A6-228-15,000-L180

TEXAS AGRICULTURAL EXPERIMENT STATION

B. YOUNGBLOOD, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

BULLETIN NO. 379 APRIL, 1928

DIVISION OF RANGE ANIMAL HUSBANDRY

Grain Sorghums vs. Corn for Fattening Lambs

FOURTH AND FIFTH EXPERIMENTS

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SYNOPSIS

The Texas Station has during the past several years conducted a number of lamb feeding experiments designed to gain more information concerning the feeding value of the leading grain sorghums—milo, kafir, and feterita—as compared with corn. The lamb feeding tests conducted in 1922-23 and 1924-25 are reported in full in this Bulletin, and the results of five lamb feeding experiments have been summarized. In this work it has been found that ground threshed milo, feterita, or kafir fed with alfalfa hay and cottonseed meal on a pound for pound basis has a feeding value practically equal to that of corn. The following are the average daily gains per head made by lambs during five experiments:

1. Lambs fed corn stood first, with an average daily gain of .371 pound.
2. Lambs fed ground threshed milo and ground threshed kafir tied with an average daily gain of .368 pound.
3. Lambs fed ground threshed feterita ranked third with an average daily gain of .365 pound.
4. Lambs fed ground milo heads ranked highest among those fed ground head grains with an average daily gain of .353 pound.

Lambs receiving the ground heads made more economical gains than lambs receiving the threshed grains but did not finish as highly.

The results of one season's test in the feeding of a ration of cottonseed meal and cottonseed hulls with no grain revealed that 80-pound lambs can be fed more than one-half pound of cottonseed meal daily for a 70-day period without any noticeable ill effects. However, the lambs receiving this ration did not finish satisfactorily. Whole cottonseed and cottonseed hulls fed as an exclusive ration to a lot of light lambs during the 1924-25 test proved very unpalatable.

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BULLETIN NO. 379 APRIL, 1928

GRAIN SORGHUMS VERSUS CORN FOR FATTENING LAMBS—FOURTH AND FIFTH EXPERIMENTS

(Including a General Summary of Five Years Lamb Feeding Investigations)

J. M. JONES, Chief, Division of Range Animal Husbandry
R. E. DICKSON, Superintendent, Substation No. 7

The development of a properly diversified system of agriculture for West Texas is an opportunity to which we may look forward with keenest anticipation. The tillable plains and prairies of this great region are in a process of transition. Thousands of additional acres of tillable lands formerly devoted exclusively to livestock grazing are coming under cultivation during each succeeding year, which process will doubtless be continued until all of the land best suited to cultivation has been utilized in this manner. Vastly increasing areas are being planted to cotton, grain sorghums, sorgo, wheat, and other crops. A pronounced readjustment in the agriculture of West Texas has been under way during the past fifteen to twenty years until at the present time no section presents greater possibilities and in no section is interest keener in all subjects of crop and livestock production. As a natural course, new facts concerning the more efficient production and marketing of crops are being earnestly sought by the progressive and enterprising farmers and stockmen in this region.

"Can the grain sorghums be economically utilized in the place of corn in the rations of fattening livestock in the area of Texas which is so much better suited to the production of these feed crops?" was a pertinent question in the minds of progressive farmers residing in the western part of the State at the time the Texas Station undertook the responsibility of seeking an answer to it in 1919, by initiating the study of the comparative values of corn and the grain sorghums for fattening livestock. This is an important economic question with all farmers interested in diversification. The grain sorghums are numbered among West Texas' surest crops.

During the years when the growing of grain sorghums first became a common farm practice in West Texas these grains sold at prices considerably below the price of corn. This limited market demand was a direct result of a lack of knowledge of the value of these grains in feeding rations.

Livestock feeding is an enterprise that has not been generally practiced by Texas farmers to the present time, although past experience in the corn belt section of the United States and in some of the European countries has shown that the inclusion of farm animals in the farming program is the most permanent and profitable system of agriculture.

As a result of a well balanced farming system, the soil is enriched and maintained at a more highly productive state than is possible or practical where livestock are not included in the general scheme of farm operations.

It had been stated that grain sorghums had an appreciably lower feeding value than corn. Considerable work, however, has now been done by the Texas Station in the way of gaining new facts concerning the feeding values of milo, kafir, and feterita, along with some preliminary work on the feeding values of less popular grain sorghums. The results of three experiments in lamb feeding and one in baby-beef feeding in which the grain sorghums were compared with corn have been published in Texas Station Bulletins 269, 285, 296, and 306. These results show that the grain sorghums have practically the same productive or feed value as corn in the rations of fattening animals. As these new and important facts become available to the progressive farmers, they will capitalize on this information. As a result of the information gained by these experiments an increasing number of lambs have been fattened on the grain sorghum crops during the past few years.

Nature has wisely endowed the virgin soils of Texas with reserve quantities of fertility but unfortunately in a great many instances the pioneer farmers have failed to maintain this fertility as they found it. Farm operators who follow the practice of marketing their crops from the farm for cash consideration year after year do not give proper thought to the fact that they are annually selling from the farm a certain definite amount of nitrogen, phosphoric acid, and potash. Few farmers, indeed, when calculating annual profits produced by certain crops marketed, deduct the value of fertilizer which the crop removed during growth.

The livestock farmer on the other hand has a double advantage over the operator of the stockless farm in that he assumes the chance of making profits both on his feed and livestock. Furthermore, he returns the manure to the soil which produced the crops and a high degree of soil fertility is naturally maintained. Careful investigation has revealed that in marketing crops via the livestock route approximately 80 per cent of the elements removed from the soil in growing the crops are contained in the manure. The injudicious use of the by-products of Texas farms has in many instances resulted in an enormous annual financial loss as well as contributed to soil depletion.

According to the 1926 Yearbook* of the United States Department of Agriculture, the acreage devoted to the production of the grain sorghums in Texas during that year totaled 1,788,000 as compared with 3,844,000 acres planted to corn or approximately 46 per cent of the corn area of the state. The production of the grain sorghums in Texas for 1927 is estimated† at 55,734,000 bushels as compared with

*U. S. D. A. Yearbook, 1926, pages 835 and 893.
†Crops and Markets, U. S. D. A., December, 1927.

119,347,000 bushels of corn. The annual yield of the grain sorghums and corn tend to vary within rather wide limits in Texas on account of the annual variation in the amount of rainfall. The average yield per acre in bushels for the grain sorghums in Texas for the years 1921 to 1925, inclusive, was 22.5 as compared with 21 bushels of corn. The comparative yields of dwarf yellow milo, dwarf blackhul kafir, darso, feterita, and Spur feterita, respectively, in variety tests at the Lubbock Substation extending over the nine-year period, 1918 to 1926, inclusive, were:

Milo	29.9 bu.
Kafir	26.19 bu.
Darso	31.38 bu.
Feterita	31.59 bu.
Spur feterita	29.62 bu.

At the Spur Substation, the yields of dwarf yellow milo and common feterita over the 11-year period, 1914 to 1925, were 30.52 and 25.64 bushels per acre, respectively. These figures show that the variation in the yield between the several varieties listed is small. The average yield of threshed grain during six years at the Lubbock Substation (1914 to 1919) was 29.44 per cent of the total crop yield. There is considerable variation in the yield of grain and stover for the several grain sorghums from year to year, depending upon the season. However, it is quite safe to assume that the percentage of threshed grain to entire plant for the several varieties will average somewhere near 30 per cent. The importance then of ascertaining full information with reference to the comparative feeding values of the grain sorghums and corn becomes apparent.

PREVIOUS GRAIN SORGHUM FEEDING EXPERIMENTS

The Kansas Agricultural Experiment Station did the pioneer work in the comparison of kafir and corn* in 1897 when fed to fattening cattle. Since that time a number of feeding trials in the comparison of the grain sorghums for fattening cattle have been completed by the Oklahoma and Texas Stations as well.† These cattle-feeding tests have shown that the grain sorghums compare very favorably with corn in the rations of fattening cattle. In some of the later experiments the cattle fed on the grain sorghums made an equal or better gain than those receiving corn; however, in the earlier tests the corn-fed cattle showed a higher finish.

