95	.95
Feed consumed per head, lbs.										
Prairie hay	2085	2035	2215	1765	1950	1965	2050	2085	2050	2022
Cottonseed cake	168	168	168	168	168	168	168	168	168	168
Days on grass	160	105	180	126	160	165	145	135	140	146
Av. final weight, lbs.	721	759	814	722	759	724	708	657	669	726
Av. summer gain, lbs.	235	190	187	152	162	178	167	140	151	174
Av. daily summer gain, lbs.	1.47	1.80	1.04	1.21	1.01	1.08	1.15	1.04	1.08	1.19
Total gain per head, lbs.	369	376	373	302	329	310	348	284	310	334
Additional gain over soy, lbs.	-31	45	24	-3	28	-16	17	-20	6	6
Feed per cwt. gain, total period										
Prairie hay, lbs.	565	541	594	584	593	634	589	734	661	588
Cottonseed cake, lbs.	46	45	45	56	51	54	48	59	54	51
Pasture, days	43	28	48	55	49	53	42	48	45	46

TABLE 7.—Feeding 1 pound of soybean oil meal daily as a supplement to prairie hay to wintering calves—eleven trials.

	Prairie hay, ad libitum 1 pound expeller soybean oil meal*											
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45	1945-46	Average
Number of animals	10	10	10	10	10	10	10	9	10	9	10	10
Days in winter period	168	168	168	168	168	168	168	168	168	168	168	168
Av. initial weight, lbs.	345	385	441	420	430	380	414	366	381	360	402	393
Av. final weight, lbs.	480	532	576	549	576	542	543	530	524	491	572	538
Av. winter gain, lbs.	135	147	135	129	146	162	129	164	143	131	170	145
Av. daily winter gain, lbs.....	.80	.88	.80	.76	.86	.96	.77	.98	.85	.78	1.01	.86
Feed consumed per head, lbs.												
Prairie hay	2100	1880	1915	1865	2015	2080	1880	2030	2030	2150	2000	1995
Soybean oil meal.....	168	168	168	168	168	168	168	168	168	168	168	168
Days on grass	160	105	180	126	160	160	165	145	135	140	140	147
Av. final weight, lbs.	745	716	790	725	731	711	740	697	685	664	718	720
Av. summer gain, lbs.....	265	184	214	176	155	169	197	167	161	173	146	182
Av. daily summer gain, lbs.	1.69	1.70	1.19	1.39	.96	1.06	1.19	1.15	1.19	1.23	1.04	1.24
Total gain per head, lbs.....	400	331	349	305	301	331	326	331	304	304	316	327
Feed per cwt. gain, total period												
Prairie hay, lbs.	525	568	549	611	670	628	577	613	668	707	633	613
Soybean oil meal, lbs.....	42	51	48	55	56	51	52	51	55	55	53	51
Pasture, days	40	32	52	54	53	48	51	44	44	46	44	45

* Solvent processed meal fed in the 1940-41 trial.

Linseed oil meal. Data from feeding linseed oil meal as a winter supplement are shown in table 8. Winter gains were less than those from feeding soybean or cottonseed oil meals, but there was little difference in total winter and summer gains between the three concentrates.

TABLE 8.—Feeding 1 pound of linseed oil meal pellets daily to wintering calves—three trials.

	Prairie hay, ad libitum 1 lb. linseed oil meal			
	1941-42	1942-43	1944-45	Average
Number of animals.....	10	10	10	10
Days in winter period.....	168	168	168	168
Av. initial weight, lbs.....	414	366	359	380
Av. final weight, lbs.....	539	524	484	516
Av. winter gain, lbs.....	125	158	125	136
Av. daily winter gain, lbs.....	.74	.94	.74	.81
Feed consumed per head, lbs.				
Prairie hay	1950	1980	2000	1977
Linseed oil meal pellets.....	168	168	168	168
Days on grass.....	165	145	140	150
Av. final weight, lbs.....	719	711	654	695
Av. summer gain, lbs.....	180	187	170	179
Av. daily summer gain, lbs.....	1.09	1.29	1.21	1.19
Total gain per head, lbs.....	305	345	295	315
Feed per cwt. gain, total period				
Prairie hay, lbs.....	639	574	678	630
Linseed oil meal pellets, lbs.....	55	49	57	54
Pasture, days	54	42	47	48

Mixed oil meals. Calves fed a supplement composed of equal parts of cottonseed, soybean, and linseed oil meals made the gains shown in table 9. The total winter and summer gain for three trials averaged 316 pounds. Gains from the three meals fed singly were 322, 320, and 315 pounds, respectively.

Tankage. Occasionally the price of tankage is low enough to make it an economical winter supplement for calves.

Table 10 presents data from one comparison between cottonseed cake and tankage fed at the rate of 1 pound per head daily. The calves fed tankage gained more than the calves fed cottonseed cake in both the winter and summer periods—one of the few exceptions to the winter and summer gain reversal.

Table 11 gives the results of a trial in which 0.75 pound tankage was compared with 1 pound of cottonseed cake per head daily. In this trial the two lots of calves made approximately the same summer gain but the calves fed cottonseed cake gained 33 pounds more per head during the winter. The calves did not seem to relish tankage but did eat it, and consumed slightly more hay than the calves fed cottonseed cake.

TABLE 9.—Feeding 1 pound of mixed protein pellets (equal parts of cottonseed, soybean and linseed oil meals) daily to wintering calves—three trials.

	Prairie hay, ad libitum 1 lb. mixed protein			
	1941-42	1942-43	1944-45	Average
Number of animals.....	9	10	10	10
Days in winter period.....	168	168	168	168
Av. initial weight, lbs.....	413	366	359	380
Av. final weight, lbs.....	553	529	483	522
Av. winter gain, lbs.....	140	163	124	142
Av. daily winter gain, lbs.....	.83	.97	.74	.84
Feed consumed per head, lbs.				
Prairie hay	1965	2085	2115	2055
Protein supplement	168	168	168	168
Days on grass.....	165	145	140	150
Av. final weight, lbs.....	721	717	647	695
Av. summer gain, lbs.....	168	188	164	173
Av. daily summer gain, lbs.....	1.02	1.30	1.17	1.15
Total gain per head, lbs.....	308	351	288	316
Feed per cwt. gain, total period				
Prairie hay, lbs.....	638	594	734	650
Protein supplement, lbs.....	54	48	57	53
Pasture, days	54	41	49	48

TABLE 10.—Feeding 1 pound of cottonseed cake vs. 1 pound of tankage daily to wintering calves—one trial.

	Prairie hay, ad libitum 1 lb. cottonseed cake 1935-36	Prairie hay, ad libitum 1 lb. tankage 1935-36
Number of animals.....	9	10
Days in winter period.....	168	168
Av. initial weight, lbs.....	352	357
Av. final weight, lbs.....	486	507
Av. winter gain, lbs.....	134	150
Av. daily winter gain, lbs.....	.80	.89
Feed consumed per head, lbs.		
Prairie hay	2085	2301
Cottonseed cake	168	.....
Tankage .....	.....	168
Days on grass.....	160	160
Av. final weight, lbs.....	721	752
Av. summer gain, lbs.....	235	245
Av. daily summer gain, lbs.....	1.47	1.54
Total gain per head, lbs.....	369	395
Additional gain, lbs.....	.....	26
Feed per cwt. gain, total period		
Prairie hay, lbs.....	565	583
Cottonseed cake, lbs.....	46	.....
Tankage, lbs.....	.....	43
Pasture, days	43	41

TABLE 11.—Feeding 1 pound of cottonseed cake vs. 0.75 pound of tankage daily to wintering calves—one trial.

