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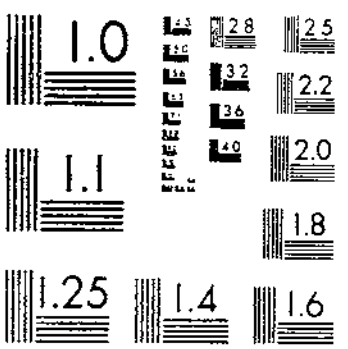

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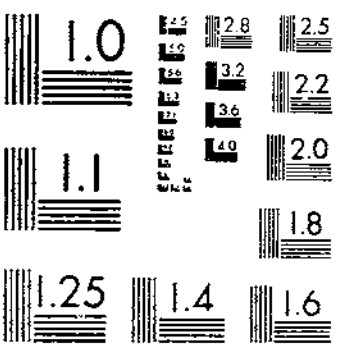

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TECHNICAL BULLETIN No. 43 FEBRUARY, 1928

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WASHINGTON, D. C.

SORGO SILAGE, SORGO FODDER, AND COTTONSEED HULLS AS ROUGHAGES IN RATIONS FOR FATTENING CALVES IN THE SOUTHWEST

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THE REGION AND ITS PROBLEMS

Thousands of acres of tillable, west Texas lands formerly utilized for grazing purposes only are being placed under cultivation during each succeeding year. Vast areas are being planted to cotton, grain sorghum, sorgo,[1] and other crops, in consequence of which a considerable readjustment in agriculture is under way. New or additional information is needed by those who are engaged in feeding or finishing livestock or who may be considering using livestock to market these crops.

Livestock feeding is an enterprise that until lately has not been generally practiced by Texas farmers, although experience in the Corn Belt section of the United States and in some of the older European countries has shown that livestock farming is one of the most permanent and profitable systems of agriculture. As a result of a properly balanced system of farming, the soil is enriched and maintained at a higher degree of fertility than is possible or practicable where livestock are not included in the general scheme of farm operations. The agricultural development has been so recent in west Texas that as yet there is available only a limited amount of reliable, experimental information with reference to livestock-feeding problems.

[1] Sorgo is the name given to the sweet sorghums by the United States Department of Agriculture to distinguish them from the grain sorghums. The Sumac variety was used in this experiment.

OBJECT OF EXPERIMENTAL WORK

Comparisons were made in three consecutive years, 1923 to 1925, inclusive, of sorgo silage, sorgo fodder, and cottonseed hulls, when fed in conjunction with milo heads and cottonseed meal to fattening calves. The experiment was conducted cooperatively by the Bureaus of Animal Industry and Plant Industry, United States Department of Agriculture, and the Agricultural Experiment Station of the Agricultural and Mechanical College of Texas, at the Big Spring field station.

The experiment was planned for the purpose of determining the relative feeding values of sorgo silage, sorgo fodder, and cottonseed hulls respectively, as sources of roughage in the rations for fattening calves. The region in which the experiment was conducted is well adapted to the production of cotton and the more common varieties of the sorghums; consequently, stockmen interested in finishing cattle are anxious to have more information on the comparative feeding values of sorgo feeds and cottonseed hulls. The method of preservation and feeding of the sorgo roughages is also of importance, hence the reason for comparing sorgo silage and sorgo fodder.

PLAN OF WORK

In each of the three tests, representative groups of well-bred Hereford calves of weaning age were fed. An individual firebrand or ear-tag number was given to each calf as a means of identification. The calves were weighed individually on three consecutive days at the beginning of each experiment, and were afterwards divided, as nearly equally as possible with reference to size and type, into three groups. The averages of the three initial and final weighings, respectively, constituted the initial and final weights. The individual weights were taken at regular 28-day periods throughout the experiments, all weighings beginning promptly at 1 p. m. The respective periods of feeding varied from 168 to 203 days in the three tests.

The following rations were fed in each of the three tests: Lot 1, ground milo heads, cottonseed meal, sorgo silage, and Sudan-grass hay; lot 2, ground milo heads, cottonseed meal, and cottonseed hulls; lot 3, ground milo heads, cottonseed meal, and sorgo fodder.

No labor charge was made against the steers, neither was any credit given for the manure produced, since it was assumed that the manurial value would offset the labor costs in feeding the cattle.

An open shed (fig. 1) 20 feet deep by 78 feet in length and having a southern exposure provided shelter during inclement weather. Each lot had an area of 60 by 26 feet. The feed bunks were made of 2-inch planks and were 18 feet long, 3 feet wide, 12 inches deep, and stood 1 foot above the ground. A fresh supply of water was available at all times. A liberal supply of granulated stock salt was available in boxes under the shed throughout the feeding period. The feed lots were situated on a sandy-loam soil, and mud was not a serious factor even during wet weather.

METHOD OF HANDLING THE CALVES

The calves were fed twice each day, about 8 a. m. and 6 p. m. The concentrates, consisting of ground milo heads and cottonseed meal, were weighed in their proper proportions and then thoroughly mixed together before being spread over and carefully mixed with the respective roughages in the feed bunks.

The sorgo fodder which was supplied to lot 3 was run through the silage cutter before being fed. Sudan-grass hay was fed once daily to the lot 1 calves, being placed in the feed bunk after the calves had consumed the bulk of the silage-concentrate mixture. In the first test all lots received the same quantity of cottonseed meal. However, during the second and third tests, the lot 2 calves, receiving cottonseed hulls, were fed a slightly increased quantity of meal, as compared with the other two lots, for the purpose of determining whether this would tend to offset the lower feeding value of the cottonseed hulls.

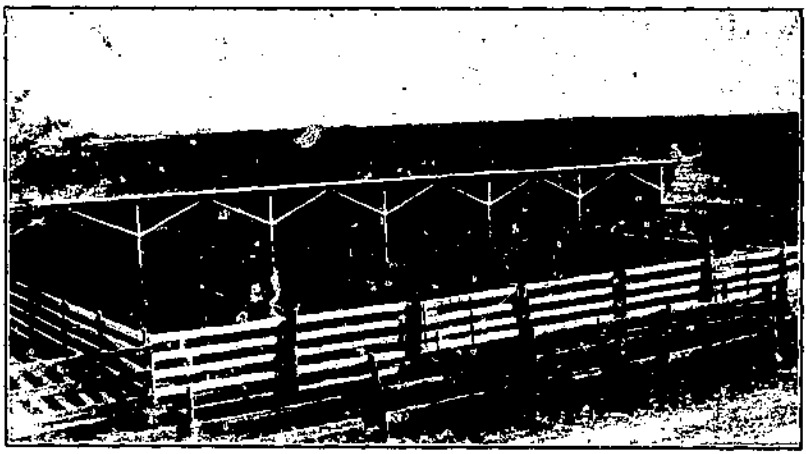

FIG. 1.—View of cattle-feeding pens, Big Spring field station

CALVES USED

The cattle used in all three tests were high-grade Hereford steer calves. Those used the first and third years were raised near Stanton, Tex., and those of the second year near Big Spring.

The calves used the first year (1923–24) were delivered to the Big Spring field station November 14 at an average cost of $27.50. As these calves had not been weaned, they were given a preliminary feeding until December 5 on a ration of 2 pounds of ground milo heads, 4 pounds of sorgo silage, 2 pounds of sorgo fodder, and 2 pounds of cottonseed hulls. They averaged 429 pounds at the time of going on the experiment proper, December 5.

The steers used the second year (1924–25) were late winter and early spring calves and were delivered to the station November 9, at a cost of $32 per head. They averaged 506 pounds, or about 75 pounds heavier than those used the year preceding. They were dehorned and branded November 12 and placed on experiment November 15.

The calves used the third year (1925–26) were late spring and early summer calves, and averaged 309 pounds. They were delivered to the station November 11 and placed on test November 13.

Forty-five calves were purchased each year and divided as evenly as possible into three lots. One steer, suffering from impaction of the rumen, in lot 2 of the last year's test, was removed from the experiment shortly after beginning.

FEEDS USED

The feeds used in all the tests were of good quality. The cottonseed meal was bought under a 43 per cent guaranty. However, two tests made each year by the Texas State chemist showed only 40.6 per cent protein the first year, 40.2 per cent the second, and 41.7 per cent the third year. A large portion of the milo heads used the first two years was shipped in from the Panhandle section of Texas, whereas during the last year all were produced locally. The milo heads were finely ground and there was practically no waste either of grain or ground head roughage. The sorgo silage was made from the first cutting of the Sumac variety of sweet sorghum, and was of good quality. The sorgo fodder was also of the first cutting and was of good quality. The cottonseed hulls were of fair to good quality. The Sudan-grass hay fed to lot 1 was of good quality.

The analyses of the various feeds used as determined by the Texas State chemist are given in Table 1.