Additional experimental evidence is needed upon the subject of the preparation of the grain sorghums for fattening livestock. In instances

*Kansas Station Bulletin No. 67.

†Oklahoma Station Report, 1899-1900; Oklahoma Station Report, 1900-1901; Kansas Station Bulletin No. 132 (1906); Texas Station Bulletin No. 97 (1907); Texas Station Bulletin No. 110 (1908); Texas Station Bulletin No. 296 (1922).

where pigs are following fattening cattle it is well recognized that it is not economical to grind corn. However, owing to the small size of the grain, it will probably pay to grind the grain sorghums before feeding them to cattle. The Texas Station in 1926-27 started some preliminary tests in a comparison of ground and unground grain sorghums when fed to fattening cattle; however, the work has not progressed far enough to justify any conclusions.

In a test conducted at the Oklahoma Station* in a study of the utilization of grain in kafir and cane silage by dairy cows it was shown that approximately one-third of the cane seed and over two-fifths of the kafir grain in silage made from these crops were voided in the manure. A comparison of the chemical analysis of the grain from the silage and that from the manure showed that a negligible amount of the nutrients in the kernels separated from the manure had been digested. At the Kansas Station it has been found when cane silage was fed that as high as 90 per cent of the seed consumed was voided in the manure. In a test in which corn chops and ground sorgo seed were fed to dairy cows, Cave and Fitch† found that there was no particular difference in the efficiency of these two kinds of grain in maintaining body weight and milk production while cows were on a liberal ration of alfalfa grain and silage. In another test at the Kansas Station,‡ Bell found that the grinding of cane seed when fed to fattening hogs increased its pork-producing value 15 per cent. In the test reported 25 per cent more ground cane seed than corn was required to produce 100 pounds of gain. At the Oklahoma Station, Thompson¶ found from a series of three experiments in the different methods of preparation of kafir for hogs that the ground threshed unsoaked grain proved to be the most efficient.

In a comparison of the feeding of corn, ground milo, feterita, and kafir to hogs in two experiments, Winchester of the Kansas Station reported§ that the corn-fed lot made the most efficient utilization of the grain in one test and the lot fed feterita in the other. The general conclusions were that the grain sorghums as a group are nearly as good as corn for growing pigs and may possibly excel corn for fattening purposes.

The Kansas and Oklahoma Stations have reported on several lamb-feeding tests in which kafir has been compared with corn. Table 1 shows the number of lambs constituting a lot, length of feeding periods, initial and final weights, average daily gains, average daily rations, and feed requirements per 100 pounds of gain in the trials listed. A careful analysis of the above table shows that lambs which received kafir grain made gains that compared very favorably with those fed corn. In a

*Oklahoma Bulletin No. 164 (1927).
†Kansas Circular 110 (1925).
‡Kansas Circular 98.
¶Proceedings American Society of Animal Production, 1924, pp. 37-39.
§Proceedings American Society of Animal Production, 1920, pp. 54-57.

test at the Oklahoma Station, 1926-27, both darso and kafir chops surpassed corn by a very small margin.

OBJECT OF EXPERIMENT

The experiments reported in this Bulletin were planned for the purpose of determining:

(1) The relative feeding values of the more popular grain sorghums including milo, feterita, and kafir, as compared with that of ground shelled corn in rations of fattening lambs. The method of preparation of the sorghum grain was an important question in carrying out this series of experiments. Three tests have already been reported in Texas Bulletins 269, 285, and 306. Whole or unground threshed milo was fed in two tests, while sorgo, schrock-kafir, and darso were each fed in only one trial.

(2) Whether cottonseed meal or cottonseed, as sole concentrates, with cottonseed hulls can be efficiently utilized in the lamb fattening ration.

(3) The comparative economy of fattening lambs or yearling wethers.

GENERAL PLAN OF THE WORK

The two final feeding tests of the series of five were conducted during the feeding seasons, 1922-23 and 1924-25. Ten lots of 20 lambs each were fattened on different rations during 1922-23, while eight lots of 20 lambs and one lot of yearling wethers were fattened during the final test.

The lambs were weighed individually on three consecutive days at the beginning and end of the experiments and the average of the three weighings, respectively, constituted the initial and final weights. In the 1922-23 ninety-day experiment, individual weights were taken at 15-day intervals while in the 1924-25 seventy-day experiment, individual weight records were taken at 14-day intervals.

The lambs were divided equally so far as it was possible with reference to type, weight, and general hardiness, at the beginning of the feeding trials. In the 1924-25 experiment, it will be observed that the lambs in Lots 7, 8, and 9, which were not used in the grain sorghum versus corn comparison, ranged in weight from 47 to 81 pounds. These lambs had to be cut out to even up the main group. They were thrifty lambs well suited for use in a feeding experiment except that they differed from the other five lots in weight. Lots 7, 8, and 9 were utilized solely for the purpose of accumulating more information about using cottonseed products in lamb-feeding rations, on which subject only a limited amount of information is available at the present time. A pen of smooth-bodied yearling Rambouillet wethers which received the same kind of a ration as the Lot 5 lambs constituted Lot 6 in the 1924-25 test.

Throughout the experiment, all weighings started promptly at 1 p. m. on the respective weighing dates.

Table 1.—Summaries of some comparisons between corn and grain sorghums when fed to fattening lambs at the Kansas and Oklahoma Stations.

Experiment Station Conducting Test	Publication Number	No. Lambs	Days	Initial Weight, Lbs.	Final Weight, Lbs.	Average Daily Gain, Lbs.	Average Daily Ration						Feed Per 100 Lbs. Gain			
							Grain		C. S. Meal, Lbs.	Alfalfa Hay, Lbs.	Silage		Grain	C. S. Meal	Alfalfa	Silage
							Kind	Lbs.			Kind	Lbs.				
Kansas, 1914	Preliminary Report	50	60	56.7	80.9	.4	Shelled corn	.89	.19	1.35	Sweet sorghum	1.09	222	47	336	271
		50	60	55.4	76.6	.35	Whole kafir	.9	.19	1.36	Sweet sorghum	1.09	254	54	385	309
		50	60	57.5	79.1	.36	Ground kafir	.9	.19	1.36	Sweet sorghum	1.09	250	53	378	303
Kansas, 1915-16	Preliminary Report	75	80	58.6	80.5	.274	Shelled corn	1.01	.16	.95	.....	1.24	370	58	348	454
		75	80	58.8	80.82	.275	Whole kafir	1.01	.16	.95	.....	1.26	369	58	347	459
		75	80	57.8	77.5	.247	Ground kafir heads	1.16	.16	.93	.....	1.09	472	65	377	445
Kansas, 1917-18	Preliminary Report	60	60	60.5	86.3	.43	Shelled corn	1.46	.....	1.54	.....	.....	340	.....	358	.....
		60	60	59.9	84.8	.41	Whole kafir	1.39	.....	1.74	.....	.....	335	.....	421	.....
Kansas, 1922-23	Circular No. 109	20	83	60.2	90.1	.36	Shelled corn	1.3	.16	1.02	Cane	.9	359	43	283	248
		20	83	60.5	88.8	.34	Whole kafir	1.3	.16	1.02	Cane	.91	379	46	299	266
		20	83	59.1	87.3	.34	Kafir chops	1.3	.16	1.02	Cane	.89	382	46	301	263
		20	83	62.6	90.8	.34	Kafir heads	2.05	.16	.96	Cane	.79	602	46	282	232
Kansas, 1923-24	Circular No. 123	25	44	75.1	89.0	.32	Shelled corn	1.34	.....	1.47	.....	.....	421	.....	457	.....
		25	44	75.2	89.2	.32	Whole kafir	1.34	.....	1.45	.....	.....	419	.....	455	.....
		25	44	75.1	89.6	.33	Kafir heads	2.15	.....	1.45	.....	.....	657	.....	439	.....
Oklahoma, 1920	Bulletin No. 133	22	96	55.9	85	.303	Kafir heads	.83	.....	1.93	Darso	2.19	276	.....	638	721
		22	96	56.3	88.3	.333	Whole kafir	.79	.....	1.96	Darso	2.18	237	.....	588	653
Oklahoma, 1926-27	Preliminary Report	30	95	54.3	84.3	.314	Gr. shelled corn	1.25	.....	1.81	.....	.....	397	.....	578	.....
		30	95	55.0	86.2	.328	Kafir chops	1.25	.....	1 8	.....	.....	379	.....	550	.....
		30	95	55.2	85.4	.318	Darso chops	1.25	.....	1 8	.....	.....	391	.....	568	.....