	Prairie hay, ad libitum 1 lb. cottonseed cake 1936-37	Prairie hay, ad libitum ¾ lb. tankage 1936-37
Number of animals.....	10	10
Days in winter period.....	168	168
Av. initial weight, lbs.....	383	389
Av. final weight, lbs.....	569	542
Av. winter gain, lbs.....	186	153
Av. daily winter gain, lbs.....	1.08	.90
Feed consumed per head, lbs.		
Prairie hay	2035	2100
Cottonseed cake	168	.....
Tankage .....	.....	126
Days on grass.....	105	105
Av. final weight, lbs.....	759	735
Av. summer gain, lbs.....	190	193
Av. daily summer gain, lbs.....	1.80	1.83
Total gain per head, lbs.....	376	346
Additional gain, lbs.....	30	.....
Feed per cwt. gain, total period		
Prairie hay, lbs.....	541	610
Cottonseed cake, lbs.....	45	.....
Tankage, lbs. ....	.....	36
Pasture, days	28	30

Grain Crops as Winter Supplement

Corn and small grains are produced in the regions adjacent to the Sandhills and on a number of small tracts interspersed throughout the area.

Corn. Two pounds of shelled corn were compared with 0.75 pound cottonseed cake as a supplement to prairie hay for wintering calves in three trials. Data are presented in table 12. The quality of corn was poor in the first trial, but average in the other two. In all three trials larger gains were made by the calves fed 0.75 pound cottonseed cake. This amounted to 33 pounds per head for the combined winter and summer periods.

The calves fed corn consumed 2.5 pounds less hay per head daily than the calves fed cottonseed cake.

In 1930-31 a direct comparison was made between wintering calves on prairie hay alone vs. prairie hay plus 2 pounds of corn. The net difference in gain in the fall was only 26 pounds per head in favor of the calves fed corn.

TABLE 12.—Feeding 0.75 pound cottonseed cake vs. 2 pounds shelled corn daily to wintering calves—three trials.

	Prairie hay, ad libitum ¾ lb. cottonseed cake					Prairie hay, ad libitum 2 lbs. shelled corn				
	1930-31	1931-32	1932-33	Average		1930-31	1931-32	1932-33	Average	
Number of animals.....	10	10	10	10		10	10	9	.....
Days in winter period.....	180	180	180	180		180	180	180	180	
Av. initial weight, lbs.....	487	403	371	420		402	402	375	422	
Av. final weight, lbs.....	645	588	533	589		567	521	459	515	
Av. winter gain, lbs.....	158	185	162	168		78	119	84	94	
Av. daily winter gain, lbs.....	.88	1.03	.90	.94		.66	.47	.52	.52	
Feed consumed per head, lbs.										
Prairie hay	2680	2395	1925	2333		1960	1405	1883	1883	
Cottonseed cake	135	135	135	135		.....	.....	.....	.....
Corn .....	.....	.....	.....	.....		360	360	360	360	
Days on grass.....	150	150	150	150		150	150	150	150	
Av. final weight, lbs.....	855	733	772	786		798	719	748	755	
Av. summer gain, lbs.....	211	145	239	198		231	198	289	239	
Av. daily summer gain, lbs.....	1.40	.97	1.59	1.32		1.54	1.32	1.92	1.60	
Total gain per head, lbs.....	369	330	401	366		309	317	373	333	
Additional gain, lbs.....	60	13	28	33		.....	.....	.....	.....
Feed per cwt. gain, total period										
Prairie hay, lbs.....	726	726	480	636		739	618	377	566	
Cottonseed cake, lbs.....	37	41	34	37		.....	.....	.....	.....
Shelled corn, lbs.....	.....	.....	.....	.....		117	114	97	108	
Pasture, days	41	45	37	41		49	47	40	45	

Barley. Table 13 presents the data from one comparison between 2 pounds of ground barley and 0.75 pound cottonseed cake fed as supplements to prairie hay for wintering calves. The gains were almost identical. The calves fed cottonseed cake consumed slightly more hay. The non-supplement lot in 1930-31 made a total gain of 284 pounds which was 83 pounds less than the calves fed 2 pounds of barley.

Tables 12 and 13 also show that the calves fed 2 pounds of ground barley (1930-31) made an average gain of 58 pounds more per head for the combined winter and summer periods than calves fed 2 pounds of shelled corn.

TABLE 13.—Feeding 0.75 pound of cottonseed cake vs. 2 pounds of ground barley to wintering calves—one trial.

	Prairie hay, ad libitum 0.75 lb. cottonseed cake 1930-31	Prairie hay, ad libitum 2 lbs. ground barley 1930-31
Number of animals.....	10	10
Days in winter period.....	180	180
Av. initial weight, lbs.....	487	488
Av. final weight, lbs.....	645	644
Av. winter gain, lbs.....	158	156
Av. daily winter gain, lbs.....	.88	.86
Feed consumed per head, lbs.		
Prairie hay	2680	2415
Cottonseed cake	135	.....
Barley .....	.....	360
Days on grass.....	150	150
Av. final weight, lbs.....	855	855
Av. summer gain, lbs.....	211	211
Av. daily summer gain, lbs.....	1.40	1.40
Total gain per head, lbs.....	369	367
Additional gain, lbs.....	2	.....
Feed per cwt. gain, total period		
Prairie hay, lbs.....	726	658
Cottonseed cake, lbs.....	37	.....
Ground barley, lbs.....	.....	49
Pasture, days	41	41

Rye. In the tilled areas of the Sandhills region rye is the principal small grain grown. It fits well in a rotation with corn since it lessens wind erosion.

Table 14 shows that ground rye at the rate of 2 pounds is equivalent to 0.75 pound cottonseed cake as a winter supplement for calves which are to be sold the next fall as yearlings. The calves relished this amount of rye and probably would have taken another pound with good results. Tables 12 and 14 show that for the two years in which comparable data are available, rye produced more gain than corn.

TABLE 14.—Feeding 0.75 pound of cottonseed cake vs. 2 pounds ground rye to wintering calves—two trials.

	Prairie hay, ad libitum 0.75 lb. cottonseed cake			Prairie hay, ad libitum 2 lbs. ground rye		
	1931-32	1932-33	Average	1931-32	1932-33	Average
Number of animals.....	10	10	10	8	10	9
Days in winter period.....	180	180	180	180	180	180
Av. initial weight, lbs.....	403	371	387	404	368	386
Av. final weight, lbs.....	588	534	561	558	485	521
Av. winter gain, lbs.....	185	162	174	154	117	135
Av. daily winter gain, lbs.....	1.03	.90	.96	.85	.65	.75
Feed consumed per head, lbs.						
Prairie hay	2395	1925	2160	2020	1890	1955
Cottonseed cake.....	135	135	135	.....	.....	.....
Rye .....	.....	.....	.....	360	360	360
Days on grass.....	150	150	150	150	150	150
Av. final weight, lbs.....	733	772	753	747	755	751
Av. summer gain, lbs.....	145	239	192	189	270	230
Av. daily summer gain, lbs.....	.97	1.59	1.28	1.26	1.80	1.53
Total gain per head, lbs.....	330	401	366	343	387	365
Additional gain, lbs.....	-13	14	1	.....	.....	.....
Feed per cwt. gain, total period						
Prairie hay, lbs.....	726	480	591	589	488	536
Cottonseed cake, lbs.....	41	34	37	.....	.....	.....
Ground rye, lbs.....	.....	.....	.....	105	93	99
Pasture, days	45	37	41	44	39	41

Oats. Oats has long been a favorite ration for calves. In the Sandhills region little oats is produced so it must be trucked in. This frequently makes the cost of oats high.

The data from three trials shown in table 15 indicate that 2 pounds of oats were equivalent to 0.75 pound of cottonseed cake when compared on the basis of winter-summer gains.

Mixture of Grain and Cottonseed Oil Meal as Winter Supplement

One pound of shelled corn plus 0.5 pound of cottonseed cake were fed in comparison with 0.75 pound cottonseed cake in three trials. Data are shown in table 16. Tables 12 and 16 also afford a comparison between 2 pounds of shelled corn and 1 pound of shelled corn plus 0.5 cottonseed cake. Replacing 1 pound of corn with 0.5 pound cottonseed cake increased the hay consumption and the combined winter and summer gain 26 pounds per head. The corn and cake combination produced almost as much gain as 0.75 pound cake.

For practical purposes 0.25 pound cake was equivalent to 1 pound of shelled corn in this trial. Corn is seldom cheap enough to provide an economical substitute for cottonseed cake in wintering calves.