TABLE 1.—*Composition of feeds used during experiment (based on two analyses of each feed)*

Kind of feed	Year	Protein	Water	Ash	Fat	Crude fiber	Nitrogen-free extract
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Cottonseed meal	1923–24	40.01	7.83	5.20	6.14	12.95	27.27
	1924–25	40.20	6.71	4.85	8.02	11.15	28.47
	1925–26	41.74	6.43	5.17	8.18	11.33	27.15
Ground milo heads	1923–24	9.67	12.67	2.02	2.29	5.52	67.23
	1924–25	9.47	10.68	3.74	2.46	6.37	67.28
	1925–26	9.28	10.25	3.53	2.33	7.77	66.84
Sorgo fodder	1923–24	5.60	32.12	6.84	2.18	14.33	38.93
	1924–25	5.03	27.45	4.79	1.71	14.75	46.27
	1925–26	5.04	30.41	5.26	1.98	14.43	42.38
Sorgo silage	1923–24	2.23	70.80	2.24	.69	6.21	17.83
	1924–25	2.03	72.89	1.65	.72	5.36	17.35
	1925–26	1.30	78.60	1.97	.53	5.77	11.83
Cottonseed hulls	1923–24	4.27	9.26	2.62	1.00	48.30	34.40
	1924–25	4.54	8.41	2.50	1.37	43.60	39.58
	1925–26	4.25	9.19	2.91	1.02	45.98	36.65
Sudan-grass hay	1924–25	7.50	9.31	6.77	2.08	20.42	47.92
	1925–26	8.23	7.44	7.14	1.80	30.55	44.84

FEED PRICES

The prices of milo heads, cottonseed meal, and cottonseed hulls are listed at actual cost, while the values assigned the sorgo silage, sorgo fodder, and Sudan-grass hay which were produced at the station were conservatively estimated. In this experiment the feeds were valued as shown in Table 2.

TABLE 2.—*Value of feeds used in experiments*

Feeds		Years		
		1923–24	1924–25	1925–26
Ground milo heads	per ton	$27.40	$30.00	$25.00
Cottonseed meal	do	45.30	42.00	33.00
Sorgo silage	do	6.00	6.00	8.00
Sorgo fodder	do	10.00	12.00	10.00
Cottonseed hulls	do	12.50	10.50	10.00
Sudan-grass hay	do	15.00	15.00	12.00

WEATHER CONDITIONS DURING TESTS

Table 3 shows the maximum and minimum temperatures as well as the distribution of rainfall during the experiments.

TABLE 3.—*Weather conditions during experiments*

Month	Maximum temperature			Minimum temperature			Precipitation		
	First year	Second year	Third year	First year	Second year	Third year	First year	Second year	Third year
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*
November		71	65		39	34		0.05	0.00
December	53	57	53	33	27	25	1.69	.13	.00
January	54	56	51	24	22	26	.03	.15	.98
February	57	70	68	30	34	33	.56	.00	.06
March	63	78	63	35	45	37	.02	.00	2.18
April	77	83	69	47	54	45	.91	4.43	2.24
May	[1] 82	[2] 81	87	55	56	61	2.85	1.02	1.96
June			[3] 90			63			.01
Total							6.60	5.78	7.43

[1] The first year's test terminated May 25.
[2] The second year's test terminated May 15.
[3] The third year's test terminated June 8.

THE FIRST TEST, 1923–24

RATIONS AND GAINS BY PERIODS

During the first 28-day period, as may be seen in Table 4, the calves in each of the respective lots consumed an average of 4.47 pounds of ground milo heads and 1.08 pounds of cottonseed meal with all the roughage that they would clean up per head daily. The average daily increase in weight per head during the first period, as shown in Table 4, was 1.51 pounds for the lot 1 calves receiving sorgo silage, 1.49 pounds for lot 2 calves receiving cottonseed hulls, and 1.3 pounds for lot 3 receiving sorgo fodder.

The rations were gradually increased throughout the fattening period until during the last seven days the steers were receiving an average feed of 13.3 pounds of ground milo heads, 2 pounds of cottonseed meal, and all the roughage that they would consume daily.

The average daily rations as well as average daily and total gains by periods are shown in Table 4.

TABLE 4.—*Average daily rations and gains by periods and for entire test of 175 days, 15 steers in each lot, 1923–24*

Lot No.	Ration and gain	First 28-day period	Second 28-day period	Third 28-day period	Fourth 28-day period	Fifth 28-day period	Last period of 35 days	Average for all periods
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	Ground milo heads	4.47	7.62	8.47	9.62	10.57	12.65	9.05
	Cottonseed meal	1.08	1.50	1.53	1.75	1.79	2.00	1.63
	Sorgo silage	16.93	19.99	20.00	19.52	19.07	19.55	19.17
	Sudan-grass hay	1.75	1.50	1.29	1.38	1.62	1.76	1.56
	Total gain per steer	42.30	61.20	70.27	53.87	58.67	48.13	55.73
	Average daily gain	1.51	2.19	2.51	1.92	2.10	1.38	1.91
2	Ground milo heads	4.47	7.62	8.47	9.62	10.66	12.65	9.06
	Cottonseed meal	1.08	1.50	1.53	1.75	1.81	2.00	1.63
	Cottonseed hulls	9.32	9.18	9.22	10.43	11.08	10.71	10.16
	Total gain per steer	44.69	23.33	61.73	30.87	38.53	33.03	40.00
	Average daily gain	1.49	.83	2.20	1.42	1.41	.97	1.37
3	Ground milo heads	4.47	7.62	8.47	9.62	10.64	12.65	9.06
	Cottonseed meal	1.08	1.50	1.53	1.75	1.81	2.00	1.63
	Sorgo fodder	12.09	10.18	9.15	8.91	8.62	7.31	9.30
	Total gain per steer	36.42	49.00	64.53	44.26	54.93	41.33	48.41
	Average daily gain	1.30	1.75	2.30	1.58	1.96	1.18	1.66

QUANTITY AND COST OF FEED REQUIRED TO PRODUCE 100 POUNDS OF GAIN

The manner in which the calves responded to sorgo silage, cottonseed hulls, and sorgo fodder is shown in Table 5. This table shows the quantity of feed required to produce 100 pounds of gain in the respective lots by 28-day periods. The average feed requirement per 100 pounds of gain for the 175-day period is also shown at the end of the table.

TABLE 5.—*Quantity of feed required to produce 100 pounds of gain, feed costs, and average gain per head by periods, first test, 1923–24*

Period	Lot number and feed	Feeds utilized per 100 pounds of gain						Cost of feed per 100 pounds' gain	Average gain per head
		Ground milo heads	Cottonseed meal	Sorgo silage	Cottonseed hulls	Sorgo fodder	Sudan-grass hay		
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Dollars*	*Pounds*
1	1, silage	396	72	1,120			116	9.91	42.3
	2, hulls	390	73		623			9.67	41.7
	3, fodder	344	84			932		11.27	36.4
2	1, silage	340	69	914			69	9.59	61.2
	2, hulls	915	180		1,101			23.50	23.3
	3, fodder	435	86			681		10.81	49.1
3	1, silage	337	61	797			51	8.78	70.3
	2, hulls	384	69		418			9.44	61.7
	3, fodder	367	66			397		8.53	64.5
4	1, silage	590	91	1,015			72	12.49	53.9
	2, hulls	675	123		733			16.01	39.9
	3, fodder	609	111			503		13.06	44.3
5	1, silage	505	85	904			77	12.13	58.7
	2, hulls	755	128		848			18.54	39.5
	3, fodder	542	92			439		11.71	54.9
6[1]	1, silage	920	145	1,422			128	21.12	48.1
	2, hulls	1,301	206		1,105			29.45	33.9
	3, fodder	1,071	169			626		21.60	41.3
Average, all periods.	1, silage	474	85	1,033			81	12.03	334.4
	2, hulls	661	119		741			16.37	240.0
	3, fodder	540	98			560		12.50	290.5

[1] Sixth period, 35 days.

The cheapest gain was made by lot 1, which received sorgo silage, the average feed cost per 100 pounds of gain being $12.03 as compared with $16.37 and $12.50 for lots 2 and 3 receiving cottonseed hulls and sorgo fodder, respectively. The cost of gain is not always a criterion of what the final profits will be. Although the cost of gains is generally very important in the determination of the financial outcome of the feeding operation, other factors, such as degree of finish, must also be given proper consideration. If the most costly gains are accompanied by a proportionally higher degree of finish, the more costly gains will be offset in a large measure by the proportionally higher selling value of the cattle on the market; on the other hand, if the more costly gains do not increase the final selling value of the cattle, the feeder is very likely to sustain a severe loss on the animals fed on such rations.

In this test the cottonseed hulls were charged against the calves at $12.50 a ton, the actual purchase price for the roughage for the 1923–24 experiment. This price for cottonseed hulls was unusually high and is no doubt considerably higher than the average Texas feeder usually pays. It was necessary to ship the cottonseed hulls to Big Spring via rail, and the transportation charges were included in the cost. Feeders or prospective feeders should bear in mind that feed prices are likely to vary considerably during a period of years. Therefore, when prices paid for feeds during a particular period are low, costs per 100 pounds of gain are also correspondingly lower than when prices of feeds are high. The experimental data on the gains made by the cattle and the relative market desirability of the lots fed on different rations are not affected by the fluctuations in the prices of the feeds with varying seasons.