Equipment of Feed Lots

All of the feed lots utilized in these experiments were of similar dimensions, an open shed 18 feet in depth serving to provide shelter during inclement weather. Slatted combination grain and hay racks of identical size and general structure were used in each of the respective lots. The water was supplied from a shallow well and according to the analysis made of a sample by the Station Chemist in 1916 it contained 390 parts of carbonate of lime, 231 parts of sulphate of lime, 548 parts of sulphate of magnesia, 325 parts of sulphate of soda, and 1240 parts of chloride of soda per million parts of water. Such a source of water supply is ordinarily referred to as "gyp" water among the residents of that particular area in West Texas. All groups of lambs were watered regularly three times daily throughout the respective feeding periods. A supply of granulated stock salt was kept before the lambs throughout the entire period.

Method of Feeding and Handling the Lambs

The lambs were fed twice each day, the morning feed being given about 7 a. m. and the evening feed about 5 p. m. The feed racks were cleaned before each feeding, all waste or refuse feed being reweighed in order to obtain as accurate a record as possible of the actual feed consumption. All unconsumed feed weighed back was deducted from the original amount supplied. This accounts for the slight differences in the consumption of feed between the respective lots in the 1922-23 test, since in supplying the feed all lots of lambs receiving the sorghum grains and corn were fed concentrates and hay on a pound for pound basis, the corn lot being taken as the standard. Increases were made as this lot was able to stand an increase in the concentrate portion of the ration. The grain and cottonseed meal were mixed in the designated proportions in quantities sufficient to last over a period of several weeks. In the 1922-23 experiment, the proportion of grain to cottonseed meal at the beginning was 7 to 3, the rather high proportion of cottonseed meal being used to stimulate growth since the lambs only weighed about 50 pounds at the outset. After a period of approximately four weeks, the proportion was changed to 9 parts of grain to 1 part of cottonseed meal, which was continued on this basis until the termination of the experiment. In the 1924-25 experiment, larger, fleshier, and better developed lambs were utilized and the proportion of grain to cottonseed meal was kept at a 9:1 ratio for the lambs receiving grain, cottonseed meal, and alfalfa hay throughout the feeding period, since they already had plenty of frame or scale. During the 1924-25 experiment, the respective lots of lambs receiving grain sorghum and corn were fed on a pound for pound basis during the first 5 weeks, after which time each lot was fed according to appetite, irrespective of what the others were capable of consuming.

Lambs Used

The lambs used in each of the two experiments were high grade Rambouillets with the exception of Lot 7 in the 1924-25 test, which were cross bred lambs. Part of the lambs were raised on Substation No. 7; the others were raised in that vicinity.

In the 1922-23 experiment, the lambs were placed on a preliminary ration November 16, during which period they were fed .5 pound of a 7:3 mixture of grain and cottonseed meal and two pounds of chopped sorghum hay. At the end of the preliminary feeding period of 13 days, they were receiving .67 pound of a 7:3 mixture of grain and cottonseed meal and 2.6 pounds of chopped sorghum hay.

The lambs used in the 1924-25 experiment showed a wider range between the heaviest and lightest ones than during the previous test. They were, however, better developed lambs and were all in a good thrifty condition at the beginning of the preliminary feeding period November 12. At the beginning of the preliminary period, while they yet had access to pasture, they received .2 pound per head daily of a mixture of equal parts of ground milo heads, and cottonseed meal. The concentrates were increased gradually until at the beginning of the test proper, December 22, they were practically on full feed and were receiving 1.2 pounds of a 9:1 mixture of grain and cottonseed meal and 1.5 pounds of alfalfa hay per head daily. Twenty lambs were assigned to each of the respective lots at the beginning of the 1922-23 and 1924-25 experiments.

In the 1922-23 experiment one lamb in Lot 9, receiving ground kafir heads, cottonseed meal, and alfalfa hay, died January 12th from unknown causes. He had not previously been off feed. This was the only loss that occurred in any of the lots receiving corn or grain sorghum in the series of five tests. In the 1924-25 experiment, one lamb was removed from Lot 7, receiving ground milo heads, cottonseed meal, and cottonseed hulls, January 5, 1925, on account of a digestive ailment that continued without improvement. On February 8, 1925, another lamb was removed from this lot on account of an enlargement of the sheath and an apparent abdominal rupture. A lamb was removed from Lot 8, receiving cottonseed meal and hulls in the 1924-25 test, January 5, 1925. This lamb had suffered from a screw-worm infestation previous to the beginning of the test and had not entirely recovered. A lamb in Lot 9, receiving cottonseed, cottonseed meal, and cottonseed hulls died January 3, 1925, after a digestive derangement which lasted several days.

Feeds Used

The corn fed in each year's feeding test was No. 2 yellow shipped from Kansas. Dwarf yellow milo and blackhul kafir were fed in each of the respective tests. An unimproved variety of feterita was fed in the 1919-20 test, while in each of the four later ones Spur feterita was

fed. Schrock-kafir, darso, and sumac sorgo (cane) seed were each used in one test. The grain fed was of good uniform quality, the bulk of the milo and feterita used having been grown on the Station. The kafir was purchased locally while the schrock and darso were shipped in from South and Central Texas. The cottonseed meal used was sold under a guarantee of 43 per cent protein, the analyses of representative samples by the State Chemist bearing this out. The grain sorghum heads used in this experiment were finely ground and there was no waste either of the grain or the ground head pomace. The cottonseed and cottonseed hulls were produced locally, the hulls being shipped from Jayton, a distance of about 30 miles from Spur.

The analyses of the feeds used as determined by the Texas State Chemist are given in Table 2.

Table 2.—Composition of feeds used during five experiments.

Kind of Feed	Year	Protein Per Cent	Water Per Cent	Ash Per Cent	Fat Per Cent	Crude Fiber Per Cent	Nitrogen-free Extract Per Cent	No. of Analyses
Ground shelled corn	1919–20	9.69	10.96	1.38	4.59	2.72	70.66	1
	1920–21	9.70	10.75	1.28	4.15	2.66	71.46	2
	1921–22	9.75	9.48	1.40	4.34	2.81	72.22	3
	1922–23	9.71	10.83	1.38	3.80	2.52	71.76	7
	1924–25	10.24	10.24	1.46	3.66	2.44	71.96	2
Average....	.....	9.82	10.45	1.38	4.11	2.63	71.61	
Ground threshed milo	1919–20	11.94	12.24	1.82	2.88	2.29	68.83	1
	1920–21	10.40	12.32	1.82	2.58	2.74	70.14	2
	1921–22	10.76	9.91	1.58	2.73	2.48	72.54	3
	1922–23	11.42	10.12	1.70	3.48	2.31	70.97	3
	1924–25	11.66	9.62	1.76	3.24	2.21	71.51	2
Average....	.....	11.24	10.84	1.74	2.98	2.40	70.80	
Whole milo	1921–22	11.89	8.69	1.57	2.99	2.83	72.03	3
	1922–23	11.34	10.23	1.51	3.06	2.54	71.32	3
Average....	.....	11.62	9.46	1.54	3.02	2.68	71.68	
Ground threshed feterita	1919–20	12.58	12.75	1.65	3.74	2.28	67.00	1
	1920–21	11.82	14.33	1.76	2.72	2.10	67.27	2
	1921–22	12.57	10.51	2.07	2.80	2.80	69.25	3
	1922–23	13.67	10.36	1.72	3.52	2.18	68.55	4
	1924–25	13.88	9.60	1.82	3.16	2.05	69.49	2
Average....	.....	12.91	11.51	1.80	3.19	2.28	68.31	
Ground threshed kafir	1919–20	11.01	11.31	1.78	3.64	2.82	69.44	1
	1920–21	10.18	12.94	1.48	3.05	2.02	70.33	2
	1921–22	11.73	10.75	1.52	2.87	1.84	71.29	3
	1922–23	11.60	10.42	1.54	3.19	2.55	70.70	3
	1924–25	13.45	9.53	1.79	3.14	2.23	69.86	1
Average....	.....	11.59	10.99	1.62	3.18	2.29	70.33	
Ground threshed schrock....	1922–23	10.17	10.96	1.69	2.97	3.40	70.81	3
Ground milo heads	1919–20	10.53	11.15	3.32	2.91	7.12	64.97	1
	1920–21	10.40	12.00	3.57	2.31	6.92	64.80	2
	1921–22	9.90	9.37	3.09	2.32	6.98	68.34	3
	1922–23	10.05	10.20	2.99	2.69	7.16	66.91	3
	1924–25	9.93	8.78	3.08	2.43	6.61	69.17	3
Average....	.....	10.16	10.30	3.21	2.53	6.96	66.84	

Table 2.—Composition of feeds used during five experiments—Continued.

