Wintering and Fattening Steers On Native Grass

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Millions of acres of native grass form the foundation for Oklahoma's beef cattle industry. When wisely used, this native range provides ample summer and winter forage for cow herds and stocker cattle. While highly nutritious for a few months during the lush growing season, most species of native grass deteriorate in nutritive value after reaching maturity. During the winter months, weathered range grass provides a source of energy for beef cattle—but may be decidedly deficient in protein, minerals (especially phosphorus) and carotene. Hence, supplemental feeding becomes necessary.

The nutrient value of native range in the winter may be much influenced by the species of grass present, although few comparisons have been possible between species within the same area. However, supplemental feeding is considered necessary with nearly all species. In choosing the most satisfactory supplement, the value of certain protein feeds for wintering stocker cattle, especially as influenced by their mineral composition, becomes an important consideration.

Summer feeding on grass in an attempt to produce a slaughter steer is often profitable. The relative value of supplements varying in protein or energy content, as well as full-feeding vs. feeding limited amounts of supplement, needs investigation. Again, the species of grass, particularly as they vary in protein content during the summer, may have a marked effect on the feeding program to be recommended.

The study reported herein was divided into two parts: Part I, to study the value of different protein and mineral supplements to dry, weathered grass for wintering steers, and the relative value of several species of native grass; and Part II, to study the effect of different sup-

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plements, methods of feeding, and type of pasture on summer performance of three-year-old steers to be sold for slaughter directly off grass.

Part I—Wintering Tests

Every cattleman knows that the cost of the supplemental feed necessary to balance out the nutrient deficiencies in the winter roughage is the largest "out of pocket" expense in stocker operations. Consequently, all efforts should be made to achieve maximum economy without sacrificing performance during the subsequent grazing season. The most profitable systems of beef production in Oklahoma are based on maximum use of native grass or other low-cost roughages, supplemented with the necessary protein, minerals, and vitamin A to balance out their deficiencies.

Previous studies at the Oklahoma Station (1) * have indicated that soybean oil meal was superior to cottonseed oil meal fed at the same poundage level as a protein supplement for wintering two-year-old steers on native tall grass pasture. In this comparison, it was further noted that the addition of bone meal, to raise the phosphorus content of the soybean meal, increased the daily gains of the cattle during the winter period. Providing extra phosphorus by including bone meal in a salt mixture was also beneficial. Other studies in the Oklahoma area at the Woodward station (2) on short grass pastures showed that the addition of bone meal to soybean meal was profitable under these pasture conditions during the winter. However, when a relatively high-phosphorus protein supplement such as cottonseed meal was fed, the addition of bone meal was not beneficial.

These studies indicate that the mineral content of the protein supplement is of considerable importance. When the roughage is on the verge of being phosphorus deficient, the higher phosphorus supplement may be more beneficial than those low in this mineral.

To further study this problem of the comparative value of various protein supplements, an experiment using yearling and two-year-old cattle wintered on native grass pastures was conducted at the Ft. Reno Station. Four wintering trials were conducted in the period from 1951-1955. The average results of the trials are presented in the first part of this bulletin.**

*Numerals in parentheses refer to the "Literature Cited," page 31.

**Results of each individual trial may be found in Oklahoma Agricultural Expriment Station Miscellaneous Publications MP-27, MP-29, MP-31, and MP-43. The results given in this bulletin are in most cases, an average of three years' results.

The study included the following comparisons:

1. Cottonseed meal vs. soybean meal, with and without added minerals, for supplementing steers on dry native grass.
2. Soybean meal vs. soybean-sesame mixtures, with and without added trace minerals.
3. Comparison of corn gluten meal and a mixture of cottonseed-soybean-linseed meals vs. cottonseed or soybean meals for wintering steers on dry native grass.
4. Solvent-extracted vs. hydraulic-processed cottonseed meals for wintering two-year-old steers on dry native grass.
5. Comparison of different species of native grass for wintering yearling and two-year-old steers.

Procedure

Steers used in these trials were stocker cattle purchased from the National Livestock Commission Company, Oklahoma City, in October. For the 1951-52 and 1953-54 trials, two-year-olds were used; while in the 1952-53 and 1954-55 trials, yearling steers were used. All steers were grade Herefords of good-to-choice quality. The cattle were started on experiment in the early part of November and allotted to treatment on the basis of body weight after an overnight shrink in drylot. They were given access to approximately 8 to 10 acres of good native grass per steer and wintered in comparable pastures. The cattle were rotated among the pastures at frequent intervals to reduce the effect of possible pasture differences. The steers were fed protein and mineral supplements every other day, twice the daily allowance at each feeding.

The pastures used in this experiment were located on opposite sides of the Ft. Reno Station. Due to previous management, the pastures on the west side consisted primarily of side oats and blue grama, buffalo grass, and less desirable annuals. Those on the east side, within a mile's distance, were primarily big and little bluestems, Indian and switch grass. Hence, the pastures on the west side of the station were classified as rather typical "short" grass pastures, while those on the east side were "tall" grass pastures.

Water was available from wells in each pasture, as well as from the collection of surface water in ponds. The cattle were maintained on the wintering tests until approximately mid-March of each year. Initial and final weights were obtained following an overnight shrink in drylot.

At the completion of the trial, the steers were appraised as feeder-stocker cattle by a committee from the Oklahoma City livestock market.

The amount of protein supplement fed varied from 3 pounds per head daily during the first trial, to 1½ to 2 pounds in the second and third trials. The amount fed varied somewhat, depending on the age and condition of the cattle and the type of pasture season encountered. The amounts of the different protein supplements fed were adjusted to provide approximately the same protein intake for cattle in all lots. The supplements were fed in bunks within large, open sheds.

In certain of the lots, a commercial trace mineral mixture was fed. In the first two trials, the minerals were weighed out separately and poured over the protein supplement, while in the third trial it was mixed thoroughly with the protein supplement in a large vertical mixer. It was estimated that the amount of trace mineral mixture fed per steer daily (0.86 gram) supplied approximately 2.8 milligrams of cobalt, 63 milligrams of manganese, 2 milligrams of zinc, 6.6 milligrams of copper and 127 milligrams of iron per steer daily.

The average analyses of feeds and pasture grass samples are given in Appendix Table I. While there was some variation from year to year in composition of grass samples, it is believed that the average analysis presented gives a sufficient picture of the composition of forage available to the cattle.

Results and Discussion

Cottonseed Meal vs. Soybean Meal

The average results obtained in a three-year comparison of cottonseed meal vs. soybean meal, with and without mineral supplements, are given in Table 1. The steers of Lot 1, grazing dry native grass and supplemented with an average of 2.17 pounds of cottonseed meal per head daily, lost 7 pounds per head during the winter. Those of Lot 4, fed soybean meal on a protein equal basis, gained an average of 25 pounds (significant at the 1% level). Similar studies at the Lake Carl Blackwell Experimental Range (1) with two-year-old steers on native "tall" grass pastures have shown that steers fed soybean meal as a protein supplement made significantly more winter gain than those fed cottonseed meal. The steers in the experiment reported herein were grazing "short" grass pastures in which buffalo and grama grasses were the predominant species. Phosphorus analyses of samples of these grasses as shown in Appendix Table I indicate a higher level for short grass as compared to tall

grass. Hence, in this trial the difference in phosphorus content of the two meals was not believed to be an important factor in relation to the difference in gain of the two lots of steers.