MARKETING DATA

The steers were sold on the Fort Worth market June 2, 1924, at prices in line with the Chicago market for that day, lot 1 bringing $9.91 a hundredweight, lot 2, $7.87, and lot 3, $8.94. Livestock commission salesmen and packer buyers pronounced lots 1 and 3, which had received sorgo silage and sorgo fodder as the roughage portion of the respective rations, good, uniform cattle but lacking slightly in finish. The calculated fatness[2] of the three lots (based on the dressing percentage and the quantity of internal fat) was 20 per cent for lot 1, 14 per cent for lot 2, and 22 per cent for lot 3.

The cost of feed per calf was $40.24, $39.30, and $36.30, respectively, for lot 1 receiving silage, lot 2 receiving cottonseed hulls, and lot 3 receiving sorgo fodder. The lot 1 calves made 94.4 pounds more gain per head than the lot 2 calves receiving cottonseed hulls at a total cost of only 95 cents in excess of the total feed cost for lot 2, while the same lot (lot 1) gained 43.9 pounds more per head during the 175-days' feeding period at a cost of $3.94 in excess of that incurred by the lot 3 steers receiving sorgo fodder. The lot 1 calves receiving silage sold for $21.48 more per head than the lot 2 steers receiving cottonseed hulls, and $9.49 more than the lot 3 steers receiving sorgo fodder. The increased return from lot 1 calves receiving sorgo silage is attributable to the seemingly higher finish carried by the calves in that lot before slaughter. The lot 1 calves receiving silage sold for $2.04 more per 100 pounds live

[2] See Journal of Agricultural Research, vol. 32, p. 754, for formula.

weight than the lot 2 calves receiving cottonseed hulls, and 97 cents per 100 pounds live weight above the lot 3 calves, receiving sorgo fodder.

HOGS FOLLOWING STEERS

Two shotes averaging about 100 pounds were placed in each of the three lots at the beginning of the experiment for the purpose of utilizing wasted and undigested grain. However, they were removed at the end of the second 28-day period on account of their failure to make satisfactory gains. Even when fed 2 pounds of milo heads and one-fourth of a pound of tankage per head during the second 28 days, the average daily gain was only 0.83 pound per pig.

Although cattle feeders have almost always found it profitable to have pigs follow older cattle in the feed lot, the experience with hogs following young steers in this experiment tended to confirm the conclusions reached in previous work. In a test conducted by the Texas Agricultural Experiment Station at substation No. 7, 1921–22 (Texas Bulletin 296), shotes following calves receiving ground milo and feterita heads and ground ear corn lost weight and were removed. These results indicate that young cattle especially utilize ground grain so efficiently that very little undigested grain is available for hogs following the cattle. Table 6 summarizes the results of the first feeding test with steers.

TABLE 6.—*Summary of first test of 175 days, December 5, 1923, to May 28, 1924, inclusive*

Item	Lot 1 (silage)	Lot 2 (hulls)	Lot 3 (fodder)
Number of steers	15	15	15
Average initial weight at feed lot—pounds	428.90	433.02	425.17
Average final weight at feed lot—do	763.33	673.07	715.07
Average final weight at Fort Worth—do	723.33	638.66	690.00
Average gain per head, feed-lot weights—do	334.43	240.00	290.50
Average gain per head, selling weights—do	294.43	205.60	270.83
Average daily gain per head, feed-lot weights—do	1.91	1.37	1.66
Average daily gain per head, selling weights—do	1.68	1.18	1.55
Average daily ration:			
Ground milo heads—do	9.05	9.06	9.06
Cottonseed meal—do	1.63	1.63	1.63
Sorgo silage (Sumac)—do	19.17		
Cottonseed hulls—do		10.16	
Sorgo fodder (Sumac)—do			9.30
Sudan-grass hay—do	1.56		
Feed required per 100 pounds gain:			
Ground milo heads—do	473.55	660.75	545.77
Cottonseed meal—do	85.03	118.69	98.05
Sorgo silage (Sumac)—do	1,003.23		
Cottonseed hulls—do		741.08	
Sorgo fodder (Sumac)—do			560.04
Sudan-grass hay—do	81.50		
Cost of feed per 100 pounds gain—dollars	12.03	16.37	12.50
Total feed consumed per head:			
Ground milo heads—pounds	1,583.47	1,585.80	1,585.40
Cottonseed meal—do	284.33	284.87	284.82
Sorgo silage (Sumac)—do	3,354.63		
Cottonseed hulls—do		1,778.60	
Sorgo fodder (Sumac)—do			1,626.87
Sudan-grass hay—do	272.73		
Financial statement:			
Initial cost per steer—dollars	27.50	27.50	27.50
Cost of feed per steer—do	40.24	39.30	36.30
Shipping and marketing cost per head—do	3.77	3.77	3.77
Total cost of steer—do	71.51	70.57	67.57
Price received per steer—do	71.71	50.23	62.22
Necessary selling price (per 100 pounds) to break even—do	9.88	11.05	9.71
Selling price per 100 pounds, market weights—do	9.91	7.87	8.94
Profit (+) or loss (−) per steer—do	+.20	−20.34	−5.35

THE SECOND TEST, 1924–25

RATIONS AND GAINS BY PERIODS

During the first trial cottonseed meal was supplied to each lot on a similar basis. However, during the second trial, lot 2, receiving cottonseed hulls, received an average of 0.27 pound more cottonseed

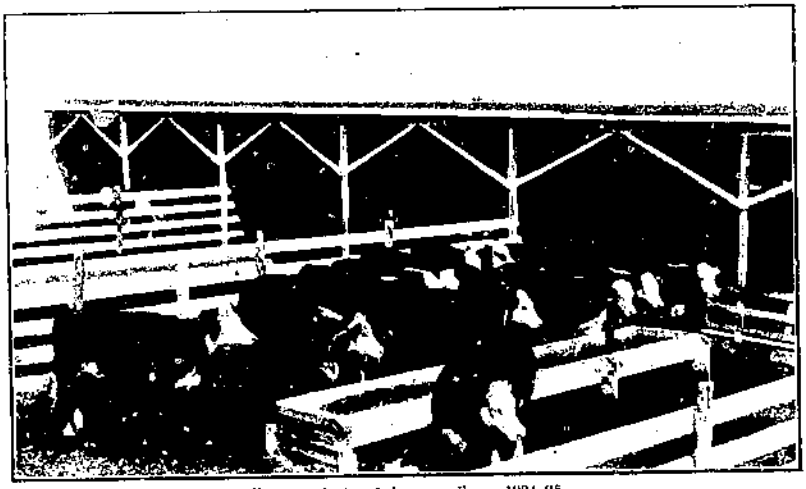

FIG. 2.—Lot 1, fed sorgo silage, 1924–25

meal per head daily throughout the entire 168 days than lots 1 and 3, receiving sorgo silage and sorgo fodder, respectively. This increase in cottonseed meal was allowed lot 2 for the purpose of ascertaining whether it would tend to offset the lower feeding value of the hulls in their ration. However, as may be observed in Table 7, the

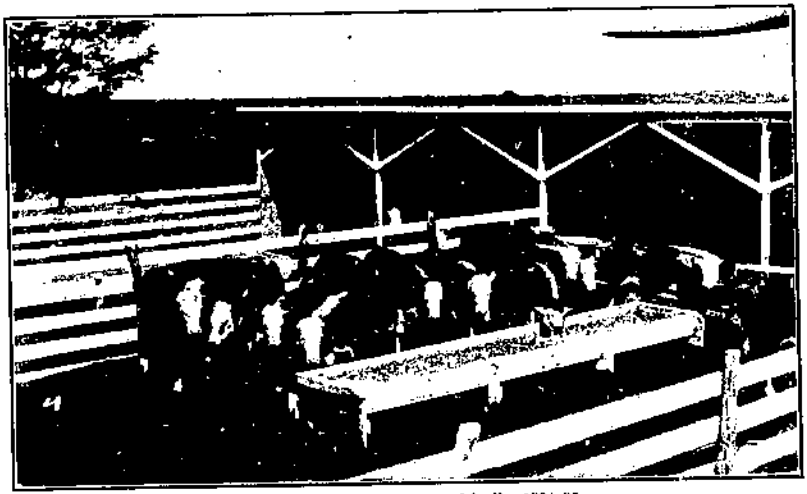

FIG. 3.—Lot 2, fed cottonseed hulls, 1924–25

average daily gains made by lot 2, receiving cottonseed hulls as the roughage portion of the ration, were 0.4 pound less per head daily, or 69 pounds less during the entire 168 days, than the gains of lot 1, which received sorgo silage. The condition of the three lots at the end of the trials is shown in Figures 2, 3, and 4.

The maximum quantity of concentrates utilized at any time by the calves was 15.3 pounds of ground milo heads per head daily fed to each of the three lots, while lot 2, receiving cottonseed hulls, consumed as high as 3.3 pounds of cottonseed meal per head daily as compared with 3 pounds for lots 1 and 3, receiving sorgo silage and sorgo fodder, respectively.