Kind of Feed	Year	Protein Per Cent	Water Per Cent	Ash Per Cent	Fat Per Cent	Crude Fiber Per Cent	Nitrogen-free Extract Per Cent	No. of Analyses
Ground feterita heads	1919–20	9.95	12.63	2.74	2.87	6.37	65.44	1
	1920–21	11.28	12.00	2.78	2.14	6.77	65.03	2
	1921–22	11.22	10.41	3.03	2.83	6.81	65.70	3
	1922–23	10.74	10.52	3.40	2.90	7.89	64.55	3
Average....	.....	10.80	11.39	2.99	2.68	6.96	65.18	
Ground kafir heads	1920–21	9.45	11.25	2.98	2.47	7.43	66.42	2
	1921–22	10.61	10.75	3.23	2.58	6.90	65.93	3
	1922–23	9.95	10.06	3.52	2.58	9.85	64.04	3
Average....	.....	10.00	10.69	3.24	2.54	8.06	65.47	
Ground threshed darso.....	1921–22	8.95	9.35	1.22	3.03	2.73	74.72	3
Ground threshed sorgo.....	1921–22	10.70	9.23	1.57	3.12	2.77	72.61	3
Whole cotton-seed	1920–21	22.08	7.99	3.63	20.50	20.66	25.14	2
	1922–23	22.89	6.90	3.81	18.21	22.09	26.10	2
	1924–25	22.10	6.05	3.44	19.02	23.48	25.91	2
Average....	.....	22.36	6.98	3.63	19.24	22.07	25.72	
Cottonseed meal	1919–20	43.38	8.25	5.99	8.38	9.04	24.96	1
	1920–21	42.68	7.04	6.11	9.56	8.86	25.75	2
	1921–22	45.54	6.38	5.56	7.27	9.72	25.53	3
	1922–23	43.21	6.46	5.30	8.01	11.51	25.51	4
	1924–25	42.76	6.61	4.94	6.67	11.38	27.64	3
Average....	.....	43.51	6.95	5.58	7.98	10.10	25.88	
Alfalfa hay	1919–20	15.76	9.71	8.85	1.50	27.68	36.50	2
	1920–21	14.36	8.88	8.49	1.77	30.48	36.02	3
	1921–22	13.98	8.34	8.40	1.57	32.40	35.31	4
	1922–23	15.03	8.05	8.61	2.15	29.20	36.96	4
Average....	.....	14.78	8.74	8.59	1.75	29.94	36.20	
Sorghum hay (sumac)	1920–21	5.79	9.30	6.26	1.95	26.48	50.22	2
	1921–22	6.52	8.38	7.44	1.87	24.48	51.31	1
Average....	.....	6.16	8.84	6.85	1.91	25.48	50.76	
Cottonseed hulls	1924–25	3.95	7.12	2.45	.85	45.61	40.02	3

Prices of Feeds

The prices of all feeds used are listed at actual cost. These figures include the cost of grinding. In this experiment the feeds were valued as shown in Table 3. A charge of $3.25 per ton was allowed to cover the cost of grinding the grain.

Weather Conditions During Test

The weather conditions including maximum and minimum temperatures, as well as the distribution of rainfall, during the experiment, are shown in Table 4.

As shown in Table 4, less than one inch of rain fell during either of the tests. No rain fell on regular weighing dates and the regular routine of the feeding trials was not interfered with or delayed.

Table 3.—Prices of feeds used in experiments.

Feeds	Years	
	1922-23	1924-25
Ground shelled corn, per ton	$36.06	$53.00
Whole threshed milo, per ton	36.66	.....
Ground threshed milo, per ton	39.91	41.50
Ground threshed feterita, per ton	39.91	41.50
Ground threshed kafir, per ton	39.91	41.50
Ground threshed schrock, per ton	39.91	.....
Ground milo heads, per ton	28.40	30.00
Ground feterita heads, per ton	28.40	.....
Ground kafir heads, per ton	28.40	.....
Whole cottonseed, per ton	40.00	30.00
Cottonseed meal, per ton	36.60	42.00
Cottonseed hulls, per ton	9.92	10.50
Alfalfa hay, per ton	33.00	30.00

Table 4. Weather data during 1922-23 and 1924-25 experiments.

Month	Maximum Temperature, Degrees F.		Minimum Temperature, Degrees F.		Precipitation, Inches	
	1922-23	1924-25	1922-23	1924-25	1922-23	1924-25
November (after 28th)	71	.....	36	.....	0.11	.....
December (1924-25 test, after December 6th)	75	78	21	—2	0.03	Trace
January	78	76	18	11	0.10	0.34
February (1922-23 test to Feb. 26)	73	84	12	20	0.72	0.16
March, to March 2nd (end of 1924-25 test)	.....	67	.....	28	.....	0.00
Total	.....	.....	.....	.....	0.96	0.50

THE 1922-23 TEST

Rations and Gains by Periods During the 1922-23 Test

The following rations were fed:

Lot 1, ground shelled corn, cottonseed meal and alfalfa hay.
Lot 2, whole threshed milo, cottonseed meal and alfalfa hay.
Lot 3, ground threshed milo, cottonseed meal and alfalfa hay.
Lot 4, ground threshed feterita, cottonseed meal and alfalfa hay.
Lot 5, ground threshed kafir, cottonseed meal and alfalfa hay.
Lot 6, ground threshed schrock, cottonseed meal and alfalfa hay.
Lot 7, ground milo heads, cottonseed meal and alfalfa hay.
Lot 8, ground feterita heads, cottonseed meal and alfalfa hay.
Lot 9, ground kafir heads, cottonseed meal and alfalfa hay.
Lot 10, ground threshed milo, cottonseed, and alfalfa hay.

During the first 30-day period, as may be observed by referring to Table 5, the lambs in Lots 1 to 9, inclusive, consumed an average of .56 pound of grain, .24 pound of cottonseed meal, and approximately 1.6 pounds of alfalfa hay per head daily. Alfalfa hay was supplied in accordance with appetites. The grain was increased gradually as the

feeding period advanced until during the second 30-day period when the lambs consumed an average of 1.1 pounds of grain, .12 pound of cottonseed meal, and around 1.5 pounds of alfalfa hay per head daily. During the third or final 30 days on feed, the average feed consumption per head daily was 1.33 pounds of grain, .15 pound of cottonseed meal, and about 1.5 pounds of alfalfa hay.

The average gains per lamb for the respective lots as well as the average daily gains per lamb are also shown by periods in Table 5. It may be observed by reference to this table that in practically every instance the average gains by periods made by the several lots of lambs were remarkably uniform and consistent throughout the 90-day feeding period.

Table 5.—Average daily rations and gains by periods, 90 days, 1922-23. Twenty lambs in each lot.