TABLE 15.—Feeding 0.75 pound of cottonseed cake vs. 2 pounds oats daily, both as supplement to prairie hay, to wintering calves—three trials.

	Prairie hay, ad libitum 0.75 lb. cottonseed cake				Prairie hay, ad libitum 2 lbs. oats			
	1928-29	1929-30	1930-31	Average	1928-29	1929-30	1930-31	Average
Number of animals.....	10	10	10	10	10	10	10	10
Days in winter period.....	170	180	180	177	170	180	180	177
Av. initial weight, lbs.....	422	390	487	433	422	390	488	433
Av. final weight, lbs.....	576	568	645	596	573	562	642	592
Av. winter gain, lbs.....	154	178	158	163	151	172	154	159
Av. daily winter gain, lbs.....	.90	.99	.88	.92	.89	.95	.85	.90
Feed consumption per head, lbs.								
Prairie hay	2465	2145	2680	2430	2350	2035	2505	2297
Cottonseed cake	128	135	135	133	.....	.....	.....	.....
Oats .....	.....	.....	.....	.....	340	360	360	354
Days on grass.....	150	150	150	150	150	150	150	150
Av. final weight, lbs.....	819	779	855	818	823	779	860	820
Av. summer gain, lbs.....	243	211	211	222	250	217	218	228
Av. daily summer gain, lbs.....	1.62	1.40	1.40	1.48	1.66	1.44	1.46	1.52
Total gain per head, lbs.	397	389	369	385	401	389	372	387
Additional gain, lbs.....	.....	.....	.....	.....	4	0	3	2
Feed per cwt. gain, total period								
Prairie hay, lbs.....	621	551	726	631	586	523	673	593
Cottonseed cake, lbs.....	32	35	37	34	.....	.....	.....	.....
Oats, lbs. ....	.....	.....	.....	.....	85	93	97	91
Pasture, days	38	39	41	39	37	39	40	39

TABLE 16.—Feeding 0.75 pound of cottonseed cake vs. 1 pound of shelled corn plus 0.5 pound of cottonseed cake to wintering calves—three trials.

	Prairie hay, ad libitum 0.75 cottonseed cake				Prairie hay, ad libitum 1 lb. corn and ½ lb. cottonseed cake			
	1930-31	1931-32	1932-33	Average	1930-31	1931-32	1932-33	Average
Number of animals.....	10	10	10	10	10	10	10	10
Days in winter period.....	180	180	180	180	180	180	180	180
Av. initial weight, lbs.....	487	403	371	420	488	404	367	420
Av. final weight, lbs.....	645	588	533	589	640	569	510	573
Av. winter gain, lbs.....	158	185	162	168	152	165	143	153
Av. daily winter gain, lbs.....	.88	1.03	.90	.94	.84	.91	.79	.85
Feed consumed per head, lbs.								
Prairie hay	2680	2395	1925	2333	2540	2270	2160	2323
Shelled corn .....	.....	.....	.....	.....	180	180	180	180
Cottonseed cake	135	135	135	135	90	90	90	90
Days on grass.....	150	150	150	150	150	150	150	150
Av. final weight, lbs.....	855	733	772	786	853	715	769	779
Av. summer gain, lbs.....	211	145	239	198	213	146	259	206
Av. daily summer gain, lbs.....	1.40	.97	1.59	1.32	1.42	.97	1.72	1.37
Total gain per head, lbs.....	369	330	401	366	365	311	402	359
Additional gain, lbs.....	4	19	-1	7	.....	.....	.....	.....
Feed per cwt. gain, total period								
Prairie hay, lbs.....	726	726	480	636	696	730	537	647
Cottonseed cake, lbs.....	37	41	34	37	25	29	22	25
Shelled corn, lbs.....	.....	.....	.....	.....	49	58	45	50
Pasture, days	41	45	37	41	41	48	37	42

Table 17 shows one year's results in feeding 0.5 pound cottonseed cake plus 1 pound of oats in comparison with 0.75 pound cake. The ration of cake and oats produced a total gain of 19 pounds more than the cake alone. Replacing 0.25 pound of cottonseed cake with 1 pound oats could be credited with this gain as the hay consumption was practically the same in both lots. The calves fed the cake and oats made more gain in both the winter and summer periods than the calves fed cake.

TABLE 17.—Feeding 0.75 pound of cottonseed cake vs. 0.5 pound cottonseed cake plus 1 pound oats daily to wintering calves—one trial.

	Prairie hay, ad libitum 0.75 lb. cottonseed cake	Prairie hay, ad libitum 0.5 lb. cottonseed cake 1 lb. oats
	1931-32	1931-32
Number of animals.....	10	10
Days in winter period.....	180	180
Av. initial weight, lbs.....	403	402
Av. final weight, lbs.....	588	603
Av. winter gain, lbs.....	185	201
Av. daily winter gain, lbs.....	1.03	1.11
Feed consumed per head, lbs.		
Prairie hay.....	2395	2415
Cottonseed cake.....	135	90
Oats.....	.....	180
Days on grass.....	150	150
Av. final weight, lbs.....	733	751
Av. summer gain, lbs.....	145	148
Av. daily summer gain, lbs.....	.97	.99
Total gain per head, lbs.....	330	349
Additional gain, lbs.....	.....	19
Feed per cwt. gain, total period		
Prairie hay, lbs.....	726	692
Cottonseed cake, lbs.....	41	26
Oats, lbs.....	.....	52
Pasture, days.....	45	43

Table 18 shows the results of two trials in which 1 pound of ground rye and 0.5 pound cottonseed cake were compared with 0.75 pound cottonseed cake. Here, as with the other grains, replacing 1 pound of grain with 0.5 pound of cottonseed cake increased the gain.

Commercial Mixed Protein Cubes and Pellets

Since the early twenties the commercial feed manufacturers have been bidding for a part of the protein supplement business of the range area. The first product was the 12 per cent protein molasses

TABLE 18.—Feeding 0.75 pound of cottonseed cake vs. 0.5 pound cottonseed cake plus 1 pound of ground rye daily to wintering calves—two trials.

	Prairie hay, ad libitum 0.75 lb. cottonseed cake			Prairie hay, ad libitum 0.5 lb. cottonseed cake 1 lb. ground rye		
	1931-32	1932-33	Average	1931-32	1932-33	Average
Number of animals.....	10	10	10	9	10	9+
Days in winter period.....	180	180	180	180	180	180
Av. initial weight, lbs.....	403	371	387	405	370	388
Av. final weight, lbs.....	588	533	560	596	538	567
Av. winter gain, lbs.....	185	162	173	191	168	179
Av. daily winter gain, lbs.....	1.03	.90	.97	1.06	.93	1.00
Feed consumed per head lbs.						
Prairie hay.....	2395	1925	2160	2340	2130	2235
Cottonseed cake, lbs.....	135	135	135	90	90	90
Ground rye.....	.....	.....	.....	180	180	180
Days on grass.....	150	150	150	150	150	150
Av. final weight, lbs.....	733	772	753	771	791	781
Av. summer gain, lbs.....	145	239	192	175	253	214
Av. daily summer gain, lbs.....	.97	1.59	1.28	1.18	1.69	1.43
Total gain per head, lbs.....	330	401	365	366	421	393
Additional gain, lbs.....	.....	.....	.....	36	20	28
Feed per cwt. gain, total period						
Prairie hay, lbs.....	726	480	591	639	506	568
Cottonseed cake, lbs.....	41	34	37	25	21	23
Ground rye, lbs.....	.....	.....	.....	49	43	46
Pasture, days.....	45	37	41	41	36	38

cube. It was soon learned that this product did not contain sufficient protein to properly supplement the native hay. Feed manufacturers began to increase the protein content of their feeds and stopped at 22 per cent because by further reducing the molasses content, a crumbly product resulted. Later, a process was developed whereby various mixtures or even oil meal alone could be pelleted into a range feed.

Table 19 shows the results of feeding 0.75 pound of 12 per cent cubes as a winter supplement. The 135 pounds of cubes produced only 21 pounds of additional gain by marketing time. By referring to table 3 it may be noted that in the same period, 0.75 pound cottonseed cake produced 84 pounds additional gain.