The increased value for soybean meal over cottonseed meal as a protein supplement for wintering cattle might be associated in part with its higher digestible protein content. The amounts of supplement fed in this comparison were equalized on a total protein content basis. As they would usually be purchased at the feed mill, soybean meal would run higher in both total and digestible protein, and would therefore supply greater amounts of available protein per ton than would cottonseed meal. It is also possible that slight differences in quality of protein, or other factors, between the cottonseed and soybean meals would influence the results obtained in this test.

In Lots 2 and 5, where the calcium and phosphorus contents of the two meals were equalized by the addition of ground limestone to cottonseed meal, or steamed bone meal to soybean meal, the winter gains of the steers were 21 pounds and 16 pounds per head, respectively. This similarity of response was apparently due to the increased performance of Lot 2 steers receiving ground limestone added to their cottonseed meal supplement. The addition of bone meal to soybean meal gave no improvement in gain (compare Lots 4 and 5).

Table 1.—Average Results in a 3-year Test Comparing Cottonseed and Soybean Oil Meals, with and without Added Minerals, for Supplementing Steers on Dry Grass (131 days on test).

	Lot 1 C.S. Meal	Lot 2 C.S.M.+ $CaCO_3$	Lot 3 C.S.M.+ $CaCO_3$+ Tr. min.	Lot 4 S.B.M. meal	Lot 5 S.B.M.+ Bone meal	Lot 6 S.B.M.+ Bone meal+ Tr. mineral
Steers per Lot	58	58	57[1]	57[1]	58	58
Avg. weights (lbs.)						
Initial	889	889	889	889	889	889
Final	882	910	904	914	905	908
Total gain or loss	—7	21	15	25	16	19
Supplements fed per steer per day[2]						
Cottonseed meal (lbs.)	2.17	2.17	2.17	——	——	——
Soybean meal (lbs.)	——	——	——	2.06	2.06	2.06
Limestone (gms.)	——	19.2	19.2	——	——	——
Bone meal (gms.)	——	——	——	——	18.6	18.6
Trace minerals (gms.)	——	——	.86	——	——	.86
Salt (lbs.)	.04	.04	.04	.04	.04	.04
Feed cost per steer ($)[3]	17.45	17.49	17.51	17.13	17.40	17.42
Appraised value per cwt. ($)[4]	28.08	28.08	28.08	28.08	28.08	28.25
Return per steer ($)[5]	—20.22	—12.39	—14.46	—10.91	—13.71	—11.34

1 One steer removed from each Lot due to sickness and are not included in these data.
2 Average amount fed for 3-year test.
3 Supplement, pasture, and mineral.
4 As determined by a committee from the Oklahoma City yards at the time of final weighing.
5 Market value less steer and feed costs. Initial cost of steers, $28.17 per cwt.

The extra gain obtained by the addition of ground limestone to the cottonseed meal supplement fed the steers of Lot 2 resulted in an average winter gain of 21 pounds per head as compared to an average loss of 7 pounds per head for the steers in Lot 1 which were receiving no mineral supplement other than salt. This advantage obtained from adding ground limestone to cottonseed meal was consistent each year in this study (significant at the 5% level of probability). The additional gains made by the steers fed cottonseed meal fortified with ground limestone on dry native grass is difficult to interpret.

Research is limited on the effect of adding calcium to cottonseed meal for beef cattle, providing a calcium: phosphorus ratio of about 1½ or 2 to 1 as practiced in this trial. It is generally believed that roughages grown on soils not deficient in calcium will contain an ample supply of this mineral to meet the needs of cattle, providing sufficient forage is available. The calcium content of grass samples taken during the study further indicates that the steers should have met their calcium needs from the grass consumed. However, the availability of calcium in forage may vary considerably. Further, the water available from the wells in the pastures used in this study was extremely "gyppy", analyzing 4,000 ppm in total soluble solids and high in sulfate content. It is possible, therefore, that the calcium added to the cottonseed meal supplement fed Lot 2 exerted a beneficial effect due to the nature of the water available to the cattle, and that this effect was above and beyond its nutrient value to the animal.

Since no additional gain was obtained in Lot 5 where steamed bone meal was added to soybean meal, it appears that the phosphorus supplied by the soybean meal, together with that present in the grass, was ample for wintering steers in this experiment. The appraised value of the steers at the completion of the trial for all lots, except lot 6, was the same. The average cost of protein and mineral supplements varied only slightly. Due to a severe drop in cattle prices during the last two years of the study, all lots lost money. The extent of the financial loss was related to the gain or loss in body weight of the steers during the wintering period, since there were only small differences in the cost of supplements, and little difference in the appraised value at the end of the trial.

In a comparison of the effect of adding trace minerals to cottonseed or soybean meals where the calcium and phosphorus contents were equalized, the performance of Lots 2 vs. 3 and Lots 5 vs. 6 can be compared. There were only slight differences in the gain or loss of body weight of the steers where trace minerals were fed as compared to those

receiving the same supplement without the addition of trace minerals. This comparison included six trials where protein supplements, with or without trace minerals, were fed. In only one instance was there an increase in the winter gains of steers apparently resulting from the addition of the trace minerals.

To further study the effect of adding small amounts of ground limestone to cottonseed meal supplements for wintering steers on grass, an additional trial was conducted during the winter of 1954-55. Two lots of 12 yearling Hereford steers each were used. Data were available on the previous gaining ability of the steers and this was used in alloting them to treatment. The native grass pastures used were the same as in the previous trials. The cattle were allotted on the basis of shrunk weight and previous summer gain, and were rotated between pastures at two-week intervals. They were fed an average of 2 pounds of cottonseed meal per head daily on alternate days. Sufficient dry, stabilized vitamin A was added to the cottonseed meal to meet their minimum requirements.

Salt was available free-choice to the steers of both lots. No other mineral supplement was fed the cattle of Lot 1. Lot 2 steers received sufficient ground limestone mixed with the cottonseed meal to provide a calcium: phosphorus ratio in the supplemental feed of approximately 1.5 to 1. At the completion of the trial, a shrunk weight was obtained following an overnight period in drylot.

The average results obtained are shown in Table 2. In this trial, steers of Lot 2 receiving cottonseed meal fortified with additional calcium gained 10 pounds more on the average than those fed cottonseed meal alone. However, the difference in overnight shrink, prior to the

Table 2.—Effect of Adding Calcium Carbonate (ground limestone) to Cottonseed Meal for Steers Wintering on Dry Grass (1954-55, 116 days on test).

	Lot 1 Cottonseed meal	Lot 2 Cottonseed meal + ground limestone
No. of steers compared	12	12
Avg. weights (lbs.)		
Initial	679	677
Final	731	739
Winter gain	52	62
Overnight shrink at completion of test (%)	6.9	5.8
Supplements fed per steer er day[1]		
Cottonseed meal[2]	2.0	2.0
Ground limestone	——	.06
Salt	.04	.04
Feed, pasture and mineral cost ($)	9.95	10.00

1 Sufficient dry, stabilized vitamin A added to meet minimum requirements.
2 Cottonseed meal contained 41.18% protein 0.21% calcium, and 0.74% phosphorus.

Table 3.—Soybean Meal vs. Soybean-sesame Meal Mixtures, With and Without Added Trace Minerals (1951-52, 131 days on test).