Lot No.	Ration	First 30-day Period, Pounds	Second 30-day Period, Pounds	Third 30-day Period, Pounds	Average for 90-day Period, Pounds
1	Ground shelled corn	.56	1.06	1.33	.98
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.64	1.58	1.40	1.54
	Total gain per lamb	12.09	12.50	11.47	*36.06
	Average daily gain	.40	.42	.38	.40
2	Whole threshed milo	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.65	1.54	1.45	1.55
	Total gain per lamb	12.98	11.15	11.94	*36.06
	Average daily gain	.43	.37	.40	.40
3	Ground threshed milo	.56	1.06	1.32	.98
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.64	1.49	1.35	1.50
	Total gain per lamb	11.61	11.25	11.82	*34.68
	Average daily gain	.39	.38	.39	.39
4	Ground threshed feterita	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.66	1.55	1.46	1.56
	Total gain per lamb	12.11	11.48	12.93	*36.51
	Average daily gain	.40	.38	.43	.41
5	Ground threshed kafir	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.62	1.59	1.54	1.58
	Total gain per lamb	12.85	11.60	12.10	*36.55
	Average daily gain	.43	.39	.40	.41
6	Ground threshed schrock	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.67	1.58	1.56	1.60
	Total gain per lamb	12.52	10.35	11.78	*34.65
	Average daily gain	.42	.35	.39	.39
7	Ground milo heads	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.66	1.52	1.42	1.54
	Total gain per lamb	12.63	11.25	10.57	*34.45
	Average daily gain	.42	.38	.35	.38

Table 5.—Average daily rations and gains by periods, 90 days, 1922-23. Twenty lambs in each lot—Continued.

Lot No.	Ration	First 30-day Period, Pounds	Second 30-day Period, Pounds	Third 30-day Period, Pounds	Average for 90-day Period, Pounds
8	Ground feterita heads	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.66	1.62	1.45	1.58
	Total gain per lamb	10.27	11.10	11.49	*32.86
	Average daily gain	.34	.37	.38	.36
9	Ground kafir heads	.56	1.06	1.35	.99
	Cottonseed meal	.24	.12	.15	.17
	Alfalfa hay	1.60	1.47	1.50	1.52
	Total gain per lamb	11.50	10.18	9.61	*31.29
	Average daily gain	.38	.34	.32	.35
10	Ground threshed milo	.53	.65	.54	.57
	Cottonseed	.27	.53	.96	.58
	Alfalfa hay	1.56	1.42	1.40	1.46
	Total gain per lamb	11.97	11.45	11.29	*34.71
	Average daily gain	.40	.38	.38	.39

*Total gain for entire period.

The lambs in Lots 1 to 9, inclusive, received grain and cottonseed meal in a proportion of 7 parts of grain to 3 parts of cottonseed meal from November 29 to December 28, when the ration was changed to 9 parts of grain to 1 of cottonseed meal, and fed in this proportion until the termination of the 1922-23 test. Lot 10 received a mixture of two parts of ground threshed milo to one part of whole cottonseed during the first four weeks of the experiment. On December 28 the ration was changed to 1.75 parts of grain to 1.25 parts of cottonseed. The ration was changed to equal parts of grain and cottonseed January 18. The proportion of cottonseed was gradually increased as the experiment progressed until at the end of the feeding period the lambs were receiving 6 parts of ground threshed milo to 11 parts of whole cottonseed; or, stated on the basis of concentrates consumed, the lambs in Lot 10 were consuming 1.1 pounds of whole cottonseed and .6 pound of ground threshed milo per head daily at the end of the 90-day feeding period. There was more of a tendency toward laxativeness on this ration than in any of the other lots. This was due to the high oil content of the cottonseed. At one time or another as the feeding period advanced, there was a slight tendency toward laxativeness in most of the lots, including Lot 1 receiving corn. The only two exceptions noted by Mr. J. H. Jones, the feeder, were Lots 6 and 8, receiving ground threshed schrock and ground feterita heads, respectively. It was observed also that the appetites of these two lots were always slightly above the average of the others.

Quantity and Cost of Feed Required to Produce 100 Pounds of Gain

Table 6 illustrates the manner in which the lambs in the respective lots responded to the different kinds of grain. This table shows the average amount of feed required to produce 100 pounds of gain during the 90-day feeding period.

The largest gain was made by Lot 5, which received ground threshed kafir, although there was less than .5 pound difference in the average total gain per head (feed lot basis) in Lots 1, 2, 4, and 5, receiving ground shelled corn, whole threshed milo, ground threshed feterita, and ground threshed kafir, respectively, during the 90-day period. The cheapest gain in any of these four lots was made by the one receiving corn. This is accounted for by the fact that corn was available during this particular year of drouth at a cost of $3.85 per ton less than the ground threshed grain sorghums, all of which were charged to the experiment at actual cost figures.

The average consumption of feed per lamb during the 90-day period was about 89 pounds of grain, 15 pounds of cottonseed meal, and 140 pounds of alfalfa hay. The feed requirement per 100 pounds of gain was remarkably low in each of the respective lots. Lot 4, which was slightly lowest in this respect, required 244 pounds of ground threshed feterita, 42 pounds of cottonseed meal, and 383 pounds of alfalfa hay at a cost of $11.96 as compared with 244 pounds of ground threshed kafir, 42 pounds of cottonseed meal, and 389 pounds of alfalfa hay in Lot 5, at a cost of $12.09. Figured on a basis of feed lot gains, Lot 5, receiving ground threshed kafir, made slightly the best showing, the total gain per lamb being 36.56 pounds as compared with 36.51 pounds and 36.06 pounds for Lots 4 and 1, receiving ground threshed feterita and ground shelled corn, respectively. However, reference to Table 6 shows that Lot 1 receiving ground shelled corn had a very slight advantage in the average total gain per head figured on the basis of market weights. Lot 6 receiving ground threshed schrock made an average total gain per lamb of 34.65 pounds as compared with 34.68 pounds made by the lambs receiving ground threshed milo. One important point of observation worthy of mention in connection with the feeding of ground threshed schrock to this lot was that it was the only lot receiving the ground threshed grain that did not at any time throughout the experiment show any tendency toward laxativeness.

The lambs receiving the ground grain sorghum heads were fed on a pound for pound basis with those being fed the threshed grain. On this basis, it is obvious that these groups (Lots 7, 8, and 9) received approximately 25 per cent less grain than the respective lots receiving the ground threshed kind and consequently required an increased amount of feed to produce 100 pounds of gain. Lot 7 stood first in point of gains among the lots receiving ground grain sorghum heads. This lot required 259 pounds ground milo heads, 44 pounds of cottonseed meal, and 401 pounds of alfalfa hay to produce 100 pounds of gain as compared with 271 pounds of ground feterita heads, 46 pounds of cottonseed meal, and 432

pounds of alfalfa hay, and 284 pounds of ground kafir heads, 49 pounds of cottonseed meal, and 438 pounds of alfalfa hay in Lots 8 and 9, respectively. The cost of feed per 100 pounds of gain in Lot 7, receiving ground milo heads, was $11.10 or 86 cents less than in Lot 4, receiving ground threshed feterita, which made the most economical gain of any of the lots receiving ground threshed grain sorghum. Reference to Table 6 will show that Lot 7 also returned the largest net profit per lamb.

The Lot 2 lambs, which received whole threshed milo in the 1922-23 test, required practically the same amount of feed per 100 pounds of gain as did Lot 3, fed ground threshed milo. There was but very little difference in the finish carried by these two lots; however, the lambs which were fed the ground threshed grain seemed to be more evenly fleshed. Further work will have to be done in a comparison of feeding whole and ground threshed grain sorghums to lambs before a definite recommendation can be made as to the most desirable method of preparation.

Lot 10, receiving whole cottonseed in place of cottonseed meal, required 149 pounds of ground threshed milo, 151 pounds of whole cottonseed, and 179 pounds of alfalfa hay per 100 pounds of gain. This lot consumed as high as 1.1 pounds of whole cottonseed per head daily during the latter part of the 90-day feeding period. Although there was a general disposition on the part of the lambs in this lot toward a laxative tendency when the maximum allowance of cottonseed was being fed, it will be observed from Tables 5 and 6 that the gains and feed requirements of this lot were consistent with the other lots.

The amount of concentrates required per 100 pounds of gain increased quite consistently in all lots as the feeding period progressed. This might well be expected since the amount of concentrates fed is gradually increased as the feeding period progresses in practically all feeding enterprises. Gains late in the feeding period consist more largely of fat than do gains made early in the feeding period, and therefore require more concentrated feed to produce them.

Table 5 illustrates very clearly that the lambs in each of the respective lots receiving the shelled or threshed grain made practically equal gains; hence the cost is the most important factor for the prospective feeder to take into consideration before purchasing a supply of one of these grains with which to feed out a band of lambs.