Table 20 shows the comparative value of cottonseed cake and 12 per cent protein cubes as supplements to prairie hay and grass. During the wintering period the calves fed cottonseed cake gained 29 pounds more but on grass the gains were the same. Neither supplement proved profitable on grass in this trial.

TABLE 19.—Feeding prairie hay vs. prairie hay plus 0.75 pound of 12 per cent protein cubes daily to wintering calves—one trial.

	Prairie hay, ad libitum	Prairie hay, ad libitum 0.75 lb. 12% protein cubes
	1929-30	1929-30
Number of animals.....	10	10
Days in winter period.....	180	180
Av. initial weight, lbs.....	391	393
Av. final weight, lbs.....	433	486
Av. winter gain, lbs.....	42	93
Av. daily winter gain, lbs.....	.23	.51
Feed consumed per head, lbs.		
Prairie hay.....	1965	2020
12% protein cubes.....	.....	135
Days on grass.....	150	150
Av. final weight, lbs.....	696	719
Av. summer gain, lbs.....	263	233
Av. daily summer gain, lbs.....	1.70	1.55
Total gain per head, lbs.....	305	326
Additional gain, lbs.....	.....	21
Feed per cwt. gain, total period		
Prairie hay, lbs.....	644	629
12% protein cubes, lbs.....	.....	41
Pasture, days.....	49	46

TABLE 20.—Feeding cottonseed cake vs. 12 per cent protein cubes both as supplements to prairie hay and grass—one trial.

	Prairie hay 0.75 lb. cottonseed cake 1 lb. cake on grass	Prairie hay 0.75 lb. cubes 1 lb. cubes on grass
	1929-30	1929-30
Number of animals.....	10	10
Days in winter period.....	180	180
Av. initial weight, lbs.....	392	391
Av. final weight, lbs.....	532	502
Av. winter gain, lbs.....	140	111
Av. daily winter gain, lbs.....	.77	.61
Feed consumed per head, lbs.		
Prairie hay.....	1965	1965
Cottonseed cake.....	135	.....
12% protein cubes.....	.....	135
Days on grass.....	150	150
Av. final weight, lbs.....	788	758
Av. summer gain, lbs.....	256	256
Av. daily summer gain, lbs.....	1.70	1.70
Cottonseed cake on grass, lbs.....	150	.....
12% protein cubes on grass, lbs.....	.....	150
Total gain per head, lbs.....	396	367
Additional gain, lbs.....	29	.....
Feed per cwt. gain, total period		
Prairie hay, lbs.....	496	535
Cottonseed cake, lbs.....	72	.....
12% protein cubes, lbs.....	.....	78
Pasture, days.....	38	41

Table 21 shows the value of 1 pound of cottonseed cake vs. two different 12 per cent and one 22 per cent protein cube supplements. The winter gain from the two 12 per cent cubes was the same, but there was a 7-pound difference in the summer gain. The calves fed the 22 per cent protein cubes showed 27 pounds more winter gain per head than those fed 12 per cent cubes. But when they were weighed off grass they showed only 2 pounds advantage over one lot fed 12 per cent cubes and 9 pounds advantage over another lot fed the 12 per cent cubes.

The calves fed 12 per cent protein cubes averaged 332 pounds total gain and those fed 22 per cent protein cubes 338 pounds compared with 373 pounds by calves fed cottonseed cake.

During the winter of 1945-46 two lots of calves were fed different brands of 32 per cent protein pellets at the rate of 1 pound per head daily. The winter gains were 172 and 176 pounds respectively compared with 179 pounds from feeding 1 pound of soybean oil meal plus 0.04 pound of bone meal and 169 pounds from 0.75 pound of soybean oil meal plus 0.06 pound of bone meal. There was also no significant difference in the summer gain.

TABLE 21.—Feeding 1 pound of cottonseed cake vs. 1 pound of commercial cubes to wintering calves—one trial.

	Prairie hay ad libitum 1 lb. cottonseed cake	Prairie hay ad libitum 1 lb. 12% protein cubes (A)	Prairie hay ad libitum 1 lb. 12% protein cubes (B)	Prairie hay ad libitum 1 lb. 22% protein cubes
	1937-38	1937-38	1937-38	1937-38
Number of animals.....	10	10	10	10
Days in winter period.....	168	168	168	168
Av. initial weight, lbs.....	441	441	441	441
Av. final weight, lbs.....	627	556	556	583
Av. winter gain, lbs.....	186	115	115	142
Av. daily winter gain, lbs.....	1.10	.68	.68	.84
Feed consumed per head, lbs.				
Prairie hay.....	2215	1930	1965	1965
Cottonseed cake.....	168	.....	.....	.....
Commercial cubes.....	.....	168	168	168
Days in summer period.....	180	180	180	180
Av. final weight, lbs.....	814	770	777	779
Av. summer gain, lbs.....	187	214	221	196
Av. daily summer gain, lbs.....	1.04	1.18	1.22	1.08
Total gain per head, lbs.....	373	329	336	338
Pounds less gain.....	.....	-44	-37	-35
Feed per cwt. gain, total period				
Prairie hay, lbs.....	594	587	585	581
Cottonseed cake, lbs.....	45	.....	.....	.....
Commercial cubes, lbs.....	.....	51	50	50
Pasture, days.....	47	55	54	53

TABLE 22.—Feeding 1 pound cottonseed cake vs. 1 pound 22 per cent protein cubes daily to wintering calves—one trial.

	Prairie hay, ad libitum 1 lb. cottonseed cake	Prairie hay, ad libitum 1 lb. 22% cubes
	1938-39	1938-39
Number of animals.....	9	10
Days in winter period.....	168	168
Av. initial weight, lbs.....	420	420
Av. final weight, lbs.....	570	522
Av. winter gain, lbs.....	150	102
Av. daily winter gain, lbs.....	.89	.60
Feed consumed per head, lbs.		
Prairie hay	1765	1780
Cottonseed cake	168	
Commercial cubes		168
Days on grass.....	126	126
Av. final weight, lbs.....	722	679
Av. summer gain, lbs.....	152	175
Av. daily summer gain, lbs.....	1.20	1.39
Total gain per head, lbs.....	302	277
Additional gain, lbs.....	25	.....
Feed per cwt. gain, total period		
Prairie hay, lbs.....	584	643
Cottonseed cake, lbs.....	56	.....
22% protein cubes, lbs.....	.....	61
Pasture, days	55	60

Legume Hay as Winter Supplement

Alfalfa. The production of legume hay in the Sandhills region is rather limited but where it can be grown it offers a solution to the protein problem.

Table 23 shows the value of feeding 4.5 pounds of alfalfa hay plus prairie hay in comparison with prairie hay alone. Feeding 4.5 pounds of alfalfa hay with prairie hay increased the winter gain 99 pounds per head and the total hay consumption 595 pounds. Balancing the ration with alfalfa hay stimulated the animals' appetites as was also noted with cottonseed cake. The increased gain may be attributed to the additional hay consumed as well as to the added protein.

Table 3 (page 11) shows that gains for calves fed 0.75 pound of cottonseed cake (1928-29) were approximately the same as in the lot fed 4.5 pounds of alfalfa hay, and that the feed consumption was approximately the same.

Table 24 presents data from a trial in which prairie hay plus 0.75 pound cottonseed cake were compared with alfalfa hay for wintering calves. The alfalfa hay was choice third-cutting hay and consumption of hay was 865 pounds more per head than in the prairie hay lot. Unless alfalfa hay is available at about the same price as prairie hay it is more economical to feed 4 or 5 pounds of alfalfa with prairie hay.

TABLE 23.—Feeding prairie hay vs. prairie hay plus 4.5 pounds of alfalfa hay daily to wintering calves—one trial.