	Lot 5 S. B. meal + bonemeal	Lot 7 S.B.-sesame meal+$CaCO_3$	Lot 6 S. B. M. + bone meal + Tr. min.	Lot 8 S. B. M. Sesame meal + $CaCO_3$ + Tr. min.
Steers per Lot	20	20	20	20
Avg. weights (lbs.)				
Initial	948	948	948	948
Final	944	936	978	957
Winter gain or loss	—4	—12	30	9
Supplement feed/steer/day				
Soybean meal, lbs.	3.0	2.0	3.0	2.0
Sesame meal, lbs.	——	1.0	——	1.0
Grd. limestone, gm.	——	7.2	——	7.2
Bone meal, gm.	6.8	——	6.8	——
Trace minerals, gm.	——	——	.8	.8
Salt, lbs.	.04	.04	.04	.04
Feed, pasture and mineral cost/steer ($)[1]	20.20	20.14	20.22	20.16
Appraised value/cwt. ($)	32.75	32.50	33.25	33.75
Return per steer (initial cost of $28.00/cwt.)	23.52	18.61	39.52	37.38

1 Sesame meal charged against Lots 7 and 8 at same price as soybean meal—although it would normally be higher due to greater freight cost.

final weight, was apparently responsible for most of the advantage obtained. While this difference in weight gain was smaller than had been observed in previous tests and was not statistically significant, the trend was in the same direction. The additional feed cost which resulted from adding ground limestone to cottonseed meal was negligible.

Soybean Meal vs. Soybean-Sesame Meal Mixture

In one trial, 1951-52, a mixture containing two parts of soybean meal and one part sesame meal was compared to soybean meal alone as the protein supplement for wintering two-year-old steers. In this comparison, the calcium: phosphorus ratio in the oil meal was adjusted to approximately 1½ to 1 by the addition of steamed bone meal. In another comparison, the relative values of the two meals were studied with trace minerals added to each. The same trace mineral mixture as previously was used. The results of the test are shown in Table 3. The average winter gains of steers fed soybean meal (Lots 5 and 6) were 14.5 pounds per head greater than those fed the soybean-sesame meal mixture (Lots 7 and 8).

The soybean-sesame meal mixture has been shown to contain a protein of higher biological value than soybean meal alone for chicks (3), but such an advantage was not apparent in these trials with two-year-old steers wintering on dry native grass. However, small differences in nutritive value, such as are likely to exist between two similar sup-

plements, might be difficult to measure with nearly mature steers wintering on the range and making small gains. Particularly is this true where the level of protein supplement fed is high (3 pounds a day, which is in excess of that required by the steers for maintenance).

Steers of Lot 8 fed the soybean-sesame meal mixture fortified with trace minerals showed more bloom and condition of the hair coat than steers of any other lot in the first trial and were appraised $.50 per cwt. higher than Lot 6.

The sesame meal used in this trial was charged into the experiment at the same price as soybean meal. However, under practical conditions it is often higher in price. Interest in sesame seed production in east Texas and the Pacific Coast region is increasing, but its use in beef cattle rations appears to be entirely proportional to its cost per unit of protein. In other words, the cattle producer could not, from the results of these tests, afford to pay more than the price for straight soybean meal when obtaining a soybean-sesame mixture to supplement native grass.

Corn Gluten Meal vs. Soybean or Cottonseed Meal

A trial conducted during the winter of 1952-53 compared corn gluten meal with cottonseed and soybean meals as protein supplements

Table 4.—Comparison of Corn Gluten Meal and a Mixture of Cottonseed-Soybean-Linseed Meals vs. Cottonseed or Soybean Meals for Wintering Steers on Dry Native Grass.

	1951-52 test (135 days)			1952-53 test (125 days)		
	Lot 1 C. S. meal	Lot 4 S. B. meal	Lot 7 corn gluten meal	Lot 2 C. S. M. + $CaCO_3$	Lot 5 S. B. M. + Bone meal	Lot 7 C. S. M.— S. B. M.— Linseed + $CaCO_3$ and Bone meal
No. of steers compared[1]	20	20	20	18	18	18
Avg. weights (lbs.)						
Initial	665	665	665	1054	1053	1054
Final	678	718	701	1065	1079	1051
Total gain or loss	13	53	36	11	26	—3
Supplemental feed/steer/day						
Cottonseed meal, lbs.	1.51	——	——	2.00	——	.66
Soybean meal, lbs.	——	1.40	——	——	1.78	.66
Corn gluten meal, lbs.	——	——	1.41	——	——	——
Linseed meal, lbs.	——	——	——	——	——	.66
Grd. limestone, gms.	——	——	——	15.4	——	8.2
Bone meal, gms.	——	——	——	——	15.9	5.5
Salt, lbs.	.04	.04	.04	.04	.04	.04
Feed, pasture and mineral cost/steer ($)	12.19	12.73	14.32	19.58	18.80	20.16
Appraised value/cwt. ($)	32.50	33.00	32.50	19.00	19.00	19.00
Return per steer ($)[2]	—11.29	4.76	—5.95	—64.91	—61.24	—68.16

1 Yearling steers were used in the 1951-52 trial; two-year-olds in 1952-53.
2 Initial cost: $33.00 for 1951-52 test; $23.50 per cwt. for 1952-53 test.

for wintering yearling steers. Corn gluten meal was used because it is recognized as being of poor quality for simple-stomached animals. The average results obtained are shown in Table 4. Steers of Lot 7, fed corn gluten meal, gained 36 pounds per head during the winter, while those of Lot 1 fed cottonseed meal and steers of Lot 4 fed soybean meal gained 13 and 53 pounds per head, respectively.

The results of this trial suggest that corn gluten meal is about intermediate between cottonseed meal and soybean meal for wintering steers on dry native grass. Kansas workers (4) reported satisfactory results when corn gluten meal was compared with cottonseed meal as the only protein supplement in a winter ration of sorghum silage for yearling steers. In earlier fattening tests, corn gluten meal was slightly superior to cottonseed meal (5). Corn gluten meal is not a common protein supplement in this area, and therefore the feed cost for wintering steers of Lot 7 was approximately $2.00 more per head than for Lots 1 and 4 fed cottonseed meal or soybean meals. The appraised value of the steers in Lots 1 and 7 was the same, with Lot 4 steers fed the soybean meal appraised at $0.50 per cwt. higher.

Supplement Mixture vs. Cottonseed and Soybean Meals

Many commercial protein supplements contain a mixture of linseed, cottonseed, and soybean meals. The manufacturers claim that such a mixture provides a better balance of amino acids, and is therefore superior to protein from a single source for wintering cattle. A single trial was conducted (1952-53) in which a mixture containing equal parts of linseed. cottonseed, and soybean meals was compared to either cottonseed or soybean meal alone. The mixture of protein supplements fed was prepared in a large vertical mixer to contain equal proportions of meal from the three sources. Sufficient bone meal or ground limestone was added to the supplements fed all lots to approximately equalize the calcium and phosphorus contents.

The average results (Table 4) show that steers of Lot 7 fed a mixture of the three protein supplements lost an average of 3 pounds per head during the winter. Those of Lot 2, fed cottonseed meal gained 11 pounds per head; and those of Lot 5, fed soybean meal, gained 26 pounds per head. Any advantage for the mixture of protein supplements vs. a single protein source was not demonstrated in this study.

The cost of the mixture of the three protein meals was greater than the cost of either cottonseed or soybean meal, hence winter feed costs were higher for Lot 7. Further, there was no advantage in rate of gain or appraised value of the steers. This is in agreement with previous work

Table 5.—Solvent-extracted vs. Hydraulic-processed Cottonseed Meals for Wintering Two-year-old Steers on Dry Native Grass (2-year test, 1951-53, 130 days on test).