Marketing Data

The lambs were sold on the Fort Worth market March 5, 1923. Livestock commission salesmen and packer buyers pronounced the several lots of lambs which had received corn and the ground threshed grain sorghum as being quite uniformly finished, although they were of the opinion that the Lot 5 lambs which had received ground threshed kafir carried slightly the highest and most uniform finish. The lambs in Lots 7, 8, and 9, which had received ground milo, feterita, and kafir

	Lot 1. Ground Shelled Corn, Cottonseed meal, Alfalfa hay	Lot 2. Whole Threshed Milo, Cottonseed meal, Alfalfa hay	Lot 3. Ground Threshed Milo, Cottonseed meal, Alfalfa hay	Lot 4. Ground Threshed Feterita, Cottonseed meal, Alfalfa hay	Lot 5. Ground Threshed Kafir, Cottonseed meal, Alfalfa hay	Lot 6. Ground Threshed Schrock, Cottonseed meal, Alfalfa hay	Lot 7. Ground Milo Heads, Cottonseed meal, Alfalfa hay	Lot 8. Ground Feterita Heads, Cottonseed meal, Alfalfa hay	Lot 9. Ground Kafir Heads, Cottonseed meal, Alfalfa hay	Lot 10. Ground Threshed Milo, Cottonseed Alfalfa hay
Number of lambs	20	20	20	20	20	20	20	20	19	20
Average initial weight at feed lot, pounds	49.96	49.50	50.28	48.34	48.77	50.48	49.39	50.38	48.45	49.35
Average final weight at feed lot, pounds	86.02	85.56	84.96	84.85	85.32	85.13	83.84	83.24	79.74	84.06
Average final weight at Ft. Worth, pounds	76.50	75.50	76.75	74.75	75.25	74.75	74.50	73.00	69.74	75.50
Average gain per head, feed-lot weights, lbs	36.06	36.06	34.68	36.51	36.55	34.65	34.45	32.86	31.29	34.71
Average gain per head, selling weights, lbs	26.54	26.00	26.47	26.41	26.48	24.27	25.11	22.62	21.29	26.15
Average daily gain per head, feed lot weights, pounds	.401	.401	.385	.406	.406	.385	.383	.365	.348	.386
Average daily gain per head, selling weights, pounds	.295	.289	.294	.293	.294	.270	.279	.251	.237	.291
Average daily ration:										
Grain, pounds	.98	.99	.98	.99	.99	.99	.99	.99	.99	.57
C. S. meal, pounds	.168	.169	.168	.169	.169	.169	.169	.169	.169	*.584
Hay, pounds	1.54	1.55	1.50	1.56	1.58	1.60	1.54	1.58	1.52	1.46
Total feed consumed per lamb:										
Grain, pounds	88.56	89.06	88.17	89.06	89.06	89.06	89.06	89.06	89.06	51.69
C. S. meal, pounds	15.149	15.206	15.107	15.206	15.206	15.206	15.206	15.206	15.206	*52.560
Hay, pounds	139.10	139.22	134.56	140.10	142.34	144.40	138.14	141.94	137.07	131.51
Feed required per 100 pounds gain:										
Grain, pounds	246	247	254	244	244	257	259	271	284	149
C. S. meal, pounds	42	42	44	42	42	44	44	46	49	*151
Hay, pounds	386	386	388	384	389	417	401	432	438	379
Cost of feed per 100 pounds gain	$ 11.56	$ 11.67	$ 12.28	$ 11.96	$ 12.06	$ 12.81	$ 11.10	$ 11.82	$ 12.14	$ 12.25
Financial statement:										
Initial cost per lamb at 11 cents	$ 5.50	$ 5.44	$ 5.53	$ 5.32	$ 5.36	$ 5.55	$ 5.43	$ 5.54	$ 5.33	$ 5.43
Cost of feed per lamb	$ 4.17	$ 4.21	$ 4.26	$ 4.37	$ 4.40	$ 4.44	$ 3.82	$ 3.88	$ 3.80	$ 4.25
Interest, labor, selling, shipping charges per head (estimate)	$ 1.40	$ 1.40	$ 1.40	$ 1.40	$ 1.40	$ 1.40	$ 1.40	$ 1.40	$ 1.40	$ 1.40
Total cost per lamb	$ 11.07	$ 11.05	$ 11.19	$ 11.09	$ 11.16	$ 11.39	$ 10.65	$ 10.82	$ 10.53	$ 11.08
Price received per lamb at 14.75 cents	$ 11.28	$ 11.13	$ 11.32	$ 11.02	$ 11.09	$ 11.02	$ 10.98	$ 10.76	$ 10.28	$ 11.13
Price necessary to break even, per pound	$ .145	$ .146	$ .146	$ .148	$ .148	$ .152	$ .143	$ .148	$ .151	$ .147
Profit or loss per lamb	$ .215 profit	$ .077 profit	$ .132 profit	$ —.064 loss	$ —.077 loss	$ —.371 loss	$ .325 profit	$ —.067 loss	$ —.255 loss	$ .050 profit

heads, respectively, did not show quite as high a finish as did the other lots; however, all lots were sold at 14.75 cents per pound straight through without any cut-backs.

The average dressing records as reported by Swift & Company for the respective lots were as follows:

	Per cent
Lot 1, receiving shelled corn	49.3
Lot 2, receiving whole threshed milo	49.2
Lot 3, receiving ground threshed milo	48.9
Lot 4, receiving ground threshed feterita	48.0
Lot 5, receiving ground threshed kafir	49.2
Lot 6, receiving ground threshed schrock	48.0
Lot 7, receiving ground milo heads	48.2
Lot 8, receiving ground feterita heads	48.1
Lot 9, receiving ground kafir heads	47.2
Lot 10, receiving milo chops and whole cottonseed	50.1

THE 1924-25 TEST

Rations and Gains by Periods for Second Test (1924-25)

Lot 1, ground shelled corn, cottonseed meal, and alfalfa hay.

Lot 2, ground threshed milo, cottonseed meal, and alfalfa hay.

Lot 3, ground threshed feterita, cottonseed meal, and alfalfa hay.

Lot 4, ground threshed kafir, cottonseed meal, and alfalfa hay.

Lot 5, ground milo heads, cottonseed meal, and alfalfa hay.

Lot 6, (yearling wethers) ground milo heads, cottonseed meal, and alfalfa hay.

Lot 7, (cross bred lambs) ground milo heads, cottonseed meal and cottonseed hulls.

Lot 8, cottonseed meal, and cottonseed hulls.

Lot 9, whole cottonseed, cottonseed meal, and cottonseed hulls.

During the first 14-day period of the 1924-25 test, as is shown in Table 7, the lambs in Lots 1 to 5, inclusive, consumed an average of 1.14 pounds of grain, .13 pound of cottonseed meal, and approximately 1.5 pounds of alfalfa hay per head daily. The alfalfa hay was fed in accordance with the appetites of the respective lots. The rejected hay was reweighed and deducted from the original amount supplied. The figures in Table 7 show the actual consumption of alfalfa by the respective lots. The concentrates were increased gradually as the feeding period advanced and during the second 14-day period the lambs in Lots 1 to 5, inclusive, consumed an average of 1.3 pounds of grain, .14 pound of cottonseed meal, and approximately 1.3 pounds of alfalfa hay per head daily. Beginning with the third 14-day period, the lambs in the respective lots were fed concentrates in accordance with their appetites. This was the first departure from the original plan of basing increases of concentrates upon the ability of the standard or corn-fed lot to take an increase. This plan was followed in the 1924-25 test

Fig. 1. The Lot 1 lambs fed in the 1924-25 test received ground shelled corn, cottonseed meal, and alfalfa hay during a 70-day period. They gained 28.2 lbs. per head and weighed 94.5 lbs. at the end of fattening period, feed-lot basis.

Fig. 2. The Lot 2 lambs fed in the 1924-25 test received ground threshed milo, cottonseed meal, and alfalfa hay during a 70-day period. They gained 28.5 lbs. per head and weighed 93.4 pounds at end of fattening period.

Fig. 3. The Lot 3 lambs fed in the 1924-25 test received ground threshed feterita, cottonseed meal, and alfalfa hay during a 70-day period. They gained 30.7 lbs. per head and weighed 96.4 lbs. at the end of the fattening period.