FIG. 4.—Lot 3, fed sorgo fodder, 1924–25

TABLE 7.—*Average daily rations and gains by periods and for entire test of 168 days, 15 steers in each lot, 1924–25*

Lot No.	Ration and gain	First 28-day period	Second 28-day period	Third 28-day period	Fourth 28-day period	Fifth 28-day period	Sixth 28-day period	Average for all periods
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	Ground milo heads	4.32	8.00	10.10	10.86	12.89	14.98	10.19
	Cottonseed meal	0.86	1.60	1.68	2.03	2.16	2.86	1.87
	Sorgo silage	21.55	21.70	19.57	13.66	13.93	13.21	17.27
	Sudan-grass hay	1.82	1.96	1.91	1.93	2.00	2.00	1.94
	Total gain per steer	60.87	68.60	64.87	57.40	76.20	50.91	63.14
	Average daily gain	2.17	2.45	2.32	2.05	2.72	1.82	2.26
2	Ground milo heads	4.32	8.00	10.10	11.26	12.91	14.98	10.26
	Cottonseed meal	0.90	2.00	1.99	2.37	2.43	3.17	2.14
	Cottonseed hulls	10.84	10.75	11.22	10.92	9.12	7.38	10.04
	Total gain per steer	40.53	52.27	62.20	66.20	54.00	35.53	51.79
	Average daily gain	1.45	1.87	2.22	2.36	1.93	1.27	1.85
3	Ground milo heads	4.32	8.00	10.10	11.26	12.91	14.98	10.26
	Cottonseed meal	0.86	1.60	1.68	2.10	2.16	2.86	1.88
	Sorgo fodder	11.62	12.85	11.44	11.34	9.15	7.68	10.68
	Total gain per steer	65.33	54.80	68.13	61.87	63.20	60.20	62.25
	Average daily gain	2.33	1.96	2.43	2.21	2.26	2.15	2.22

QUANTITY AND COST OF FEED REQUIRED TO PRODUCE 100 POUNDS OF GAIN

Table 8 illustrates the manner in which the cattle responded to the respective rations fed to the three lots throughout the 168-day feeding period. Lot 1 required 452 pounds of ground milo heads, 83 pounds of cottonseed meal, 766 pounds of sorgo silage and 86 pounds of Sudan-grass hay to produce 100 pounds of gain. The average cost per 100 pounds of gain for lot 1 was $11.46. Lot 1 made more economical gains than either of the other lots.

Lot 2 required 555 pounds of ground milo heads, 116 pounds of cottonseed meal, and 542 pounds of cottonseed hulls to produce 100 pounds of gain at a cost of $13.60, or an increase of $2.14 above the cost of gains made by the lot 1 steers.

Lot 3 required 461 pounds of ground milo heads, 84 pounds of cottonseed meal, and 480 pounds of Sumac fodder to produce 100 pounds of gain at a cost of $11.57 or a cost of only 11 cents above the cost of gains made by the lot 1 steers.

It is illustrated clearly that there was a general tendency for the quantity of concentrates required per 100 pounds of gain to increase as the fattening period advanced, the only exception in the 1924–25 test being the lot 1 steers during the fifth 28-day period. This table serves to emphasize that when both sorgo roughages and cottonseed hulls are available as feedstuffs, it is important that the prospective feeder take into consideration the productive values and the cost of the respective roughages per ton laid down at the feed lots. In each of the three feeding trials reported in this bulletin, cottonseed hulls were necessarily charged against the cattle at prices somewhat higher than usual in Texas, owing to the fact that freight charges were included. The cottonseed hulls fed in the 1924–25 test were purchased at an actual cost of $10.50 a ton, a figure apparently considerably above their actual worth. The cheapest gain was made in lot 1, which received sorgo silage, the average feed cost per 100 pounds of gain being $11.46 as compared with $13.60 and $11.57 for lots 2 and 3, receiving cottonseed hulls and sorgo fodder, respectively.

Table 8 shows the quantity and cost of feeds required to produce 100 pounds of gain both by 28-day intervals and for the entire 168-day period.

TABLE 8.—*Quantity of feed required to produce 100 pounds of gain, feed cost, and average gain per head by periods; second test, 1924–25*

Period	Lot number and feed	Feeds utilized per 100 pounds gain						Cost of feed per 100-pounds gain	Average gain per head
		Ground milo heads	Cottonseed meal	Sorgo silage	Cottonseed hulls	Sorgo fodder	Sudan-grass hay		
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Dollars*	*Pounds*
1	1, silage	199	39	991			84	7.41	60.9
	2, hulls	200	62		743			9.63	40.5
	3, fodder	185	37			499		6.54	65.3
2	1, silage	320	65	886			80	9.53	68.6
	2, hulls	428	107		576			11.69	52.3
	3, fodder	409	82			057		11.70	54.8
3	1, silage	436	73	845			83	11.22	64.9
	2, hulls	464	90		505			11.35	62.2
	3, fodder	415	69			470		10.49	68.1
4	1, silage	630	99	666			94	12.73	57.4
	2, hulls	476	100		462			11.67	66.2
	3, fodder	510	95			513		12.73	61.9
5	1, silage	474	79	512			74	10.87	76.2
	2, hulls	670	126		472			15.16	54.9
	3, fodder	572	90			406		13.02	63.2
6	1, silage	756	145	667			101	17.14	50.9
	2, hulls	968	205		477			21.32	35.5
	3, fodder	629	120			323		13.91	60.2
All periods	1, silage	452	83	766			86	11.46	378.9
	2, hulls	555	116		542			13.60	310.8
	3, fodder	461	84			480		11.57	373.6

MARKETING DATA

The calves were sold on the Fort Worth market May 18, 1925. Livestock commission salesmen and packer buyers pronounced the lots 1 and 3 calves, which received sorgo silage and sorgo fodder as the roughage portion of the respective rations, the better and more uniformly finished cattle, and agreed that the lot 1 cattle carried a slightly higher finish than the fodder-fed lot. The lot 2 calves which had received cottonseed hulls were not so highly finished as were the lots 1 and 3 calves, although there seemed to be much less difference in finish than in the preceding year or following year. The estimated quantity of fat in the live animals at the close of the experiment (estimates based on dressing percentages and on weight of internal fat) was 25 per cent for lot 1; 26 per cent for lot 2; and 25 per cent for lot 3.

TABLE 9.—*Summary of second test of 168 days, November 25, 1924, to May 12, 1925, inclusive*

Item	Lot 1 (silage)	Lot 2 (hulls)	Lot 3 (fodder)
Number of steers	15	15	15
Average initial weight at feed lot—pounds	506.58	504.45	506.65
Average final weight at feed lot—do	885.44	815.20	880.20
Average final weight at Fort Worth—do	823.33	760.00	812.00
Average gain per head, feed-lot weights—do	378.86	310.75	373.55
Average gain per head, selling weights—do	316.75	255.55	305.35
Average daily gain per head, feed-lot weights—do	2.26	1.85	2.22
Average daily gain per head, selling weights—do	1.88	1.52	1.82
Average daily ration:			
Ground milo heads—do	10.19	10.26	10.26
Cottonseed meal—do	1.80	2.14	1.88
Sorgo silage (Sumac)—do	17.27		
Cottonseed hulls—do		10.94	
Sorgo fodder (Sumac)—do			10.68
Sudan-grass hay—do	1.94		
Feed required per 100 pounds gain:			
Ground milo heads—do	451.78	554.65	461.44
Cottonseed meal—do	82.72	115.86	84.47
Sorgo silage (Sumac)—do	705.77		
Cottonseed hulls—do		542.46	
Sorgo fodder (Sumac)—do			480.44
Sudan-grass hay—do	85.96		
Cost of feed per 100 pounds gain—dollars	11.46	13.60	11.57
Total feed consumed per head:			
Ground milo heads—pounds	1,713.63	1,723.63	1,723.63
Cottonseed meal—do	313.38	360.03	315.51
Sorgo silage (Sumac)—do	2,901.20		
Cottonseed hulls—do		1,686.07	
Sorgo fodder (Sumac)—do			1,794.60
Sudan-grass hay—do	325.67		
Financial statement:			
Initial cost per steer—dollars	32.00	32.00	32.00
Cost of feed per steer—do	43.30	42.26	43.25
Shipping and marketing cost per head—do	3.75	3.75	3.75
Total cost of steer—do	79.14	78.01	79.00
Price received per steer—do	90.57	77.92	85.77
Necessary selling price per 100 pounds to break even—do	9.61	10.26	9.73
Selling price per 100 pounds, market weights—do	11.00	10.25	10.56
Profit (+) or loss (−) per steer—do	+11.43	−0.09	+6.77

Table 9 shows that the lot 1 calves gained 68.11 pounds more than those in lot 2, but only 5.31 pounds more than lot 3. The additional gain of lot 1 over lot 2 was effected only at an additional feed cost of $1.13 over that of lot 2. However, reference to Table 9 shows a profit of $11.43 per head for the lot 1 calves as compared with a 9-cent loss per head on the lot 2 calves. The lot 3 steers, which received sorgo fodder, showed a profit of $6.77 a head. In this test the larger profit returned by the lot 1 steers is attributable to the

larger gain and their higher selling value on the market. This serves to emphasize the importance of properly finishing commercially fed cattle before offering them on the market as killers.