	Lot 1 Hydraulic-processed C. S. meal	Lot 2 Solvent-extracted C. S. meal
No. of steers compared	38	38
Avg. weights (lbs.)		
Initial	859	859
Final	855	859
Total gain or loss	—4	0
Supplements fed per steer per day		
Hydraulic-Proc. C. S. meal	1.75	——
Solvent-extracted C. S. meal		1.67
Salt	.04	.04
Feed, pasture and mineral cost per steer ($)[1]	15.86	15.34
Appraised value ($)	25.75	25.75
Return per steer ($ initial cost of $28.25/cwt.)	38.27	—36.82

1 The two differently processed meals were charged into the experiment at the same price. Over the past few years, the solvent-extracted meal has been slightly cheaper than the hydraulic meal in price.

as cited by Snapp (6) which has failed to show a beneficial effect from complex mixtures of protein supplements over a single protein source for beef cattle.

Solvent-Extracted vs. Hydraulic-Processed Cottonseed Meals

Two trials were conducted (1951-52 and 1952-53) in which pre-press solvent extracted cottonseed meal* was compared to hydraulic processed cottonseed meal as protein supplements to dry native grass for wintering steers. The average results of the two trials are given in Table 5.

Steers of Lot 1 fed the hydraulic-processed meal lost an average of 4 pounds per head during the two-year study, while those of Lot 8 fed the solvent-extracted cottonseed meal maintained their body weight during the winter. The results slightly favored the solvent-extracted cottonseed meal in one trial and the hydraulic meal in the other. Thus, little difference appears to exist in the nutrient value of the two meals for steers wintering on dry native grass.

The chemical analyses of the two meals, as shown in Appendix Table I reveal a difference in fat content of 5.55 percent in favor of the hydraulic-processed meal. The lower fat content of the solvent-extracted meal did not appear to affect the performance of the steers in this test.

*Pre-press solvent extracted cottonseed meal used in these trials was supplied by the National Cotton Products Assoc., Dallas, Texas.

The average appraised value of the steers at the end of the trial was the same for the two lots.

Other studies at the Texas Station (7) and the Southern Great Plains Station at Woodward (2) have failed to reveal large differences in nutritive value between the two meals when fed to steers wintering on the range or to beef cows. However, in tests with lactating ewes (8) and with steers being fattened in drylot (9, 10), hydraulic-processed cottonseed meal has been slightly superior to the solvent-extracted product. It seems that under conditions of maximum gain or lactation in comparison to maintenance of body weight (as occurs with steers wintering on dry grass), a difference in the nutritive value of the two meals may exist, and that this difference is associated with the energy content of the two differently-processed meals.

"Short" vs. "Tall" Grass Pastures

The relative value of short grass (buffalo and grama) vs. tall grass (bluestems, Indian and switch) as forages for wintering yearling and two-year-old steers was studied at Ft. Reno, where rather typical areas of short-grass and tall-grass made this comparison possible. Three trials were conducted during the course of the experiment in which comparable groups of cattle were fed the same amount of cottonseed meal supplement on either short grass or tall grass pastures. The steers used in this test were handled in the manner described for previous studies, and grazed either short-grass (Lot 1) or tall grass (Lot 9) pastures for approxi-

Table 6.—Comparison of Different Species of Native Grass for Wintering Yearling and Two-year-old Steers (3-year average, 131 days on test).

	Lot 1 C. S. meal on "Short" grass[1]	Lot 9 C. S. meal on "Tall" grass[2]
No. of steers compared	58	57[3]
Avg. weights (lbs.)		
Initial	889	889
Final	882	831
Total winter loss	—7	—58
Supplements fed/steer/day		
Cottonseed meal, lbs.	2.17	2.17
Salt, lbs.	.04	.04
Feed, pasture and mineral cost per steer ($)	12.34	12.34
Appraised value/cwt. ($)	28.08	28.17
Return per steer ($, initial cost of $28.17 per cwt.)	—20.22	—33.98

1 Predominant species in "short" grasses were buffalo, blue grama, and side oats grama.
2 Predominant species of "tall" grasses were big and little bluestem, Indian, and switch.
3 One less steer used in this lot in 1952-53 trial.

mately 131 days on the average. The average results of the three trials are shown in Table 6. The chemical composition of the pasture grasses by periods during the winter trials are shown in Appendix Table I. No mineral supplement other than salt (free-choice) was available to the steers.

Steers grazing tall grass pastures (Lot 9) lost an average of 58 pounds per head during the winter period. In contrast, steers grazing short grass pastures (Lot 1) lost only 7 pounds per head. Thus, the steers on short grass pastures were 51 pounds per steer heavier at the end of the winter period than those on tall grass pastures. The difference was statistically significant at the 5% level.

It is generally accepted that the so-called "short" grasses are superior to tall grasses for wintering cattle, and such an advantage is pointed out in this study. The chemical composition of grass samples reveals that the short grasses were higher in protein and phosphorus than tall grasses from November to February; in fact, in respect to these two constituents, the values were almost twice as high. Therefore, smaller amounts of supplemental protein and phosphorus should be needed to produce the same rate of gain when cattle are wintered on short grass as compared to those wintered on tall grass. Crude fiber was also lower for short grass and this may have improved digestibility.

The financial returns for steers of Lots 1 and 9 were directly related to the loss of weight during the winter, since the appraised value at the end of the trial and the cost of protein supplements were essentially the same.

Summary

Wintering trials involving a total of 543 yearling and two-year-old Hereford steers were conducted at the Ft. Reno Station during 1950-53 in a study of the comparative value of various protein and mineral supplements to dry native grass. Also included in this study was a comparison of the relative value of different species of native grass for wintering steers, and the advisability of adding minerals to the protein supplements for steers wintering on the range.

The results of the three-year study show soybean meal to be significantly superior to cottonseed meal when no mineral supplement other than salt was fed. When calcium (ground limestone) was added to cottonseed meal and phosphorus (steamed bonemeal) was added to soybean meal to equalize the calcium and phosphorus content of the two supplements, winter gains of the steers were not significantly dif-

ferent. The study revealed that the steers receiving cottonseed meal plus ground limestone made greater gains than those fed the meal without mineral supplement. This was further borne out in an additional trial with yearling steers, although the differences were not large. The addition of steamed bone meal to soybean meal was of no advantage where steers were grazing short grass pastures. Analyses of grass samples taken during the winter trial revealed that the short grasses were relatively high in phosphorus content.

In three wintering trials, the addition of trace minerals to cottonseed or soybean meals failed to increase the gains of the steers. In one trial with a mixture of soybean and sesame meals, the addition of trace minerals did improve rate of gain. However, in a total of seven comparisons in which trace minerals were fed, in only two instances did they apparently increase the rate of gain of the steers. These tests were conducted in an area that had never been cropped and on soils that were not believed to be deficient in trace minerals. Consequently, the results may not be applicable to certain areas of the state where the land has been extensively cultivated and the top-soil may be deficient in certain mineral elements.

Steers fed a mixture of two parts soybean meal and one part of sesame meal made slightly less winter gain than those fed soybean meal alone. Corn gluten meal proved to be little different in value from cottonseed meal for wintering yearling and two-year-old steers on dry native grass. A mixture of equal parts of cottonseed, soybean, and linseed meals did not prove to be superior to either cottonseed or soybean meals alone. Pre-press solvent-extracted cottonseed meal was of essentially the same value as hydraulic-processed meal when fed at equal protein levels for wintering steers. From this it seems that quality of protein, either as affected by source of protein supplement or by method of processing, is of minor importance in determining its nutritive value for stocker cattle wintering on the range where only moderate gains are desired.

In a three-year study, "short" grass pastures were superior to "tall" grass pastures. Steers grazing "short" grass lost 51 pounds less weight during the winter period than their mates grazing "tall" grass under the same climatic conditions. This significant difference bears out the contention of ranchers that cattle grazing pastures which contain considerable "short" grass require less protein, or phosphorus, supplement during the winter than where the "tall" species predominate. Chemical analyses of grass samples from the two areas revealed that the "short" grass contained nearly twice as much total protein and phosphorus as did "tall" grass.