	Prairie hay, ad libitum	Prairie hay, ad libitum 4.5 lbs. alfalfa hay
	1928-29	1928-29
Number of animals.....	10	10
Days in wintering period.....	170	170
Av. initial weight, lbs.....	419	421
Av. final weight, lbs.....	452	553
Av. winter gain, lbs.....	33	132
Av. daily winter gain, lbs.....	.19	.77
Feed consumed per head, lbs.		
Prairie hay	1920	1750
Alfalfa hay .....	.....	765
Days on grass.....	150	150
Av. final weight, lbs.....	722	812
Av. summer gain, lbs.....	270	259
Av. daily summer gain, lbs.....	1.80	1.72
Total gain per head, lbs.....	303	391
Additional gain, lbs.....	.....	88
Feed per cwt. gain, total period		
Prairie hay, lbs.....	634	448
Alfalfa hay, lbs.....	.....	196
Pasture, days	50	38

TABLE 24.—Feeding prairie hay plus 0.75 pound of cottonseed cake daily vs. alfalfa hay to wintering calves.

	Prairie hay, ad libitum 0.75 lb. cottonseed cake	Alfalfa hay, ad libitum
	1932-33	1932-33
Number of animals.....	10	10
Days in winter period.....	180	180
Av. initial weight, lbs.....	371	365
Av. final weight, lbs.....	533	617
Av. winter gain, lbs.....	162	252
Av. daily winter gain, lbs.....	.90	1.40
Feed consumed per head, lbs.		
Prairie hay	1925	.....
Alfalfa hay .....	.....	2790
Cottonseed cake	135	.....
Days in summer period.....	150	150
Av. final weight, lbs.....	772	823
Av. summer gain, lbs.....	239	206
Av. daily summer gain, lbs.....	1.59	1.37
Total gain per head, lbs.....	401	458
Additional gain, lbs.....	.....	57
Feed per cwt. gain, total period		
Prairie hay, lbs.....	480	.....
Cottonseed cake, lbs.....	34	.....
Alfalfa hay, lbs.....	.....	609
Pasture, days	37	33

Mixed clover. Many acres of the subirrigated meadows of the Sandhills produce a mixed clover hay, the result of seeding red and alsike clover in the native sod.

Table 25 shows the results obtained from two trials in which prairie hay was compared with mixed clover hay. The mixed hay fed in the first trial was approximately one-third clover; that fed in the second trial approximately one-fifth clover.

The additional gain for the combined winter and summer periods averaged 75 pounds per head in favor of the mixed hay. This was comparable to results obtained from feeding from 0.5 to 0.75 pound of cottonseed cake.

TABLE 25.—Feeding prairie hay vs. mixed clover hay to wintering calves—two trials.

	Prairie hay ad libitum			Mixed clover hay ad libitum		
	1926-27	1927-28	Average	1926-27	1927-28	Average
Number of animals.....	10	10	10	10	10	10
Days in wintering period....	150	170	160	150	170	160
Av. initial weight, lbs.....	323	420	372	323	391	357
Av. final weight, lbs.....	348	407	378	478	470	474
Av. winter gain, lbs.....	25	-13	6	155	79	117
Av. daily winter gain, lbs.....	.16	-.07	.037	1.03	.46	.74
Feed consumed per head, lbs.						
Prairie hay	1370	1550	1460	.....	.....	.....
Mixed hay .....	.....	.....	.....	1890	2110	2000
Days on grass.....	140	150	145	140	150	145
Av. final weight, lbs.....	600	670	635	685	706	695
Av. summer gain, lbs.....	252	263	257	207	236	221
Av. daily summer gain, lbs.	1.80	1.75	1.77	1.48	1.57	1.52
Total gain per head, lbs.....	277	250	263	362	315	338
Additional gain, lbs.....	.....	.....	.....	85	65	75
Feed per cwt. gain, total period						
Prairie hay, lbs.....	495	620	554	.....	.....	.....
Mixed hay, lbs.....	.....	.....	.....	522	670	591
Pasture, days	51	60	55	39	48	43

Mineral Supplements

The phosphorus content of Sandhills meadow hay is relatively low, averaging around 0.10 per cent. It may run as low as 0.05 per cent. The amount of hay consumed by a weanling calf does not supply sufficient phosphorus to meet the requirements for normal growth. In the wintering tests at Valentine, additional phosphorus was supplied with steamed bone meal or monocalcium phosphate. Bone meal was fed alone and in a simple mixture with ground limestone and salt. Ground limestone was also fed alone in four trials.

TABLE 26.—Feeding prairie hay vs. prairie hay plus steamed bone meal to wintering calves—one trial.

	Prairie hay ad libitum	Prairie hay bone meal ad libitum
	1927-28	1927-28
Number of animals.....	10	10
Days in winter period.....	170	170
Av. initial weight, lbs.....	420	415
Av. final weight, lbs.....	407	418
Av. winter gain, lbs.....	-13	3
Av. daily winter gain, lbs.....	-.07	.02
Feed consumed per head, lbs.		
Prairie hay	1550	1700
Bone meal .....	.....	6
Days on grass.....	150	150
Av. final weight, lbs.....	670	687
Av. summer gain, lbs.....	263	269
Av. daily summer gain, lbs.....	1.75	1.81
Total gain per head, lbs.....	250	272
Additional gain, lbs.....	.....	22
Feed per cwt. gain, total period		
Prairie hay, lbs.....	620	625
Bone meal, lbs.....	.....	2.2
Pasture, days	60	55

Steamed bone meal with prairie hay. The results obtained from feeding steamed bone meal as a supplement to prairie hay during the winter of 1927-28 are shown in table 26.

The calves fed steamed bone meal in addition to prairie hay made an average gain per head of 22 pounds more than the calves fed prairie hay without the mineral. This was a small increase in gain compared with that obtained from feeding protein supplements, so for a number of years all of the wintering tests were devoted to protein supplements.

The droughts of the 1930's focused attention on the question of mineral supplements. The question was further augmented by the fact that soybean oil meal did not produce as large gains as cottonseed cake and that it was thought this difference might be accounted for, partially at least, by the difference in the phosphorus content of the two products.

Wintering tests conducted during the 1940's with soybean oil meal plus steamed bone meal showed little increase in total gain over feeding the soybean oil meal alone. Steamed bone meal or monocalcium phosphate proved beneficial in winter supplements containing urea.

Mineral mixture with prairie hay and soybean oil meal. Table 27 shows the results of four trials in which a mineral mixture was added to a ration of prairie hay and soybean oil meal. The mineral consisted of 40 parts steamed bone meal, 40 parts ground limestone, and 20 parts

TABLE 27.—Feeding 1 pound of soybean meal vs. 1 pound of expeller soybean oil meal plus 0.1 pound mineral (40-40-20) daily to wintering calves—four trials.

	Prairie hay, ad libitum 1 lb. expeller soybean oil meal				Prairie hay, ad libitum 1 lb. expeller soybean oil meal plus 0.1 lb. mineral mixture			
	1937-38	1938-39	1939-40	Average	1937-38	1938-39	1939-40	Average
Number of animals.....	10	10	10	10	10	10	10	10
Days in winter period.....	168	168	168	168	168	168	168	168
Av. initial weight, lbs.....	441	420	430	418	441	420	430	418
Av. final weight, lbs.....	576	549	576	561	621	570	615	592
Av. winter gain, lbs.....	135	129	146	135	180	150	185	174
Av. daily winter gain, lbs.....	.80	.76	.86	.80	1.07	.89	1.10	1.08
Feed consumed per head, lbs.....	1915	1865	2015	1905	2050	1915	2100	2059
Prairie hay.....	168	168	168	168	168	168	168	168
Soybean oil meal.....					16.8	16.8	16.8	16.8
Mineral mixture.....								
Days on grass.....	180	126	160	155	180	126	160	154
Av. final weight, lbs.....	790	725	731	741	799	745	763	710
Av. summer gain, lbs.....	214	176	155	180	178	175	148	163
Av. daily summer gain, lbs.....	1.19	1.39	.97	1.16	.98	1.39	.92	.99
Total gain per head, lbs.....	349	305	301	318	338	326	333	337
Additional gain, lbs.....					9	20	32	13
Feed per cwt. gain, total period.....	549	611	669	609	573	589	631	611
Prairie hay, lbs.....	48	55	56	50	47	52	50	51
Soybean oil meal, lbs.....					4.7	5.2	5.0	5.1
Mineral, lbs.....					50	51	48	49
Pasture, days.....	52	54	53	44	50	51	48	49

salt and was fed mixed with the soybean oil meal at the rate of 0.1 pound per head daily.