The lot 1 calves sold at $11 per 100 pounds straight; 14 of the lot 3 calves sold at $10.75 and 1 at $8; while 11 head of the lot 2 cattle went over the scales at $10.50, and 4 at $9.50. The lot 3 calf which sold at $8 per 100 pounds was a large, rough steer that presented a staggy appearance, and the fact that it sold at a lower figure than the others of the lot was probably not due at all to the ration fed.

THE THIRD TEST, 1925–26

RATIONS AND GAINS BY PERIODS

Since the purpose of this test was that of comparing sorgo silage, cottonseed hulls, and sorgo fodder, it was planned to feed ground milo heads to each of the three lots on an equal basis. However, there was a slight difference in the average quantity consumed by lot 2 and that consumed by lots 1 and 3, owing to the fact that one steer in lot 2 suffered a severe attack of digestive trouble in the early part of the third 28-day period and had to be removed from the experiment. Feed was deducted in proportion to its weight, which accounts for the slight discrepancy in the average quantities of ground milo heads consumed.

The concentrate portions of the respective rations were increased gradually throughout the feeding period until during the last period lots 1 and 3 consumed an average of 13.9 pounds of ground milo heads and 2.4 pounds of cottonseed meal as compared with 12.33 pounds of ground milo heads and 2.33 pounds of cottonseed meal in lot 2, receiving cottonseed hulls. The smaller average daily concentrate and roughage consumption in lot 2 during the final period was no doubt, in a measure, attributable to the long feeding period and to the high temperature prevailing during the latter part of the feeding period. The average rations consumed per head and the average total and daily gains are given by periods for the respective lots in Table 10.

TABLE 10.—*Average daily rations and gains by periods and for entire test of 203 days, 15 steers in lots 1 and 3, 14 steers in lot 2, 1925–26*

Lot No.	Ration and gain	First 28-day period	Second 28-day period	Third 28-day period	Fourth 28-day period	Fifth 28-day period	Sixth 28-day period	Last period of 35 days	Average all periods
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	Ground milo heads	4.49	6.27	7.70	9.10	11.08	12.99	13.94	9.53
	Cottonseed meal	.77	1.12	1.41	1.69	2.03	2.26	2.40	1.69
	Sorgo silage	14.12	11.79	14.25	14.05	13.13	12.75	11.51	13.03
	Sudan-grass hay	.62	.82	.86	.81	.88	.95	.92	.84
	Total gain per steer	50.63	55.00	54.67	43.87	70.73	62.13	53.91	52.99
	Average daily gain	1.81	1.25	1.95	1.57	2.53	2.22	1.54	1.83
2	Ground milo heads	4.55	6.35	7.80	9.26	11.27	13.23	12.33	9.36
	Cottonseed meal	.82	1.27	1.56	1.86	2.21	2.42	2.33	1.83
	Cottonseed hulls	7.64	8.09	7.56	7.74	7.26	6.47	3.23	6.76
	Total gain per steer	56.62	42.71	39.71	43.00	57.92	58.57	26.14	46.38
	Average daily gain	2.02	1.53	1.42	1.54	2.07	2.09	.75	1.60
3	Ground milo heads	4.49	6.27	7.70	9.10	11.08	13.00	13.93	9.53
	Cottonseed meal	.77	1.12	1.41	1.69	2.03	2.26	2.40	1.69
	Sorgo fodder	8.06	8.30	8.07	7.55	7.49	6.89	6.22	7.46
	Total gain per steer	50.74	47.29	47.60	53.80	56.40	66.73	48.75	53.03
	Average daily gain	1.81	1.69	1.70	1.92	2.01	2.38	1.39	1.83

The maximum quantity of concentrates utilized by the calves at any time was 14.66 pounds of ground milo heads by lots 1 and 3, and 15 pounds of ground milo heads by lot 2 during the early part of the last feeding period. Lots 1 and 3 consumed a maximum of 2.4 pounds of cottonseed meal during the last period as compared with a maximum of 2.33 pounds per head daily by lot 2 receiving cottonseed hulls.

QUANTITY AND COST OF FEED REQUIRED TO PRODUCE 100 POUNDS OF GAIN

The amount and cost of the respective rations required to produce 100 pounds of gain is given by periods as well as for the entire 203-day period in Table 11. The average feed consumption per 100 pounds of gain, including costs, is given at the foot of Table 11.

TABLE 11.—*Quantity of feed required to produce 100 pounds of gain, feed costs, and average gain per head by periods, third test, 1925–26*

Period	Lot number and feed	Feeds utilized per 100 pounds gain						Cost of feed per 100 pounds gain	Average gain per head
		Ground milo heads	Cottonseed meal	Sorgo silage	Cottonseed hulls	Sorgo fodder	Sudan-grass hay		
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Dollars*	*Pounds*
1	1, silage	248	43	781			34	6.36	50.6
	2, hulls	225	40		378			5.30	56.6
	3, fodder	248	43			445		6.02	50.7
2	1, silage	502	90	943			66	10.97	35.0
	2, hulls	417	83		530			9.24	42.7
	3, fodder	372	67			492		8.21	47.2
3	1, silage	395	72	730			44	8.57	54.7
	2, hulls	550	110		527			11.34	39.7
	3, fodder	453	83			475		9.40	47.6
4	1, silage	581	108	896			52	12.04	43.9
	2, hulls	603	121		504			12.06	43.0
	3, fodder	473	88			393		9.34	53.8
5	1, silage	438	80	520			35	8.58	70.7
	2, hulls	545	107		351			10.33	57.9
	3, fodder	550	101			372		10.39	56.4
6	1, silage	585	102	575			42	10.97	62.1
	2, hulls	632	116		399			11.36	58.6
	3, fodder	545	95			288		9.83	66.7
7 [1]	1, silage	905	156	747			60	16.48	53.9
	2, hulls	1,769	334		464			29.95	26.1
	3, fodder	1,000	172			446		17.57	48.8
Average, all periods	1, silage	521	93	713			46	10.47	371.0
	2, hulls	595	114		422			11.44	324.7
	3, fodder	521	93			408		10.08	371.2

[1] Seventh period, 35 days.

Although there are some apparent inconsistencies in the quantities of feed consumed per 100 pounds of gain by 28-day periods, Table 11 illustrates in a general way that the feed required per 100 pounds of gain increased as the feeding period advanced.

The amount of concentrates required per 100 pounds of gain was much higher during the seventh period than in any of the preceding periods. In this particular test, one of the principal reasons for such small gains during the last period may be attributable to the unusually warm weather prevailing at that time. In this (as was true in the 1924–25 test) the gains in the cottonseed-hull lot dropped off much more in the last period than those in the other two lots, which received sorgo silage and sorgo fodder, respectively.

MARKETING DATA

The calves were sold on the Fort Worth market June 14, 1926. These cattle, on account of their younger age, did not show so much finish as did those fed in 1924–25. Livestock commission salesmen and packer buyers pronounced the animals in lots 1 and 3, which had been fed sorgo silage and sorgo fodder as the roughage portions of the respective rations, better and more uniformly finished, and agreed that the lot 3 calves carried a slightly better finish than the silage-fed calves. The lot 2 calves which had received cottonseed hulls showed considerably less finish than lots 1 and 3. The lot 3 calves sold at $9.75 per 100 pounds straight; the lot 1 calves sold at $9.50 per 100 pounds straight; while in lot 2, 1 calf, the highest finished steer in the lot, sold at $10 per 100 pounds, 9 head sold at $9.25 per 100 pounds, 2 sold at $8 and 2 at $7.50 per 100 pounds. The lot 2 calf which sold at $10, a figure 25 cents higher than was paid for the lot 3 steers, was a smooth individual but the dressed-carcass grades did not bear out the previous judgment of the commission salesmen, since the dressed carcass of this steer graded only medium. The estimated percentages of fat in the live animals at the close of the experiment (based upon dressing percentages and upon weights of internal fat) were 22 per cent for lot 1, 17 per cent for lot 2, and 22 per cent for lot 3.