Part II—Fattening Steers on Native Grass

Although the trend in beef production in this area is toward younger and lighter cattle, there is still considerable interest in fattening long-aged steers on native grass. In earlier experiments at this station, three-year-old steers which were wintered moderately for three successive seasons made 80 to 90 percent of their total gain during the summer grazing period. (11)

Further, there is considerable interest in the relative value of supplements fed to cattle on native grass during the summer. In earlier experiments on tall grass pastures at the Lake Carl Blackwell experimental range (12) feeding a small amount of supplement (3½ lbs. of either corn or cottonseed cake daily) to two-and three-year-old steers increased summer gains and improved the market grade and selling price of the cattle. In general, supplemental feeding during the summer has been profitable, although an increase in selling price is often necessary if the practice is to pay. The extra gain obtained through supplemental feeding is often not enough to offset the additional feed cost.

In order to obtain further information the production of slaughter steers off grass, as well as to compare various supplements and methods of feeding, a three-year study was conducted at the Ft. Reno experiment station during the summers of 1951 to 1953. A total of 553 head of three-year-old steers was used. These steers had previously been used on wintering tests in which the value of various protein and mineral supplements were studied, as reported in Part I.

The following comparisons were made during the summer tests:

1. The value of "tall" and "short" grasses* for fattening three-year-old steers;

2. Corn, cottonseed cake, and 20 percent protein pellets as supplements for fattening steers on short grass pasture;

3. A comparison of feeding a small amount of supplement (20% protein) throughout the summer grazing season vs. feeding the same daily amount, or full-feeding, during the last 45 days of the grazing period;

4. Marketing steers off grass in August vs. marketing them in September, as related to the gains made on short and tall grass pastures;

*For a general description of native grass pastures see Part I.

5. The value of supplemental feeding during the late summer vs. grass alone for steers to be marketed in September.

Average results of these comparisons are presented in the following pages.*

Procedure

Three trials were conducted during the summers of 1950, 1951, and 1953 with three-year-old grade Hereford steers divided equally into 9 or 10 groups of 18 to 20 steers each during each summer test. In 1950 and 1951, the steers were purchased as two-year-old stocker cattle from the National Commission Company of Oklahoma City in the fall preceding the test. For the 1953 trial, the steers were purchased as yearling stockers 18 months previously (fall of 1951), and were used in two successive winter tests before being placed on summer treatment.

The protein and mineral supplements used in the winter tests are described in Part I of this bulletin. During the winter period, the steers grazed either short or tall grass pastures with approximately 2 pounds of protein supplemental per head daily, plus various mineral supplements. In most cases, they made very small gains during the winter period preceding the summer feeding test. The winter tests terminated each year about the middle of March and the summer trials reported in this section started approximately May 5. Consequently, there was a six- to seven-week lapse in time between the termination of the winter tests and initiation of the summer experiments. The steers used in the summer test were allotted on the basis of shrunk weight, grade, and their previous winter treatment; thus an equal number of steers from each winter treatment was present in each summer test lot.

The steers started the summer grazing season in good thrifty condition. They were appraised by a committee from the Oklahoma City yards at the beginning and also at the completion of the experiment. The steers were allowed approximately 8 acres of native grass per head. Ample grass was available in each test, except for an early season drought during the 1953 summer grazing season. The steers were rotated among the short grass pastures at approximately 2-week intervals to minimize pasture differences. Salt was available to the cattle at all times, but no other mineral supplement was fed. Horn flies were controlled by spraying cattle in the first two trials, and by means of a rubbing post device during the third trial.

*Data for individual trials may be found in Oklahoma Agricultural Experiment Station Miscellaneous Publications MP-22, MP-27, and MP-34.

The cattle received the following treatments, and supplemental feed per head daily, according to lots:

Lots 1 & 2—Tall grass pasture, no supplement.

Lots 3 & 4—Short grass pasture, no supplement.

Lot 5 —Short grass plus 3½ pounds of ground shelled corn per head daily.

Lot 6 —Short grass plus 3½ pounds of cottonseed meal.

Lot 7 —Short grass plus 3½ pounds 20% protein pellets, (65% ground corn and 35% cottonseed meal).

Lot 8 —Short grass plus 3½ pounds of 20% protein pellets after July 1.

Lot 9 —Short grass plus of full feed of 20% protein pellets after July 1.

Lot 10 —Short grass plus 3½ pounds of 20% protein pellets after August 1 (1951-53, two trials only).

The steers of all lots except 2, 4, and 10 were marketed approximately August 15 of each year as slaughter cattle. The remaining lots were sold about September 15. Data on selling price, dressing percentage (yield) and carcass grades were obtained only during the 1953 test. An over-night shrink in drylot preceded the taking of the final weights in each trial.

Results and Discussion

Tall vs. Short Grass

The average results are given according to the most convenient grouping of experimental lots. For all trials, the chemical composition of feed and grass samples are given in Appendix Table II. The results in the comparison of "tall" and "short" grass pastures are given in Table 7. In a three-year comparison, steers grazing "tall" grass (Lots 1 and 2) gained slightly more during the summer fattening period than those of Lots 3 and 4 on short grass pastures (1.94 vs. 1.81 lbs., average daily gain). The results were fairly consistent within all three trials, thus bearing out the contention of ranchers that, while short grass pastures are somewhat superior to tall grass for wintering cattle, the abundance of feed in the tall grass pasture during the growing season makes it more desirable for fattening steers. Further, the carcass grades and yield of the cattle, as obtained in the third trial, indicate that those on tall grass pasture were slightly fatter.

Table 7.—"Tall" Grass vs. "Short" Grass for Fattening Three-year-old Steers at Ft. Reno.[1] (Average of 3 years: 1950-51 and 1953).

	Sold mid-Aug. (108 days)		Sold mid-Sept. (136 days)	
	Lot 1 Tall grass	Lot 3 Short grass	Lot 2 Tall grass	Lot 4 Short grass
No. of steers compared	58	58	57[2]	58
Avg. weights (lbs.)				
Initial	991	989	990	986
Final	1199	1181	1256	1239
Total gain	208	192	266	253
Ave. daily gain	1.93	1.77	1.95	1.85
Pasture and mineral cost per steer ($)	14.86	14.86	16.28	16.28
Selling price/cwt. ($)[3]	25.53	25.62	26.33	26.00
Net return/steer ($)	36.98	34.29	58.78	51.06
Dressing percent[4]	59.4	59.9	60.3	59.7
Ave. U. S. carcass grade[4]	Ave. Gd	Low Gd.	High Gd.	Ave. Gd.

1 Predominant species of "tall" grass were big and little bluestem, Indian and switch. Those of "short" grass were buffalo, side oats grama and blue grama.
2 One steer removed from experiment and not included in data.
3 Appraised value in second trial, actual selling price in first and third trials.
4 Dressing percent and carcass grade obtained only in third trial.

The extra advantage of the tall grass pastures appeared to carry over into the longer grazing season for cattle sold in mid-September, although this was not entirely consistent from year to year. Rate of gain and selling price of the cattle of Lots 2 and 4 grazed to mid-September were approximately the same as for cattle on the same pastures when sold mid-August. The net return per steer corresponded directly. It appears that for fattening big steers on native grass, abundance of forage, not quality, is perhaps the more desirable feature in the native grass.