Fig. 4. The Lot 4 lambs fed in the 1924-25 test received ground threshed kafir, cottonseed meal, and alfalfa hay during a 70-day period. They gained 27.7 lbs. per head and weighed 94.5 lbs. at the end of the fattening period.

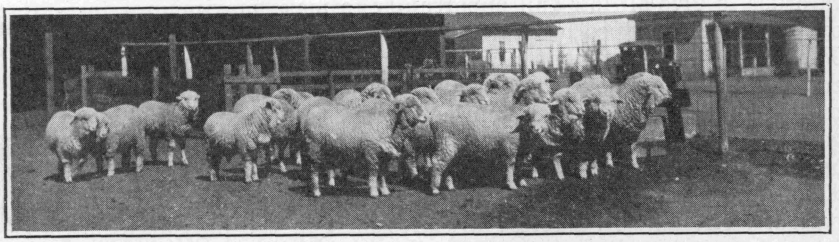

Fig. 5. The Lot 5 lambs fed in the 1924-1925 test received ground milo heads, cottonseed meal, and alfalfa hay during a 70-day period. They gained 28.7 lbs. per head and weighed 94.9 pounds at the end of the fattening period.

Fig. 6. The Lot 7 crossbred sheared lambs fed in the 1924-1925 test received ground milo heads, cottonseed meal, and cottonseed hulls during a 70-day period. They gained 24.7 lbs. per head and weighed 101.4 lbs. at the end of fattening period.

Fig. 7. The Lot 8 pen of heavy lambs fed in the 1924-1925 test received cottonseed meal and cottonseed hulls during a 70-day period. They gained 21.7 lbs. per head and weighed 103.2 lbs. at the end of the fattening period. These lambs failed to put on a good finish.

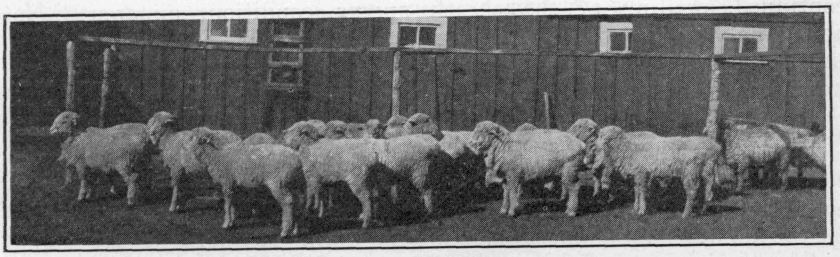

Fig. 8. The Lot 9 pen of light lambs fed in the 1924-1925 test received whole cottonseed and cottonseed hulls during the first few weeks on feed. Cottonseed meal was later added to the ration, which enhanced their gains considerably during a 70-day period. They gained 17.5 lbs. per head and weighed 64.25 lbs at the end of the fattening period. They sold as feeders.

in order to give all lots full opportunity to make maximum gains without being handicapped by any other group's performance in this respect. Table 7 shows the amount of feed supplied to the respective lots by 14-day periods throughout the 70-day feeding period. This table furthermore shows that a great amount of emphasis should not be placed on gains made by the lambs during such short intervals since too great an opportunity is afforded to allow outside influences such as weather conditions, etc., to affect the weights at the beginning or at the end of the period. The data in Table 7 are presented in the present form, however, since it is believed that they will prove useful for inexperienced feeders to follow in increasing the concentrate portion of the ration gradually as the period of feeding progresses. The last column at the right of Table 7 includes figures showing the average daily ration per head, also the average daily and total gains per head during the 90-day period. The average daily gains made by the lambs in this test compare very favorably with those made in the 1922-23 experiment as shown in Table 5, also in general summary Table 6. The lambs in Lot 5, receiving ground milo heads, consumed an average of 1.48 pounds of grain, .16 pound of cottonseed meal, and 1.31 pounds of alfalfa hay per head daily during the 70-day feeding period and made an average gain of 28.71 pounds per lamb. This compares with an average daily ration of 1.39 pounds of ground threshed milo, .15 pound of cottonseed meal, and 1.29 pounds of alfalfa hay and an average gain of 28.46 pounds made by the Lot 2 lambs. Lot 3, receiving ground threshed feterita, made the best gain of any of the lots during the 1924-25 test, showing a gain of 30.65 pounds per lamb during the 90-day period.

Feeding Grain and Cottonseed Hulls

Cottonseed hulls constituted the roughage portion of the ration of the cross bred lambs comprising Lot 7, which were fed ground milo heads and cottonseed meal in a proportion of 7 parts of grain to 3 parts of meal. These lambs made the most inconsistent gain of any of the lots fed in the 1924-25 test. This was possibly due to the liberal allowance of cottonseed meal, since a maximum of .69 pound per head daily was fed during the fifth 14-day period. As previously reported, two lambs were removed from Lot 7 during the progress of the experiment, one on account of a serious digestive ailment and the second on account of a continued swelling of the sheath and a condition, apparently an abdominal rupture, which appeared simultaneously. The high dressing percentage of this lot is partially explained by the fact that they were sheared at the beginning of the feeding test.

A Ration of Cottonseed Meal and Cottonseed Hulls

The Lot 8 lambs, which received a sole ration of cottonseed meal and cottonseed hulls, made rather inconsistent gains also. The average daily feed allowance per lamb throughout the 70-day period was .58 pound

of cottonseed meal and 2.6 pounds of cottonseed hulls. This group of lambs was a vigorous lot and not once during the period did a single lamb show any indications of any ill effects of the cottonseed meal and hull ration. One lamb which had been infested with screw worms previous to the beginning of the test was removed at the end of the first 28-day period. The average daily gain per head made by this lot was .31 pound. The lambs made good growth but did not put on much fat. The shrinkage in shipment to market as well as in dressing was higher in this than in any of the other lots. The lambs which received cottonseed meal and cottonseed hulls sold at a figure of $1.50 per hundredweight below the price brought by the grain-, cottonseed meal- and alfalfa-fed lots.

Feeding Whole Cottonseed as Sole Concentrate

The lambs in Lot 9 which received whole cottonseed and cottonseed hulls at the outset were dependent upon this feed combination during the first 14 days of the test. During this initial period this combination of feed proved very unpalatable. One lamb died during this interval. It was therefore decided that the ration would have to be supplemented. A small allowance of cottonseed meal was introduced at the end of the first 14 days. The meal was sprinkled over the cottonseed hulls at each subsequent feeding and the palatability was greatly improved. Table 7 shows that this lot made satisfactory gains during the second, third, and fourth 14-day periods; however, they seemed to lose their appetites during the final period and showed an actual loss in weight. Cottonseed as a sole concentrate cannot be recommended upon the basis of this trial. The lambs did not finish and were disposed of as feeders on the market.

Feeding Yearling Wethers

The yearling Rambouillet wethers in Lot 6 were fed the same feed combination that was supplied to the lambs constituting Lot 5. During the 70-day period this lot consumed an average of 1.72 pounds of ground milo heads, .19 pound of cottonseed meal, and 2.12 pounds of alfalfa hay per head daily. The Lot 5 lambs consumed 14 per cent less grain, 15 per cent less cottonseed meal, and 38 per cent less alfalfa hay, and made practically the same gain per head, that for the lambs being 28.71 pounds as compared with 28.96 pounds for the wethers.

Quantity and Cost of Feed Required to Produce 100 Pounds of Gain

The average feed requirements per 100 pounds of gain for the several lots during the entire period of 70 days are given in Table 8.

In the 1924-25 test the concentrate requirement was slightly higher than in the 1922-23 test, while on the other hand the alfalfa necessary to produce 100 pounds of gain was considerably less than in the 1922-23 test. The cost of feed per 100 pounds of gain was approximately the same in each of the two tests, the greatest difference being in the cost

Table 7. Average daily rations and gains by periods, 70 days, 1924-1925.