TABLE 12.—*Summary of third experiment of 203 days, November 13, 1925, to June 4, 1926, inclusive*

Item	Lot 1 (silage)	Lot 2 (hulls)	Lot 3 (fodder)
Number of steers	15	14	15
Average initial weight at feed lot, pounds	310.89	310.23	306.80
Average final weight at feed lot, do	681.85	634.93	678.02
Average final weight at Fort Worth, do	640.00	599.30	635.33
Average gain per head, feed-lot weights, do	370.96	324.70	371.22
Average gain per head, selling weights, do	329.11	289.07	328.53
Average daily gain per head, feed-lot weights, do	1.83	1.60	1.83
Average daily gain per head, selling weights, do	1.62	1.42	1.62
Average daily ration:			
Ground milo heads, do	9.52	9.51	9.52
Cottonseed meal, do	1.69	1.83	1.69
Sorgo silage (Sumac), do	13.03		
Cottonseed hulls, do		6.76	
Sorgo fodder (Sumac), do			7.46
Sudan-grass hay, do	.84		
Feed required per 100 pounds gain:			
Ground milo heads, do	521.24	594.83	520.86
Cottonseed meal, do	92.69	114.34	92.62
Sorgo silage (Sumac), do	713.08		
Cottonseed hulls, do		422.63	
Sorgo fodder (Sumac), do			408.16
Sudan-grass hay, do	45.95		
Cost of feed per 100 pounds gain, dollars	10.47	11.44	10.08
Total feed consumed per head:			
Ground milo heads, pounds	1,933.57	1,931.42	1,933.57
Cottonseed meal, do	343.83	371.26	343.83
Sorgo silage (Sumac), do	2,645.20		
Cottonseed hulls, do		1,372.29	
Sorgo fodder (Sumac), do			1,515.20
Sudan-grass hay, do	170.47		
Financial statement:			
Initial cost per steer, dollars	30.00	30.00	30.00
Cost of feed per steer, do	38.80	37.13	37.42
Shipping and marketing cost per head, do	4.06	4.06	4.06
Total cost of steer, do	72.86	71.19	71.48
Price received per steer, do	60.80	53.42	61.94
Necessary selling price per 100 pounds to break even, do	11.38	11.88	11.25
Selling price per 100 pounds market weights, do	9.50	8.91	9.75
Profit (+) or loss (−) per steer, do	−12.06	−17.77	−9.54

Table 12 shows that the calves in lots 1 and 3 gained on an average about 46 pounds more per head during the 203-day feeding period than the lot 2 steers. The additional 46 pounds gained by lot 1 over lot 2 was made at an additional feed cost of only $1.67 over that of lot 2. Although lots 1 and 3 made similar gains, the feed cost per head was $1.38 higher for the lot 1 cattle than for those of lot 3. As shown in Table 12, lot 1 showed a loss of $12.06, lot 2 a loss of $17.77, and lot 3 a loss of $9.54 a head. These severe losses are accounted for by the fact that calves were purchased as feeders at a higher price per 100 pounds than the market paid for them after they had been fed 203 days. Only minimum gains were made during the last 35 days of the feeding period, which factor also exerted considerable influence in increasing the final loss sustained.

PRODUCTIVE ENERGY VALUES

A comparison of the productive energy values obtained in the feeding tests with calves at Big Spring, Tex., in the three tests, is shown in Table 13. Sorgo fodder was used as the standard. The "calculated" values in this table were made from the actual composition and production coefficients given in Texas Station Bulletin No. 329, Energy-production coefficients of American feeding stuffs.

TABLE 13.—*Comparison of productive values of sorgo silage and cottonseed hulls expressed in terms of net energy per 100 pounds of feed (calculated from composition of feeds used and actual gains made in the Big Spring feeding tests)*

Feed	1923–24		1924–25		1925–26	
	Calculated	Found from test	Calculated	Found from test	Calculated	Found from test
	Therms	*Therms*	*Therms*	*Therms*	*Therms*	*Therms*
Sorgo fodder (standard)	29.5		33.0		31.0	
Sorgo silage	13.7	16.8	13.4	17.7	9.2	15.7
Cottonseed hulls	15.6	14.8	19.7	17.6	17.1	17.4

In calculating the value of a feed in actual experimental feeding work, it is necessary to take one feed as a standard from which to calculate the productive energy of the other feeds to be compared, and to assume a definite maintenance requirement for the animal. In this calf-feeding experiment[3] sorgo fodder was used as the standard. The productive values of the concentrates used were calculated, by using the coefficients given in Texas Bulletin 329, and the maintenance requirements given in Armsby's Principles of Animal Feeding.

Although these assumptions may be said to lead to some uncertainty, yet since the figures are also used in connection with the other feeds compared with the standard, comparative results should be obtained. This is especially the case if there is little difference between the quantity of additional feeds fed, and no great difference in the average weights of the animals.

The method of calculation of the productive energy of the sorgo silage and cottonseed hulls used in the first experiment (1923–24)

[3] Similar calculations covering experiments in lamb and steer feeding have been reported in Texas Station Bulletins Nos. 269, 285, 296, 305, and 309.

is given in Table 14. The maintenance requirements of 100 pounds of the average weight was assumed, after Armsby, as 0.75 therms. The therms required for 1 pound in gain of weight when ground milo heads and cottonseed meal were fed were 3.92 in the 1923–24 test. The values of the gains with the other feeds in terms of therms were calculated for 1923–24 using this figure (3.92 therms). The therms required for 1 pound gain in weight for 1924–25 were 3.78, and for 1925–26, 3.90. In the tests reported in this bulletin, the sorgo silage had a higher feeding value than the cottonseed hulls, and evidently a somewhat higher one than is indicated by the productive value calculated from the information which has heretofore been available. The results of this work will be used to aid in obtaining the correct feeding value of sorgo silage, as has already been done with ground-kafir grain and kafir heads.[4] Cottonseed hulls had apparently the same feeding value as calculated but the value found is no doubt too high because the cost of the gain in therms was really less than the value assumed; that is to say, the lot of calves receiving cottonseed hulls carried less finish at the end of the feeding period than the sorgo-silage-fed lot, which means that the gain in weight contained a smaller percentage of fat than the gain in weight in the silage-fed calves, and this was produced at a lower cost in productive energy. The lower gain in weight of the lot receiving cottonseed hulls was attributable chiefly to the fact that the feeding value of the ration eaten by the calves was considerably less than that supplied the sorgo-silage and sorgo-fodder lots.

TABLE 14.—*Productive energy value of sorgo silage and cottonseed hulls*

Item	Lot 1 (sorgo silage)	Lot 2 (cotton-seed hulls)	Lot 3 (sorgo fodder)
	Pounds	*Pounds*	*Pounds*
Initial weight of animal	429	429	425
Final weight of animal	763	673	716
Average weight of animal W	596	551	571
Average daily gain of animal G	1.91	1.37	1.66
Average daily feed:			
Milo heads	9	9	9
Cottonseed meal	1.6	1.6	1.6
Sorgo silage, Z	19.5		
Sudan hay	2.0		
Sorgo hay			9.4
Cottonseed hulls, H_2		10.0	
	Therms	*Therms*	*Therms*
Productive value:			
Milo heads, 9×0.769=R	6.92	6.92	6.92
Cottonseed meal, 1.6×0.699=S	1.10	1.10	1.10
Sorgo hay, 9.4×0.295			2.77
Therms total, T			10.79
Maintenance required per animal, W×H*=M	4.47	4.13	4.28
Productive balance, T−M=B			6.51
Therms for 1 pound gain, B÷G=K			3.92
Therms for daily gain, K×G=L	7.49	5.37	
Total energy value of ration, M+L=O	11.96	9.50	
Therms in grain fed, R+S=P	8.02	8.02	
Therms in sudan hay fed, Z×0.328=U	.656		
Therms in cottonseed hulls, O−P=V		1.48	
Therms in silage, O−(P+U)=X	3.28		
Productive energy of silage (X÷Z)×100	16.8		
Productive energy of cottonseed hulls (V÷H_2)×100		14.8	

* H=0.0075 or the maintenance requirement in therms for each pound of live weight (Armsby).

[4] Texas Station Bulletin No. 329.

SUMMARY

AVERAGE GAINS

The average gains made by the calves during 28-day [5] intervals throughout the three experiments are shown by the weight curves in Figures 5, 6, and 7. In these experiments, the cottonseed hulls fed to lot 2 constituted 49 per cent of the ration in the 1923–24 test, 45

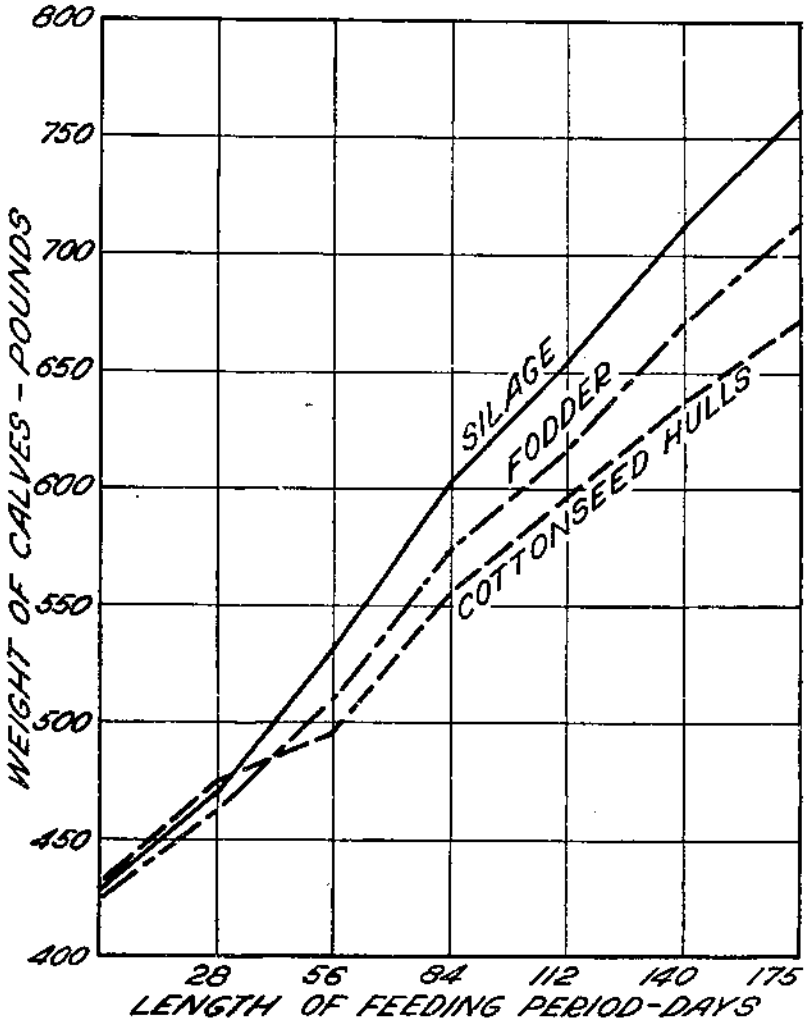

FIG. 5.—Gains by periods, first test, 1923–24

per cent in the 1924–25 test, and only 37 per cent in the final test. This probably explains why the hulls ration gave results more nearly equal to the silage and fodder rations in the final test than it did in the first and second tests; the reason for which is that the roughage constituted a smaller part of the ration in the third test.