As an average of the four trials, the calves fed the mineral gained 30 pounds more per head during the winter but 17 pounds less on grass, thus giving a net additional gain of 13 pounds for the calves fed the mineral during the wintering period.

Mineral mixture with prairie hay and cottonseed cake. Table 28 shows the results of two trials in which the mineral mixture was fed with cottonseed cake as a winter supplement. As might be expected the additional gain was not as great as with soybean oil meal because the phosphorus content of soybean oil meal is only approximately 60 per cent that of cottonseed cake.

Under normal conditions in this area the phosphorus requirement of a weaned calf is apparently supplied by feeding 1 pound of cottonseed cake with prairie hay, although this ration supplies somewhat less phosphorus intake than that suggested by the National Research Council.

TABLE 28.—Feeding 1 pound of cottonseed cake vs. 1 pound of cottonseed cake plus 0.1 pound of mineral daily to wintering calves—two trials.

	Prairie hay, ad libitum 1 lb. cottonseed cake			Prairie hay, ad libitum 1 lb. cottonseed cake plus 0.1 lb. mineral*		
	1938-39	1939-40	Average	1938-39	1939-40	Average
Number of animals.....	9	10	.....	10	10	.....
Days in winter period.....	168	168	168	168	168	168
Av. initial weight, lbs.....	420	430	425	420	430	425
Av. final weight, lbs.....	570	597	583	577	604	590
Av. winter gain, lbs.....	150	167	159	157	174	165
Av. daily winter gain, lbs.....	.89	.99	.94	.93	1.04	.99
Feed consumed per head, lbs.....						
Prairie hay.....	1765	1950	1858	1780	2085	1933
Cottonseed cake.....	168	168	168	168	168	168
Mineral.....				16.8	16.8	16.8
Days on grass.....	126	160	143	126	160	143
Av. final weight, lbs.....	722	759	740	744	750	747
Av. summer gain, lbs.....	152	162	157	167	146	157
Av. daily summer gain, lbs.....	1.21	1.01	1.11	1.32	.91	1.11
Total gain per head, lbs.....	302	329	316	324	320	322
Additional gain, lbs.....	.....	*.....	.....	22	-9	6
Feed per cwt. gain, total period, lbs.....						
Prairie hay.....	584	593	589	549	642	600
Cottonseed cake.....	56	51	53	52	53	52
Mineral.....	55	49	52	51	50	50

* 2 parts steamed bone meal, 2 parts ground limestone, and 1 part salt.

TABLE 29.—Feeding 0.5 pound of soybean oil meal daily with and without 0.08 pound of steamed bone meal to wintering calves—three trials.

	Prairie hay, ad libitum 0.5 lb. soybean oil meal			Prairie hay, ad libitum 0.5 lb. soybean oil meal 0.08 lb. steamed bone meal		
	1943-44	1944-45	1945-46	1943-44	1944-45	1945-46
Number of animals	10	9	10	10	10	10
Days in winter period	168	168	168	168	168	168
Av. initial weight, lbs.	371	364	379	371	359	402
Av. final weight, lbs.	479	440	504	474	508	565
Av. winter gain, lbs.	108	76	125	103	137	163
Av. daily winter gain, lbs.	.64	.45	.74	.61	.82	.97
Feed consumed per head, lbs.						
Prairie hay	1915	1850	1945	1903	1965	2035
Soybean oil meal	84	84	84	84	84	84
Steamed bone meal				13.4	13.04	13.4
Days on grass	135	140	140	138	140	140
Av. final weight, lbs.	640	650	690	660	650	741
Av. summer gain, lbs.	161	210	186	186	172	176
Av. daily summer gain, lbs.	1.19	1.50	1.33	1.34	1.16	1.26
Total gain per head, lbs.	269	286	311	289	294	339
Additional gain, lbs.					25	28
Feed per cwt. gain, total period					5	19
Prairie hay, lbs.	712	647	625	661	668	600
Soybean oil meal, lbs.	31	29	27	29	29	25
Steamed bone meal, lbs.					4.6	4.0
Pasture, days	50	49	45	48	46	41
						45

Bone meal with prairie hay and soybean oil meal. Tables 29, 30, 31 and 32 give the data obtained from winter feeding soybean oil meal at the rates of 0.5, 0.75, and 1 pound per head daily both with and without steamed bone meal. The increase in winter gain due to feeding the bone meal was the largest with the 0.5-pound rate of soybean oil meal. The average total gains for three trials with the three rates of soybean oil meal with bone meal were 308, 305, and 312 pounds per head, and without bone meal 289, 294, and 308 pounds respectively.

Calves fed steamed bone meal free choice in one trial with 0.5 pound of soybean oil meal gained 15 pounds less than calves fed 0.08 pound of steamed bone meal daily. Likewise, calves fed steamed bone meal free choice with 1 pound of soybean oil meal gained 12 pounds less than calves fed 0.04 pound of steamed bone meal daily. Since a certain amount of bone meal is lost by wind when fed free choice, it is difficult to estimate consumption.

TABLE 30.—Feeding 0.75 pound of soybean oil meal to wintering calves—five trials.

	Prairie hay, ad libitum 0.75 pound soybean oil meal					
	1941-42	1942-43	1943-44	1944-45	1945-46	Average
Number of animals	9	10	10	10	10	10
Days in winter period	168	168	168	168	168	168
Av. initial weight, lbs.	420	366	371	359	395	382
Av. final weight, lbs.	516	504	494	462	543	504
Av. winter gain, lbs.	96	138	123	103	148	122
Av. daily winter gain, lbs.	.57	.82	.73	.61	.88	.73
Feed consumed per head, lbs.						
Prairie hay	1900	1900	1950	1965	2010	1945
Soybean oil meal	126	126	126	126	126	126
Days on grass	165	145	135	140	140	145
Av. final weight, lbs.	710	693	652	644	712	682
Av. summer gain, lbs.	194	189	158	182	169	178
Av. daily summer gain, lbs.	1.17	1.30	1.17	1.30	1.21	1.23
Total gain per head, lbs.	290	327	281	285	317	300
Feed per cwt. gain, total period						
Prairie hay, lbs.	655	581	694	689	634	648
Soybean oil meal, lbs.	43	39	45	44	40	42
Pasture, days	57	44	48	49	44	48

TABLE 31.—Feeding 0.75 pound of soybean oil meal plus 0.06 pound of steamed bone meal daily to wintering calves—five trials.

	Prairie hay, ad libitum 0.06 pound steamed bone meal 0.75 pound soybean oil meal					Average
	1941-42	1942-43	1943-44	1944-45	1945-46	
Number of animals.....	10	10	10	10	10	10
Days in winter period.....	168	168	168	168	168	168
Av. initial weight, lbs.....	414	366	376	359	403	384
Av. final weight, lbs.....	528	516	517	494	572	526
Av. winter gain, lbs.....	114	150	141	135	169	142
Av. daily winter gain, lbs....	.68	.89	.84	.80	1.00	.85
Feed consumed per head, lbs.						
Prairie hay	1930	1950	2015	1930	2000	1965
Soybean oil meal	126	126	126	126	126	126
Steamed bone meal	10	10	10	10	10	10
Days on grass	165	145	135	140	140	145
Av. final weights, lbs.....	701	706	660	657	736	692
Av. summer gain, lbs.....	173	190	143	163	164	166
Av. daily summer gain, lbs..	1.05	1.31	1.06	1.16	1.17	1.14
Total gain per head, lbs. ...	287	340	284	298	333	308
Additional gain due to mineral, lbs.	-3	13	3	13	16	8
Feed per cwt. gain, total period						
Prairie hay, lbs.....	672	573	709	648	600	638
Soybean oil meal, lbs.....	44	37	44	42	38	41
Steamed bone meal, lbs.	3.5	2.9	3.5	3.4	3.0	3.3
Pasture, days	57	43	48	47	42	47

TABLE 32.—Feeding 1 pound soybean oil meal with 0.04 pound of steamed bone meal daily to wintering calves—six trials.