Comparison of Supplements for Fattening Steers on Grass

The average results of three trials in which equal amounts of corn, cottonseed meal and 20% protein pellets were fed are shown in Table 8. The results indicate that feeding 3½ lbs. of supplement daily to steers on native grass during the entire grazing season increased average daily gains, selling price, carcass grades and yield. With the exception of Lot 6 where cottonseed meal was fed, supplemental feeding also increased net returns.

Previous trials at the Oklahoma Station's Lake Carl Blackwell Experimental Range near Stillwater showed that corn produced essentially equal gains to cottonseed meal, and was considerably more economical to feed. (12) The average results of the three tests reported here, likewise indicate that corn was the best supplement from the standpoint of rate and economy of gain.

Steers of Lot 5 fed 3½ pounds of corn as a daily supplement to native grass from the start of the experiment (May 3) until they were sold after 108 days on grass (August 19), gained 2.11 pounds per head daily. Those fed cottonseed meal (Lot 6) gained 1.92 lbs., while those fed 20% protein supplement gained 1.97 lbs. Hence, the higher energy value of corn was apparent in the greater gains of Lot 5 cattle. Further, the lower cost of corn as a supplement in these trials produced much more economical gains.

Total feed costs per steer were $25.40 per head for the Lot 5 cattle fed ground corn; $31.18 for those fed cottonseed meal, and $28.60 for those fed 20% pellets. Selling price per hundredweight was very little different, although slightly favoring the corn-fed lot. The greater gains of the steers fed corn, at lower feed cost, resulted in a much greater net return for this lot. This difference was approximately $12.00 greater for those fed corn over cottonseed meal, and approximately $7.00 greater than for steers fed the 20% protein pellet. Dressing percentage and carcass grades as obtained in the third trial were also higher for the corn lot. Thus, in this experiment, corn appeared to produce greater gain on fattening steers, due to its higher energy content, and also proved to be a more economical supplement.

Table 8.—Comparison of Corn, Cottonseed Meal, and 20% Protein Pellets for Fattening Three-year-old Steers on Short Grass. (Average of 3 years, 108 days on test, sold Aug. 19).

	Lot 3 No Supplement	Lot 5 3½ lbs. corn ground	Lot 6 3½ lbs. C. S. meal	Lot 7 3½ lbs. 20% protein pellets
No. of steers compared	58	58	58	58
Avg. weights (lbs.)				
Initial	989	988	989	989
Final	1181	1216	1197	1202
Total gain	192	228	208	213
Ave. daily gain	1.77	2.11	1.92	1.97
Avg. daily supplements fed (lbs.)				
Ground shelled corn	——	3.5	——	——
Cottonseed cake or meal	——	——	3.5	——
20% protein pellets[1]	——	——	——	3.5
Total feed and pasture cost per steer ($)	14.86	25.40	31.18	28.60
Selling price/cwt. ($)[2]	25.62	26.53	26.37	26.49
Net return per steer ($)	34.29	44.73	32.49	37.53
Dressing percent[3]	59.9	61.9	60.7	61.3
Ave. U. S. carcass grade[3]	Low Gd.	High. Gd.	Ave. Gd.	Ave. Gd.

1 20% protein pellets contained 65% ground corn and 35% cottonseed meal.
2 Represents appraised value at end of second trial, and actual selling price in first and third trials.
3 Dressing percent and carcass grades obtained only in last trial.

Considering the relative energy values of corn and grain sorghums, it seems likely that ground milo would compare favorably with corn, as it has in numerous drylot fattening trials.

Lot 7 steers were fed 3½ lbs. of 20% protein pellets containing 65% ground corn and 35% cottonseed meal. These steers gained only slightly more than those fed straight cottonseed meal (Lot 6), but the lower cost of the supplement resulted in more profit. Dressing percentage and carcass grades of cattle in the two lots were essentially the same.

It appears that the native grass in these trials contained ample protein for fattening steers of this age and weight. Hence, additional protein, as supplied by cottonseed meal or 20% protein supplement, was not advantageous over low protein (but high energy) supplements. Under poor pasture conditions, or if cattle are to be carried later than mid-August, the extra protein content of these supplements might become beneficial. In regard to whether or not to add protein, the rancher might well consider the condition of his pastures, and add a small amount (approximately 1 pound) of protein supplement per head daily after mid-July if the pastures are deteriorating badly. If pasture conditions stay good, it is doubtful that additional protein will pay.

Delayed vs. Summer-long Supplemental Feeding

The average results obtained in a comparison of feeding 20% protein pellets during the last 45 days on grass vs. the entire period are shown in Table 9. The left side of this table compares Lots 3, 7, and 8 in which the cattle received, respectively: No supplement; 3½ pounds of 20% pellets daily throughout the grazing season; and 3½ pounds of 20% pellets only during the last 45 days of the grazing season. These results apply to cattle sold in mid-August. On the right side of this table are the results obtained from cattle of Lots 4 and 10 (two-year average), where cattle remained on summer pasture until mid-September, and the 20% protein supplement was fed during the last 45 days before marketing.

The results indicate that feeding 20% protein supplement either throughout the entire period, or after July 1 (last 45 days), was profitable in this study. Steers of Lot 3, receiving no supplemental feed, gained 1.77 lbs. per head daily, while those fed 3½ lbs. throughout (Lot 7) gained 1.97 lbs. Steers of Lot 8 receiving the 20% protein pellets for the last 45 days only gained 1.93 lbs. Similarly, for cattle marketed in mid-September, the comparison was 1.82 pounds per head daily for no supplement vs. 1.93 pounds for 3½ lbs. fed the last 45 days. Further, feeding the protein supplement, in each case, increased the selling price of

the cattle. Although adding to the cost of production, it considerably increased the net return per head due to the greater selling price and market weight. Carcass grades and dressing percentage obtained in the third trial further indicated an advantage for late summer feeding.

In a comparison of Lots 7 and 8 in which the same amount of 20% protein supplement was fed daily, but over varying lengths of time, the results as shown in Table 9 indicate very little difference in average daily gains. However, the cattle fed supplements for the last 45 days only were more profitable due to the much lower feed costs (approximately $8.00 per head) plus essentially the same selling price, yield, and carcass grade.

Steers of Lot 7 receiving 3½ pounds of 20% protein supplement throughout the summer grazing season and sold in mid-August, returned a net profit of $37.53 per head, while those of Lot 8, fed the same daily amount of 20% protein supplement during the last 45 days before marketing, returned $42.13. This was approximately $6.00 more than their mates which received the same amount of supplement throughout the grazing period. Weight gains up to July 1 when feeding was started show little difference in gain between Lots 7 and 8. Consequently, the supplemental feed given Lot 7 during May and June apparently was not utilized to produce greater gains. This is further borne out by experimental work at the Lake Carl Blackwell Experimental Range in

Table 9.—Comparison of Feeding 20% Protein Pellets Throughout Grazing Period vs. Last 45 Days before Marketing (Average of 3 trials).[1]

	Sold mid-Aug. (108 days)			Sold mid-Sept. (136 days)	
	Lot 3 No supplement	Lot 7 3½ lbs. throughout	Lot 8 3½ lbs. last 45 days	Lot 4 No supplement	Lot 10 3½ lbs. last 45 days
No. of steers compared	58	58	57[2]	38	37[2]
Avg. weights (lbs.)					
Initial	989	989	988	1034	1037
Final	1181	1202	1196	1287	1299
Total gain	192	213	208	253	262
Ave. daily gain	1.77	1.97	1.93	1.82	1.93
Supplements fed/steer/day (lbs.)					
20% protein pellets	——	3.5	3.53	——	3.53
Total feed and pasture cost per steer ($)	14.68	28.60	20.47	16.93	23.22
Selling price/cwt. ($)	25.62	26.49	26.46	26.25	27.75
Net return/steer ($)	34.29	37.53	42.13	53.44	71.67
Dressing percent[4]	59.9	61.3	60.7	59.7	61.9
Ave. U. S. carcass grade[4]	Low Gd	Avg. Gd.	Avg. Gd.	Avg. Gd.	Avg. Gd.