[5] Except the final periods in the first and third tests, which covered a 35-day period.

AVERAGE FEED CONSUMPTION

During the first two tests the average concentrates consumed per head daily averaged approximately 2.5 per cent of the initial weight of the calves, whereas in the third trial the average was 3.6 per cent. The average daily gains per 1,000 pounds of live weight were also calculated, and as shown in Table 15 the light-weight calves fed in

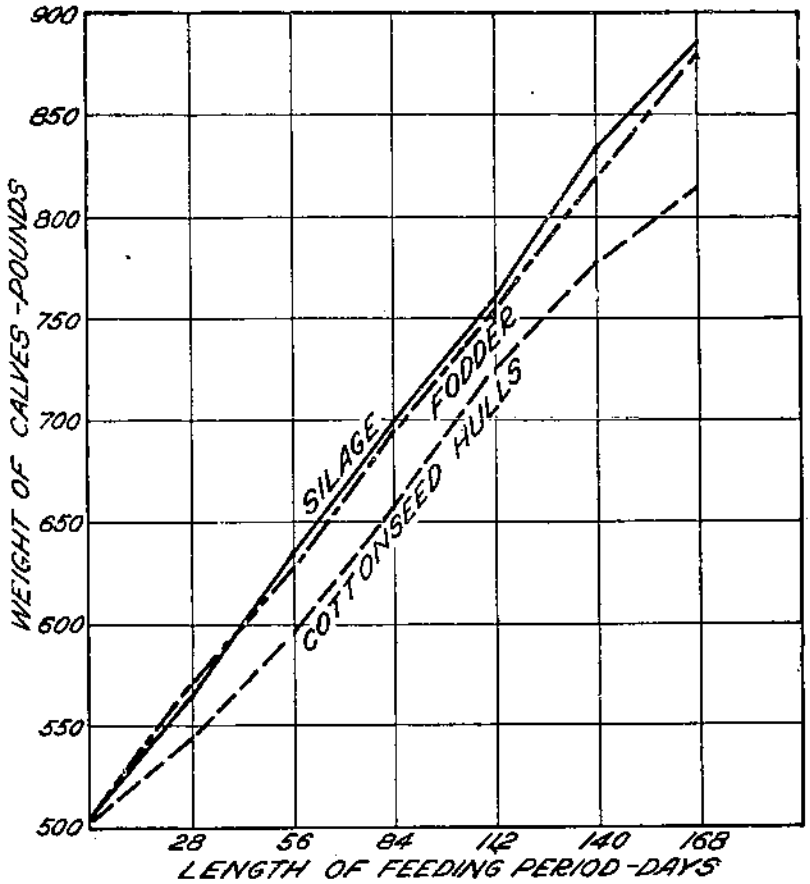

FIG. 6.—Gains by periods, second test, 1924–25

the third trial made considerably larger gains than the heavier calves fed in each of the preceding tests. This is probably accounted for by the fact that the lighter calves consumed considerably more concentrates daily in proportion to their weight than the calves fed in the first two tests. The roughage portion of the rations of the lighter calves fed in the third trial averaged considerably under the daily roughage consumption in the two preceding trials.

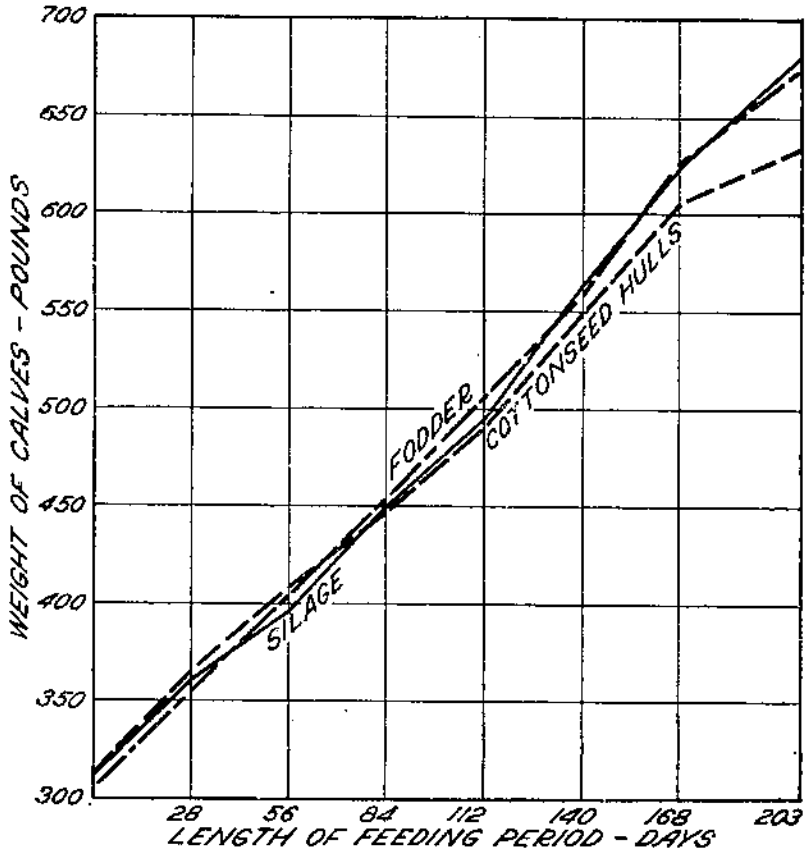

FIG. 7.—Gains by periods, third test, 1925–26

TABLE 15.—*Average daily feed consumed per calf and average daily gain per calf and per 1,000 pounds live weight*

Lot number and feed	Year	Average daily feed consumed						Average initial weight	Average daily gain	
		Milo heads	Cottonseed meal	Sorgo silage	Cottonseed hulls	Sorgo fodder	Sudan-grass hay		Per head	Per 1,000 pounds live weight
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1, silage	1923–24	9.0	1.6	19.2			1.6	429	1.91	3.50
	1924–25	10.2	1.9	17.3			1.9	507	2.20	3.24
	1925–26	9.5	1.7	13.0			.8	311	1.83	3.69
	Average	9.6	1.7	16.5			1.4	415	2.00	3.38
2, hulls	1923–24	9.1	1.6		10.2			433	1.37	2.48
	1924–25	10.3	2.1		10.0			505	1.85	2.80
	1925–26	9.5	1.8		6.8			310	1.60	3.39
	Average	9.6	1.8		9.0			416	1.61	2.89
3, fodder	1923–24	9.1	1.6			9.3		425	1.60	2.91
	1924–25	10.3	1.9			10.7		507	2.22	3.25
	1925–26	9.5	1.7			7.5		307	1.83	3.72
	Average	9.6	1.7			9.2		413	1.90	3.29

In averaging the concentrate requirements per 100 pounds of gain by a simple arithmetical average in order to give equal emphasis to each of the three experiments, it was found that the silage-fed calves required 20 per cent less ground milo heads and 25 per cent less meal per 100 pounds gain than the cottonseed-hull-fed calves, and 5.4 per cent less ground milo heads and 5.5 per cent less cottonseed meal than the fodder lot.

As shown in Table 16 it required an average of 482 pounds of ground milo heads, 87 pounds of cottonseed meal, 827 pounds of sorgo silage, and 71 pounds of Sudan-grass hay to produce 100 pounds of gain in the calves of lot 1 as compared with 604 pounds of ground milo heads, 116 pounds of cottonseed meal, and 568 pounds of cottonseed hulls in lot 2, and 509 pounds of ground milo heads, 92 pounds of cottonseed meal, and 483 pounds of sorgo fodder in lot 3.