	Prairie hay, ad libitum 1 pound soybean oil meal, 0.04 pound steamed bone meal						Average
	1940-41	1941-42	1942-43	1943-44	1944-45	1945-46	
Number of animals.....	10	9	10	10	10	10	10
Days in winter period.....	168	168	168	168	168	168	168
Av. initial weight, lbs.....	379	422	366	371	359	410	384
Av. final weight, lbs.....	558	533	523	533	514	589	541
Av. winter gain, lbs.....	179	111	157	162	155	179	157
Av. daily winter gain, lbs.	1.07	.66	.93	.96	.92	1.06	.93
Feed consumed per head, lbs.							
Prairie hay	2020	1880	2050	2050	2115	2135	2040
Soybean oil meal.....	168	168	168	168	168	168	168
Steamed bone meal.....	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Days on grass	150	165	145	135	140	140	146
Av. final weight, lbs.....	728	723	705	648	677	752	705
Av. summer gain, lbs.....	170	190	182	115	163	163	164
Av. daily summer gain, lbs.	1.13	1.15	1.25	.85	1.16	1.16	1.12
Total gain per head, lbs..	349	301	339	277	318	342	321
Additional gain due to mineral,* lbs.	18	-25	8	-27	14	26	2.5
Feed per cwt. gain, total period							
Prairie hay, lbs.....	579	624	605	740	665	624	635
Soybean oil meal, lbs....	48	56	50	61	53	49	63
Steamed bone meal, lbs.	1.9	2.2	2.0	2.4	2.1	2.0	2.1
Pasture, days	43	55	43	49	44	41	45

* See table 7 for gains obtained from soybean oil meal alone.

Ground limestone with soybean oil meal. The effect of feeding 0.1 pound of ground limestone with 1 pound of soybean oil meal is shown in table 33. Winter gains were depressed in each trial. This is not surprising since an excess of calcium in relation to phosphorus frequently proves to be undesirable.

Steamed bone meal with distillers' dried grains and dried solubles. During the winter of 1944-45 two lots of calves weighing 359 pounds were fed prairie hay ad lib supplemented with 1 pound of a half-and-half mixture of distillers' dried grains and dried solubles. The supplement averaged 27 per cent protein. In addition to this supplement, one lot received 0.04 pound of steamed bone meal per head daily. There was no difference in the winter gain, but the calves fed the bone meal averaged 12 pounds more total gain at the close of the grazing period. These gains were 294 and 306 pounds and compare favorably with the gains from feeding 1 pound of the oil meals that year.

TABLE 33.—Feeding 1 pound of soybean oil meal with and without 0.1 pound of ground limestone daily to wintering calves—three trials.

	Prairie hay, ad libitum 1 pound soybean oil meal				Prairie hay, ad libitum 1 pound soybean oil meal 0.1 pound ground limestone			
	1941-42	1942-43	1943-44	Average	1941-42	1942-43	1943-44	Average
Number of animals	10	9	10	10	10	9	10	10
Days in winter period	168	168	168	168	168	168	168	168
Av. initial weight, lbs.	414	366	381	387	428	373	381	394
Av. final weight, lbs.	543	530	524	532	545	525	503	524
Av. winter gain, lbs.	129	164	143	145	117	152	122	130
Av. daily winter gain, lbs. ....	.77	.98	.85	.86	.70	.90	.73	.77
Feed consumed per head, lbs.								
Prairie hay	1880	2030	2030	1980	2035	2015	2015	2032
Soybean oil meal	168	168	168	168	168	168	168	168
Ground limestone					16.8	16.8	16.8	16.8
Days on grass	165	145	135	148	165	145	135	148
Av. final weight, lbs.	740	697	685	707	729	713	659	700
Av. summer gain, lbs.	197	167	161	175	184	188	156	176
Av. daily summer gain, lbs.	1.19	1.15	1.19	1.18	1.12	1.30	1.15	1.19
Total gain per head, lbs.	326	331	304	320	301	340	278	306
Additional gain, lbs.	25	-9	26	14				
Feed per cwt. gain, total period								
Prairie hay, lbs.	577	613	668	619	676	593	725	661
Soybean oil meal, lbs.	52	51	55	53	56	49	60	55
Ground limestone, lbs.					5.6	4.9	6.0	5.5
Pasture, days	51	44	44	46	55	43	49	49

Mixed supplements. Mixed supplements consisting of alfalfa meal, soybean oil meal, ground corn, urea, and steamed bone meal in various combinations were fed to 11 lots of calves during the winter of 1946-47. Data for the wintering and grazing periods are shown in table 34. The amount of supplement and formulation of ingredients was adjusted so as to supply approximately the same daily intake of protein (nitrogen \times 6.25) in each lot. Sufficient steamed bone meal was included in the supplements of seven lots to bring the daily intake of phosphorus per calf up to about 12 grams. This amount of phosphorus in the ration stimulated the appetite of the calves to the extent that they consumed about 24 per cent more prairie hay than calves receiving low phosphorus rations.

Winter gains were directly correlated with the total digestible nutrient intake. T.D.N. is the total amount of digestible material in the crude protein, carbohydrates, and fat consumed by the animal and is usually expressed in pounds of daily intake or pounds per unit of gain. The four high gaining lots were 5, 9, 10, and 11 ranging from 179 to 186 pounds. The intake of T.D.N. per hundred pounds of gain for this group averaged 611 pounds. The next group, lots 2, 3, and 4, gained 150 to 164 pounds with an average intake of 681 pounds of T.D.N. per hundred pounds of gain. The other four lots, 1, 6, 7, and 8, gained 115 to 129 pounds with an average intake of 782 pounds of T.D.N. per hundred pounds of gain. At the close of the grazing season there was less spread in gains than at the end of the winter feeding period, because those lots that gained little in winter made up by gaining more during the summer. However, the group that made high gains during the winter averaged 22 pounds per head more than the second group and 29 pounds more than the third group at the end of the grazing season. The composition of the supplements fed the four high gaining lots consisted of soybean oil meal and steamed bone meal or various percentages of soybean oil meal, ground corn, urea, and steamed bone meal.

These feeding trials indicate that urea may be substituted for part of the protein in a supplement for wintering calves. Even though the total gains from the supplements based on sun-cured alfalfa meal were a little lower than those based on soybean oil meal, the efficiency of gain for the winter and summer period was about the same, assuming they ate the same amount of grass.

Mixed supplements consisting of dehydrated alfalfa, oil meals, urea, ground corn, ground limestone, and monocalcium phosphate in various combinations were fed to 15 calves during the winter of 1947-48 in comparison to feeding no supplement to one lot. Data for the wintering and grazing periods are shown in table 35.

Inadequate protein in the rations of lots 1, 13, and 14 resulted in low consumption of hay and the lowest winter gains—4, 41, and 40

TABLE 34.—Supplements fed with prairie hay to wintering calves November 20, 1946, to May 7, 1947, 168 days. Ten calves per lot. Hay fed ad libitum. Heifers grazed for 140 days on native grass, May 7, 1947, to September 24, 1947. Average weight into wintering lots, approximately 400 pounds per head.