1 Three-year average for those cattle sold August 19, and a two-year average for those sold September 17.
2 One steer removed from Lot 8; one less steer used in Lot 10 in third trial.
3 Average amount fed last 45 days before marketing.
4 Dressing percent and carcass grades obtained only on third trial.

which feeding cottonseed meal throughout the grazing period vs. feeding it only the last 45 days did not produce greater gains or increased market value for the cattle. (12)

Results from feeding no supplement vs. 3½ lbs. of 20% protein pellets the last 45 days before the steers were marketed in mid-September, indicate essentially the same trend. In this case, steers of Lot 4 gained 1.82 pounds per head daily vs. 1.93 for those receiving the 3½ pounds of 20% pellets during the last 45 days (Lot 10). While the amount of 20% pellets fed to Lot 10 steers increased the feed cost by approximately $6.00 per head, the selling price was advanced by $1.50 per hundredweight, and the steers proved to be much more profitable than those receiving no supplemental feed. This advantage in selling price was justified by the increase in dressing percentage, although the carcass grades of the cattle was not greatly different.

Full Feeding vs. Limited Feeding Last 45 Days

The average results of tests in which 20% protein pellets were full-fed during the last 45 days for steers marketed in mid-August are shown in Table 10. Lot 8 cattle, fed 3½ pounds of 20% protein pellets during the last 45 days, made less gain than their mates in Lot 9 which received a full feed of the same pellets during the last 45 days before marketing. In Lot 9, the cattle were worked up slowly to a full-feed of 20% pellets and were then fed all they could clean up, once daily. Considerable trouble developed in the first trial where the full-feeding procedure was used, and several steers were foundered when the cattle missed their daily feding, and were fed larger than intended amounts on the next day.

Differences in daily gain of .18 pounds per head favored the steers full-fed the 20% protein pellets (Lot 9). However, the total feed cost for these steers was raised $9.25 per head by the full-feeding program as compared to steers fed 3½ pounds per head daily. The selling price was advanced by only $0.26 per hundredweight. Consequently, even though the steers in Lot 9 out-gained their mates fed limited amounts of supplement, the greater total feed costs reduced the net return per steer: $42.13 for Lot 8 vs. $40.78 for those of Lot 9 which were full-fed. Yield and carcass grades were the same in both lots in the third trial. Consequently, it seems that the greater amounts of supplement fed Lot 9 steers may have decreased their consumption of grass without a corresponding profitable increase in rate of gain and market value.

Also, it is possible that the full-feeding period was too short to obtain the most profitable response. Had the steers of Lot 9 been full-fed

for periods of 30 to 60 days longer on grass, a profitable increase in selling price might have been obtained. In these trials, with no increase in yield or grade of the cattle which would have resulted in a higher selling price, the additional supplement fed Lot 9 caused them to be less profitable than where limited amounts of supplement were fed.

It should be borne in mind that the three-year-old steers used in this test were high-quality feeder cattle. Carcass grades at the end of the trial averaged U. S. Good, which were low considering their quality. In most years, this grade of cattle would find their most profitable market as feeder cattle. However, the results obtained in these trials might still apply in the production of fleshy feeder steers. In the tests reported herein, feeding any of the supplements tested was more profitable than grass alone, with the exception of Lot 6 fed cottonseed meal. Here the supplemental feed cost proved to be too high to increase net returns

Mid-August vs. Mid-September Selling

A comparison can be made of selling three-year-old slaughter steers in mid-August vs. carrying them to mid-September, as shown in Table 11. In this table, a three-year average is given for Lots 1, 2, 3, and 4 and a two-year average for Lots 8 and 10. Steers of Lots 1 and 2 grazed tall grass pastures without supplemental feed, and those in Lots 3 and 4 were placed on short grass pastures without supplement. Lots 8 and 10 grazed short grass pastures with 3½ pounds of supplemental feed during the last 45 days before marketing in each case.

Table 10.—Comparison of Feeding Limited Amounts of 20% Protein Pellets vs. Full-feeding during Last 45 days before Slaughter. (3-year average, steers sold Aug. 19, 108 days on test).

	Lot 8 3½ lbs. of Supple. last 45 days	Lot 9 Full-feed of Supple. last 45 days
No. of steers compared	57	55[1]
Avg. weights (lbs.)		
Initial	988	988
Final	1196	1216
Total gain	208	228
Avg. daily gain	1.93	2.11
Supplement fed/steer/day (lbs.)[2]		
20% protein pellets	3.5	9.3
Total feed and pasture cost per steer ($)	20.47	29.72
Selling price per cwt. ($)	26.46	26.72
Net return per steer ($)	42.13	40.78
Dressing percent[2]	60.7	60.7
Ave. U. S. carcass grade[3]	Avg. Gd.	Avg. Gd.

1 Two steers less per lot than for Lot 8 in third trial.
2 Average daily amount fed last 45 days prior to marketing.
3 Dressing percent and carcass grade during third trial only.

It will be seen that the additional month on grass for steers sold in mid-September was quite beneficial in increasing total selling weight, average carcass grade and yield. Weight gains during late August and early September continued to be good, and slaughter condition improved during this period. Further, the additional cost of pasture from mid-August to mid-September was small. This is usually the case as ranchers are required to pay for a full summer of grass whether they use it or not. Consequently, grazing steers for an additional month increased pasture costs only slightly.

In a number of experiments at the Lake Carl Blackwell Experimental Range (10), steers sold in mid-August made almost 75 percent of their total summer gain by the early part of July. However, it was observed in the current experiment that the steers continued to make good gains through the late August and early September period. As mentioned above, these gains were put on at a very nominal cost, and with the resulting improvement in yield and grade, proved to be highly profitable.

It is common practice to sell grass-fat cattle in July and August. Hence a marketing date of mid-August was selected for use in this study with the majority of cattle. However, if grass is abundant and remains succulent, steers may continue to gain well through the late summer and improve somewhat in slaughter finish by mid-September. Also, it is common for the fat cattle market to advance somewhat in price as the September-October period is approached. Consequently, in these studies, it was approximately $21.00 per head more profitable to market

Table 11.—Comparison of Selling Steers in Mid-August vs. Mid-September with or without Supplements to Native Grass.

	No Supplemental Feed		3½ lbs. 20% Pellets last 45 days on grass[1]	
	Lots 1 & 3 (sold Aug. 19)	Lots 2 & 4 (sold Sept. 17)	Lot 8 (sold Aug. 19)	Lot 10 (sold Sept. 17)
No. of Steers Compared	116	115	38	37
Avg. weights (lbs.)				
Initial	990	988	1036	1037
Final	1190	1247	1262	1299
Total gain	200	259	226	262
Avg. Daily gain	1.85	1.90	2.09	1.93
Total Feed and Pasture Cost/Steer ($)	14.86	16.28	21.64	23.22
Selling price/cwt. ($)	25.57	26.16	26.67	27.75
Net Return/Steer ($)	35.63	54.92	48.17	71.67
Dressing percent[2]	59.6	60.0	60.7	61.9
Avg. U. S. Carcass Grade[2]	Avg. to Low Good	Avg. to High Good	Avg. Good	Avg. Good

1 Two-year average, summers of 1951 and 1953.
2 Dressing percent and carcass grades obtained only in third trial.

steers in mid-September than to market them in mid-August. Whether or not a rancher should be advised to hold cattle for mid-September marketing would of course depend upon the condition of his pasture and the relative price picture. If pastures remain good, later marketing might increase the slaughter condition of the cattle at little extra cost.