TABLE 16.—*Feed required per 100 pounds of gain*

Lot No.	Year	Days on feed	Milo heads	Cottonseed meal	Sorgo silage	Cottonseed hulls	Sorgo fodder	Sudan-grass hay
			Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1	1923-24	175	474	55	1,003	.....	.....	81
	1924-25	168	452	83	766	.....	.....	86
	1925-26	203	521	93	713	.....	.....	46
	Average	.....	482	87	827	.....	.....	71
2	1923-24	175	661	119	.....	741	.....	.....
	1924-25	168	555	110	.....	542	.....	.....
	1925-26	203	595	114	.....	422	.....	.....
	Average	.....	604	116	.....	568	.....	.....
3	1923-24	175	546	98	.....	.....	560	.....
	1924-25	168	461	81	.....	.....	480	.....
	1925-26	203	521	93	.....	.....	408	.....
	Average	.....	509	92	.....	.....	483	.....

AVERAGE SALT CONSUMPTION

Granulated salt was kept before the calves at all times. Table 17 shows the daily salt consumption per head.

TABLE 17.—*Average salt consumption per head daily*

Year	Days on feed	Lot 1 (silage)	Lot 2 (hulls)	Lot 3 (fodder)
		Ounces	*Ounces*	*Ounces*
1923-24	175	0.76	1.53	0.76
1924-25	168	.67	1.13	.86
1925-26	203	1.13	1.33	.97
Average for 3 years	.....	.85	1.43	.86

SHRINKAGE AND SLAUGHTER DATA

Table 18 shows that shrinkage varied from 2.75 per cent to 7.75 per cent of the weight of the animal. In the first year, shrinkage was lowest in lot 3, fed fodder as a roughage, and highest in lot 1, fed silage. In the second test the fodder lot showed the heaviest shrinkage and the hull-fed cattle the lowest. In the third year the hull-fed cattle showed the lowest shrinkage, but on an average of three

years lot 3, fed fodder, had the lowest shrinkage. The cattle were shipped a distance of 267 miles.

TABLE 18.—*Shrinkage in transit and slaughter data of animals in test*

Lot number and feed	Year	Shrinkage per head		Average weight dressed carcasses	Dressing percentage		Average weight internal fat	Average weight of hide
					Basis feed-lot weights	Basis market weights		
		Pounds	*Per cent*	*Pounds*	*Per cent*	*Per cent*	*Pounds*	*Pounds*
1, silage	1923–24	40.00	5.24	412.13	54.00	56.07	28.99	58.10
	1924–25	62.11	7.01	498.94	56.34	60.60	39.52	59.28
	1925–26	41.85	6.14	368.85	54.09	57.63	27.60	52.15
2, hulls	1923–24	34.41	5.10	337.46	50.13	52.83	19.90	49.42
	1924–25	55.20	6.77	456.65	50.01	60.08	38.04	57.76
	1925–26	35.63	5.61	328.35	51.71	54.78	21.70	48.11
3, fodder	1923–24	10.67	2.75	381.26	53.27	54.80	30.60	52.85
	1924–25	68.20	7.75	492.27	55.92	60.62	40.00	61.23
	1925–26	42.60	6.29	301.20	53.27	56.85	28.50	50.31

The dressing percentage, as shown in Table 18, was a trifle higher in case of the lot fed silage for the first and third years. All lots killed out about the same—60 per cent, market-weight basis—in the second test. The hull lot was considerably lower in the first and third years.

Lot 3, fed fodder, had a noticeably greater quantity of internal fat in every test, followed by lot 1, fed silage. The internal fat in this instance is the ruffle and caul fat, the quantity of which is considered an index to the fatness of the carcass as a whole.

Table 19 shows the grading of the dressed carcasses as determined by a committee of three beef men from the packing industry. A study of this table shows clearly that the carcasses of lot 2, fed cottonseed hulls, did not possess the finish or degree of fatness found in those of lots 1 and 3. The carcasses in lot 1 graded somewhat higher than lot 3 for the first two years but lot 3 showed considerable advantage in the last test.

TABLE 19.—*Number of beef carcasses in various grades*

Year	Lot No.	Grades				
		Choice	Good to choice	Good	Medium to good	Medium
1923–24	1	4	6	4		1
	2		1	1		13
	3	2	4	7		2
1924–25	1	9	6			
	2	3	8	1		3
	3	8	5	2		
1925–26	1	4		5	5	1
	2			2	7	5
	3	4	4	5	2	

The third year's test was a part of the cooperative meat project, "A study of the factors affecting the quality and palatability of meat," conducted by the United States Department of Agriculture, State experiment stations and other cooperating agencies. The steers were graded as feeders at the beginning of the test, as fat steers at the end of the list, and their carcasses were graded after slaughter.

CONCLUSIONS AND RECOMMENDATIONS

Sorgo silage and sorgo fodder, in each of the three tests, proved to be more efficient than cottonseed hulls when fed to fattening calves. The average gain per head for the silage-fed calves was 361.4 pounds; for the calves fed cottonseed hulls 291.8 pounds; and for those fed chopped sorgo fodder 345.1 pounds.

The silage-fed calves on the basis of three years' average gained 23.9 per cent more than the calves fed on cottonseed hulls and 4.7 per cent more than the calves fed on sorgo fodder.

The average daily gain made by the silage-fed calves was 2 pounds per head or 3.38 pounds per 1,000 pounds live weight; for the calves fed cottonseed hulls, 161 pounds per head or 2.89 pounds per 1,000 pounds live weight; and for the calves fed fodder, 1.9 pounds per head, or 3.29 pounds per 1,000 pounds live weight.

The calves fed silage and fodder, respectively, made larger and more uniform gains throughout the feeding period than those fed on cottonseed hulls.

The calves fed cottonseed hulls through feeding periods ranging between 168 and 203 days made reduced gains during the latter part of the feeding period, which factor tended greatly to increase the feed requirement per 100 pounds of gain.

The cottonseed-hull-fed calves did not possess so high a finish as was found in the silage and fodder-fed lots. There was little difference in finish between the silage-fed calves and the fodder-fed calves. The silage-fed lot before slaughter seemed to possess a slight advantage in this respect in the first two tests, while the fodder-fed calves showed a slightly higher finish in the third experiment. However, the carcasses from lots 1 and 3 on a three-year average were about the same in quality. Those from lot 1, fed silage, at slight advantage the first year, and lot 3 a considerable advantage the last year. Judging from the internal fat, lot 3, fed fodder, showed more finish in each test.

This experiment shows conclusively that sorgo silage and fodder are more satisfactory roughages than cottonseed hulls when fed with ground milo heads and cottonseed meal to fattening calves.

In total cost of feed per head there was little variation among lots, the cottonseed-hull ration being slightly cheaper than the others during the last two years of the experiment. There is no correlation, however, between the total cost of feed per steer and the cost of 100 pounds gain and the net returns. Lot 1, fed silage, had the highest total feed cost, yet it had the lowest cost per 100 pounds' gain and accordingly brought the greatest returns. On the basis of a three-year average, lot 1, fed silage, showed a cost of $11.32 per 100 pounds gain; lot 2, fed cottonseed hulls, a cost of $13.80; and lot 3, fed fodder, a cost of $11.38.

The economy and rate of gain and sales price are the factors directly affecting the net returns. Cattle that make the greatest gains, other things being equal, have the highest finish and bring higher prices. Higher sales prices usually offset any increased cost of gain.

SUPPLEMENTARY EXPERIMENTAL RESULTS

In a feeding test conducted by Burns and Metcalf, of the Texas station at Clarendon in 1911–12 (Texas Station Bulletin 153), a comparison was made of cottonseed hulls and silage composed chiefly of milo, when fed to 3 and 4 year old steers. The results of that experiment indicated that a ration of cottonseed meal and silage may be used far more profitably than a ration of cottonseed meal and cottonseed hulls for fattening cattle. The silage-fed cattle finished better and sold at a slightly higher price.

In a feeding test conducted by Burns, of the Texas station, in 1912–13 (Texas Station Bulletin 159), to compare unchopped sorgo hay and cottonseed hulls when fed with silage to 2-year-old steers it was found that those receiving sorgo hay made a slightly larger gain and finished better than those receiving cottonseed hulls. In another test by Burns (Texas Station Bulletin 198) to compare cottonseed hulls and Sudan-grass hay when supplemented with silage in the rations of fattening calves during the 1915–16 feeding season, the Sudan-grass hay was found to be superior to cottonseed hulls. In the feeding season of 1919–20, Burns (Texas Station Bulletin 263) conducted a test with Hereford yearlings with a view of determining whether any advantage would be gained in substituting sorgo silage for a part of the cottonseed hulls in a ration composed of cottonseed meal, ground corn or milo, blackstrap molasses, and cottonseed hulls. In this test no advantage was gained by substituting sorgo silage for a portion of the cottonseed hulls.

In a cooperative steer-feeding experiment between the Bureau of Animal Industry, United States Department of Agriculture, and the North Carolina station in 1914–15, Ward, Curtis, and Peden (United States Department of Agriculture Bulletin 628) when comparing corn silage and cottonseed hulls fed to 2 and 3 year old steers found that the steers which received corn silage as the entire roughage portion of the ration made much more efficient and economical gains than when cottonseed hulls constituted the entire roughage portion.

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