Lot number	1	2	3	4	5	6	7	8	9	10	11
Average daily feed per head, lbs.											
Prairie hay	9.5	11.7	12.2	11.9	11.8	9.6	10.1	9.7	12.3	12.0	12.3
Supplement (pelleted)	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Composition of supplement, per cent											
Alfalfa meal	100.0	80.0	60.2	40.3	.....	.....	.....	.....	.....	.....	.....
Soybean oil meal .....	.....	.....	22.6	45.6	92.9	20.0	40.0	60.0	18.1	36.1	55.0
Ground corn .....	.....	.....	.....	.....	.....	70.0	52.5	35.0	63.3	48.0	32.0
Urea .....	.....	10.0	7.7	5.2	.....	10.0	7.5	5.0	9.1	6.9	4.6
Steamed bone meal .....	.....	10.0	9.5	8.9	7.1	.....	.....	.....	9.5	9.0	8.4
Average gain per head, lbs.											
Winter	129	150	157	164	186	127	120	115	179	184	186
Summer	183	170	143	170	162	183	181	205	160	150	152
Total gain per head, lbs.	312	320	300	334	348	310	301	321	339	334	338
Feed per cwt. gain, total period											
Prairie hay, lbs.	511	614	683	599	569	519	563	508	609	603	611
Alfalfa, lbs.	135	42	34	20	.....	.....	.....	.....	.....	.....	.....
Soybean, lbs. ....	.....	.....	13	23	45	11	22	31	9	18	27
Corn, lbs. ....	.....	.....	.....	.....	.....	38	29	18	31	24	16
Urea, lbs. ....	.....	5	4	3	.....	5	4	3	5	4	2
Bone meal, lbs. ....	.....	5	5	5	3	.....	.....	.....	5	5	4
Pasture, days	45	44	47	42	40	45	47	44	41	42	41

TABLE 35.—Supplements fed with prairie hay to wintering calves November 26, 1947, to May 12, 1948, 168 days. Ten calves per lot. Hay fed ad libitum. Heifers grazed for 120 days on native grass, May 12, to Sept. 9, 1948; average weight into wintering lots, approximately 480 pounds per head.

Lot number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Av. daily feed per head, lbs.																
Prairie hay	10.7	12.1	13.8	13.0	13.2	13.0	12.8	12.7	11.2	12.2	13.1	12.1	10.3	10.5	12.6	13.0
Supplement (pelleted) .....	.....	1.0	1.0	1.1	1.1	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Composition of supplement, per cent:																
Soybean oil meal	100.0	95.9	90.9	90.9	99.1	.....	.....	32.0	.....	.....	.....	.....	.....	.....	.....	.....
Cottonseed meal .....	.....	.....	.....	.....	.....	.....	97.4	32.0	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal .....	.....	.....	.....	.....	.....	.....	.....	32.0	.....	.....	.....	.....	.....	.....	.....	.....
Dehydrated alfalfa .....	.....	.....	.....	.....	.....	.....	.....	.....	97.3	94.0	84.3	47.0	.....	.....	.....	.....
Ground corn .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.0	100.0	94.2	86.7	81.5
Ground limestone .....	.....	.....	.....	9.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Monocalcium phosphate .....	.....	.....	4.1	.....	9.1	0.9	2.6	4.0	2.7	6.0	6.1	6.1	.....	5.8	.....	6.0
Urea .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9.6	10.9	.....	.....	13.3	12.5
Av. gain per head, lbs.																
Winter	4	99	152	118	154	190	144	135	146	112	146	127	41	40	99	141
Summer	199	158	112	131	120	117	115	132	133	144	112	144	176	170	145	134
Total gain per head, lbs.	203	257	264	249	274	307	259	267	279	256	258	271	217	210	244	275
Feed per cwt. gain, total period																
Prairie hay	887	791	878	877	809	711	830	799	674	801	853	750	797	840	868	794
Soybean oil meal .....	.....	65	61	68	61	108	.....	20	.....	.....	.....	.....	.....	.....	.....	.....
Cottonseed meal .....	.....	.....	.....	.....	.....	.....	63	20	.....	.....	.....	.....	.....	.....	.....	.....
Linseed meal .....	.....	.....	.....	.....	.....	.....	.....	20	.....	.....	.....	.....	.....	.....	.....	.....
Dehydrated alfalfa .....	.....	.....	.....	.....	.....	.....	.....	.....	117	68	55	29	.....	.....	.....	.....
Ground corn .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22	77	75	60	50
Ground limestone .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Monocalcium phosphate .....	.....	.....	3	7	6	1	2	3	3	4	4	4	.....	5	.....	4
Urea .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	7	.....	.....	9	8
Pasture, days	59	47	45	48	44	39	46	45	43	47	46	44	55	57	49	44

pounds, respectively. The highest average gain (190 pounds) was in lot 6 which received 2 pounds per head daily of a mixture of soybean oil meal and monocalcium phosphate. Feeding 1 pound of soybean oil meal plus the phosphate (lot 3) resulted in an increase in winter gain but a very small increase in total gain over lot 2. Increasing the phosphate in lot 5 to twice that fed lot 3 resulted in only a small increase in gain. Feeding ground limestone with soybean oil meal to the calves in lot 4 depressed the total gain. See tables 27, 29, 31, 32, and 33 for further data on feeding minerals with soybean oil meal.

The supplement fed lot 6 afforded approximately the same phosphorus intake and twice the amount of soybean oil meal as lot 3. The 43 pounds of increased total gain was hardly sufficient to offset the extra cost. The supplement consisting of cottonseed meal and phosphate fed to lot 7 and that composed of equal parts of cottonseed meal, soybean oil meal, and linseed meal fed with phosphate to lot 8 produced gains comparable to lot 3.

The gains produced in lots 9, 10, 11, and 12, which received supplements based on dehydrated alfalfa, indicate the possibilities this product has for wintering calves. The total phosphorus intake supplied the calves in these four lots was approximately 12 grams per head daily. The pellets fed lots 9 and 10 contained 25.2 and 25.1 per cent of protein, respectively. The additional pound fed lot 9 increased the total average gain over lot 10 by 23 pounds. In lot 11 a portion of the dehydrated alfalfa was replaced by urea, raising the crude protein equivalent of the pellets to 45.8 per cent. This additional protein equivalent is reflected by the 34 pounds more winter gain than made by lot 10. However, there was no significant difference in total winter and summer gains and these compare favorably with the total gains from the oil meals. Lot 12 was fed a supplement supplying the same amount of crude protein equivalent and phosphorus as in lot 11 but ground corn replaced part of the dehydrated alfalfa and the amount of urea was increased. While the winter gain from the supplement fed in lot 12 was lower than might be expected, the average total gain of 271 pounds ranked third highest for lots receiving less than 2 pounds of supplement per head daily.

The results from feeding supplements based on ground corn (lots 13, 14, 15, and 16), offer some interesting data. Inadequate protein depressed hay consumption in lots 13 and 14. Supplying adequate phosphorus with the corn in lot 14 had little effect on hay consumption or gain. The 3 bushels of corn fed each calf in lot 13 resulted in only 14 pounds more total winter and summer gain than made by the calves in lot 1 wintered on prairie hay alone.

Comparing the results between lots 14 and 15, it seems apparent that the first limiting factor in wintering rations under Sandhills conditions is likely to be protein. The supplement fed lot 15 contained a

crude protein equivalent of 42 per cent and the winter gain was comparable to that where soybean oil meal was fed without phosphate, but the total winter and summer gain was 13 pounds less. The best results with corn were obtained in lot 16 where 6 per cent of the supplement consisted of monocalcium phosphate and 12.5 per cent urea. These additions to ground corn raised the crude protein equivalent to 41 per cent and increased the daily intake of phosphorus to approximately 12 grams per head daily. These calves receiving adequate nitrogen and phosphorus ate 26 per cent more hay and gained 100 pounds more than those in lot 13. A comparison of the gains in lots 13, 14, 15, and 16 shows that an ample supply of both nitrogen and phosphorus is essential for maximum gain.

Urea was included in the supplements fed to lots 11, 12, 15, and 16 to make the nitrogen content of the supplements approximately equal to that of the oil meal supplements. It was used in this trial to obtain further data on the practicability of using it as a substitute for some of the crude protein of supplements such as oil meals and to study further the practicability of formulating supplements based on corn and dehydrated alfalfa combined with urea and a phosphorus carrier. The high percentage of urea in lot 15 made the supplement unpalatable to the extent that the calves took most of the day to clean up 1 pound per head. The addition of the monocalcium phosphate in lot 16 increased the palatability somewhat.

A repetition of these trials the following year was disrupted by an outbreak of bovine hyperkeratosis and attention was diverted from winter supplements to a study of the disease. This study continued until the fall of 1951 when the station was closed.

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