Summary

A total of 553 three-year-old grade Hereford steers were used in a three-year study comparing various pasture grasses, systems of management, and the effect of various supplements on the production of slaughter cattle off grass. The steers started the experiment during the first week of May and were sold either in mid-August or mid-September after approximately 108 to 136 days on grass. Data were obtained on rate of gain, feed cost, and selling price or appraised value. Yield and carcass grades were also obtained in one trial.

Tall grass pastures were slightly superior to short grass under the conditions of this study. Steers on tall grass made greater gains during the summer grazing period, whether sold in mid-August or mid-September. While the results were not entirely consistent from year to year, they tend to bear out the contention of ranchers that tall grass pastures are superior to short grass for producing optimum gain and finish on older steers that are to be sold as slaughter cattle. Also, they indicate that amount of grass, rather than quality, is perhaps the more important factor in comparing the two types of native range.

It was profitable in all but one comparison to feed at least 3½ lbs. of supplement per head daily to three-year-old steers that were sold as slaughter cattle in either mid-August or mid-September. Only when the cost of supplemental feed was prohibitive (as was true with cottonseed meal in these trials) was feeding on grass not profitable. Feeding on grass increased the daily gains of cattle and improved their selling price, as was reflected in their carcass grade and yield. Although the cost of production was increased, the improvement in weight and selling price of the cattle was enough to offset the additional feed cost and return more net profit.

Corn proved to be a more efficient and economical supplement than either cottonseed meal or 20% protein pellets. Steers fed 3½ lbs. per head daily of ground shelled corn throughout the grazing season made greater gains at lower feed cost and sold for slightly more than those fed either cottonseed meal or 20% protein pellets. This increase in rate of gain, at a lower feed cost, greatly improved the net return per steer. Twenty percent protein pellets were only slightly superior to

cottonseed meal in terms of increasing rate of gain, but proved to be a more economical supplement and therefore resulted in greater net returns.

Feeding a limited amount (3½ lbs. per head daily) of 20% protein supplement during the last 45 days on grass for steers sold in mid-August resulted in slightly less gain than feeding the same daily amount throughout the grazing period. This feeding program considerably reduced the total feed cost per steer, without a reduction in selling price; thus increasing the net return. Dressing percentage and carcass grades were essentially the same for the two groups. Steers fed limited amounts of supplement early in the grazing period may not utilize the feed to maximum advantage until the amount and quality of grass declines in early July.

Full-feeding 20% protein pellets vs. feeding a limited amount (3½ lbs. per head daily) over the last 45 days of the grazing period were compared. Steers full-fed the supplement gained slightly more than those fed limited amounts, and sold at a slightly higher price. However, this increase in gain and selling price was not enough to pay for the additional cost of feed for cattle full-fed on grass. The steers receiving limited amounts of protein supplement proved to be the most profitable group.

Steers sold in mid-September were much more profitable than their mates sold in mid-August. Daily gains continued good during late August and early September. In addition, it appears from the appraised value and slaughter data that the steers which had the benefit of an extra 30 days on grass were in better flesh when sold. Since the additional pasture cost was small, grazing to mid-September was $21.00 per head more profitable in this experiment. Where grass is ample and the pasture outlook is good, cattle could well be carried to a later marketing date, which is often more favorable for slaughter cattle.

Appendix Table I.—Average Chemical Composition of Feed and Grass Samples, and Feed Prices, used in a Study of Various Protein and Mineral Supplements for Wintering Steers on Native Grass (Ft. Reno Station, 1951-54).

	Percent Dry matter	Percentage composition of dry matter							Price (dollars per ton)
		Ash	Crude protein	Fat	Crude Fiber	N-free Extract	Ca	P	
Feeds									
Cottonseed meal (Hyd.)	92.65	6.95	44.01	6.30	11.00	31.71	.22	1.10	87.83
Cottonseed meal (Solvent)	91.36	6.48	46.87	0.75	12.79	33.11	.23	.97	87.83
Soybean meal	91.80	6.75	49.34	2.83	7.92	33.16	.44	.77	92.50
Sesame meal	93.91	7.08	49.01	7.42	6.39	30.11	.22	1.35	75.00[1]
Corn gluten meal	91.34	2.43	48.74	1.16	3.33	44.34	.12	.35	108.00[1]
Linseed meal	93.00	6.82	38.36	3.93	10.89	40.00	.47	.70	117.80[1]
Ground limestone	99.14	——	——	——	——	——	38.00	——	14.67
Bone meal	86.74	——	——	——	——	——	32.00	14.80	105.00
Pasture Grass[2]									
Oct.-November									
Tall grass	——	8.17	3.53	1.87	31.75	52.61	.42	.06	——
Short grass	——	9.74	6.84	1.79	28.97	52.66	.34	.09	——
December									
Tall grass	——	5.95	1.97	1.96	38.81	43.35	.26	.03	——
Short grass	——	8.92	4.98	1.62	32.62	50.28	.32	.08	——
February-March									
Tall grass	——	7.81	2.33	1.70	37.27	49.28	.30	.03	——
Short grass	——	9.83	3.86	1.56	31.63	49.36	.31	.07	——

1 Prices listed for trial in which feed was used. Other feeds are average of two to three-year periods.
2 Average of predominate species of tall grass (big and little bluestem, Indian and switch) and short grass (buffalo, side oats grama and blue grama). Cost of winter pasture calculated at $5.00 per head.

Appendix Table II.—Average Chemical Composition of Feeds and Feed Prices Used in Summer Feeding Trials (1950, 1951 and 1953).

	Percent Dry Matter	Percentage Composition of Dry Matter							Feed Pricse ($) per ton
		Ash	Crude Protein	Fat	Crude Fiber	N. F. E.	Calcium	Phos.	
Ground Shelled Corn	90.52	1.88	10.13	5.03	2.08	78.37	.04	.30	63.07
Cottonseed meal	93.63	7.11	42.98	6.14	10.52	33.25	.25	1.06	87.83
20% Protein pellets[1]	90.80	3.47	21.14	4.62	5.57	65.23	.22	.61	74.25
Pasture Grasses:[2]									
May:									
Short Grass	——	8.50	9.97	2.64	26.56	52.28	.35	.17	——
Tall Grass	——	10.40	9.67	2.96	29.79	47.77	.37	.18	——
June:									
Short Grass	——	9.50	9.06	2.70	30.32	48.93	.41	.18	——
Tall Grass	——	9.00	8.59	3.06	31.18	48.44	.34	.15	——
July:									
Short Grass	——	11.00	10.28	1.87	30.77	46.92	.43	.17	——
Tall Grass	——	8.20	7.50	3.19	33.32	47.92	.39	.13	——
August:									
Short Grass	——	——	7.62	1.87	31.65	48.32	.38	.15	——
Tall Grass	——	——	5.42	2.49	37.16	46.83	.32	.12	——
September:									
Short Grass	——	9.00	8.19	2.15	30.35	49.55	.38	.13	——
Tall Grass	——	7.40	5.24	2.33	33.85	39.87	.36	.11	——

1 Contained 65% ground shelled corn and 35% cottonseed meal.
2 Short grass species included buffalo, side oats grama, and blue grama; tall species included big and little bluestem, Indian and switch grass.

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