Lot No.	Ration	First 14-day Period, Pounds	Second 14-day Period, Pounds	Third 14-day Period, Pounds	Fourth 14-day Period, Pounds	Fifth 14-day Period, Pounds	Average for 70-day Period, Pounds
1	Ground shelled corn	1.14	1.30	1.35	1.40	1.53	1.34
	Cottonseed meal	.13	.14	.15	.16	.17	.15
	Alfalfa hay	1.44	1.32	1.20	1.28	1.22	1.29
	Total gain per lamb	7.65	2.90	8.43	3.87	5.36	*28.21
	Average daily gain	.55	.21	.60	.28	.38	.40
2	Ground threshed milo	1.14	1.30	1.39	1.48	1.62	1.39
	Cottonseed meal	.13	.14	.15	.16	.18	.15
	Alfalfa hay	1.46	1.33	1.21	1.27	1.19	1.29
	Total gain per lamb	5.36	5.03	6.32	5.03	6.72	*28.46
	Average daily gain	.38	.36	.45	.36	.48	.41
3	Ground threshed feterita	1.14	1.30	1.43	1.58	1.71	1.43
	Cottonseed meal	.13	.14	.16	.18	.19	.16
	Alfalfa hay	1.46	1.35	1.24	1.26	1.23	1.31
	Total gain per lamb	8.38	4.45	7.30	5.83	4.69	*30.65
	Average daily gain	.60	.32	.52	.42	.34	.44
4	Ground threshed kafir	1.14	1.30	1.39	1.48	1.62	1.39
	Cottonseed meal	.13	.14	.15	.16	.18	.15
	Alfalfa hay	1.43	1.31	1.21	1.28	1.19	1.28
	Total gain per lamb	5.22	4.25	8.15	4.80	5.28	*27.70
	Average daily gain	.37	.30	.58	.34	.38	.40
5	Ground milo heads	1.14	1.30	1.43	1.62	1.89	1.48
	Cottonseed meal	.13	.14	.16	.18	.21	.16
	Alfalfa hay	1.47	1.35	1.25	1.28	1.21	1.31
	Total gain per lamb	6.85	4.18	7.05	5.82	4.81	*28.71
	Average daily gain	.49	.30	.50	.42	.34	.41
6	Ground milo heads	1.29	1.48	1.76	1.89	2.16	1.72
	Cottonseed meal	.14	.16	.20	.21	.24	.19
	Alfalfa hay	2.47	2.34	2.05	1.98	1.79	2.12
	Total gain per lamb	8.18	4.73	4.32	9.25	2.48	*28.96
	Average daily gain	.58	.34	.31	.66	.18	.41
7	Ground milo heads	1.03	1.22	1.32	1.47	1.62	1.33
	Cottonseed meal	.44	.52	.57	.63	.69	.57
	Cottonseed hulls	2.46	2.60	2.39	1.68	1.74	2.09
	Total gain per lamb	7.67	1.45	3.80	8.56	3.26	*24.74
	Average daily gain	.55	.10	.27	.61	.23	.35
8	Cottonseed meal	.50	.53	.63	.63	.63	.58
	Cottonseed hulls	2.48	2.61	2.59	2.62	2.74	2.61
	Total gain per lamb	7.93	—1.00 loss	5.45	4.34	4.99	*21.70
	Average daily gain	.57	—.07 loss	.39	.31	.36	.31
9	Cottonseed	.50	.53	.53	.53	.53	.52
	Cottonseed meal	.....	**.19	.24	.26	.26	***.19
	Cottonseed hulls	.95	1.23	1.43	1.56	1.42	1.32
	Total gain per lamb	3.42	4.50	5.16	4.45	—0.04 loss	*17.49
	Average daily gain	.24	.32	.37	.32	loss	.25

*Total for entire period.
**Fed only during last 56 days.
***Average for 70-day period.

of feed in Lot 1. This is accounted for by the fact that the corn was available at a cost of $36.06 per ton in the 1922-23 test while in the 1924-25 experiment it was charged against the lambs at the rate of $53.00 per ton.

The largest and most economical gain made by lambs receiving ground threshed grain sorghum was made by the Lot 3 lambs, receiving ground threshed feterita. However, Lot 5, receiving ground milo heads, made a total gain of 28.71 pounds as compared with the gain of 30.65 pounds made by Lot 3 at a feed cost of 99 cents less per 100 pounds of gain. It is obvious that the Lot 5 lambs utilized their feed to better advantage than did any of the other lots receiving grain and alfalfa hay. This lot consumed 361 pounds of ground milo heads, 40 pounds of cottonseed meal, and 320 pounds of alfalfa hay per 100 pounds of gain as compared with a feed requirement of 327 pounds of ground threshed feterita, 36 pounds of cottonseed meal, and 299 pounds of alfalfa hay in Lot 3, which had the lowest requirement of any of the lots receiving ground threshed grain. Assuming that 25 per cent of ground milo heads con-

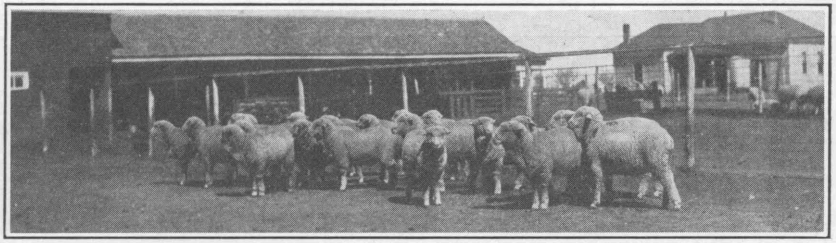

Fig. 9. The Lot 6 pen of yearling wethers fed in the 1924-1925 test received ground milo heads, cottonseed meal, and alfalfa hay during a 70-day period. They gained 29 lbs. per head and weighed 118.2 lbs. at the end of the fattening period.

sists of head stems or pomace, Lot 5 actually consumed 17 per cent less grain, 11 per cent more cottonseed meal, and 7 per cent more alfalfa hay than was consumed by the Lot 3 lambs, which received ground threshed feterita.

The cost of feed per 100 pounds of gain is not always a criterion as to the financial outcome of the feeding enterprise as is well illustrated by referring to the record made by the Lot 8 lambs receiving cottonseed meal and hulls. The cost of feed per 100 pounds of gain in this lot was $8.36. These lambs made a fairly satisfactory gain (.31 pound daily) throughout the feeding period; however, they failed to attain a desirable finish and sold at 1.5 cents per pound below the price received for the grain-fed lambs and consequently returned a smaller profit. The Lot 7 lambs receiving ground milo heads, cottonseed meal, and cottonseed hulls required 377 pounds of grain, 162 pounds of cottonseed meal, and 593 pounds of cottonseed hulls to produce 100 pounds of gain at a feed cost of $12.16. The gains were rather inconsistent; however, the average daily gain of .353 pound per head through-

Table 8.—Summary of fifth test, December 22, 1924, to March 2, 1925, inclusive, 70 days.

	Lot 1. Ground Shelled Corn, Cottonseed meal, Alfalfa hay	Lot 2. Ground Threshed Milo, Cottonseed meal, Alfalfa hay	Lot 3. Ground Threshed Feterita, Cottonseed meal, Alfalfa hay	Lot 4. Ground Threshed Kafir, Cottonseed meal, Alfalfa hay	Lot 5. Ground Milo Heads, Cottonseed meal, Alfalfa hay	Lot 6.† Ground Milo Heads, Cottonseed meal, Alfalfa hay	Lot 7. Ground Milo Heads, Cottonseed meal, Cottonseed hulls	Lot 8. Cottonseed meal, Cottonseed hulls	Lot 9. Cottonseed, Cottonseed hulls
Number of lambs	20	20	20	20	20	20	18	19	19
Average initial weight at feed lots, lbs.	66.25	64.89	65.77	66.82	66.15	89.22	76.66	81.46	46.76
Average final weight at feed lots, lbs.	94.46	93.35	96.42	94.53	94.86	118.18	101.40	103.16	64.25
Average final weight at Ft. Worth, lbs.	90.00	88.50	90.50	88.75	88.50	114.50	92.78	93.42	.....
Average gain per head, feed-lot weights, pounds	28.21	28.46	30.65	27.71	28.71	28.96	24.74	21.70	17.49
Average gain per head, selling weights, pounds	23.75	23.61	24.73	21.93	22.35	25.28	16.12	11.96	.....
Average daily gain per head, feed lot weights, pounds	.403	.406	.437	.396	.410	.414	.353	.310	.249
Average daily gain per head, selling weights, pounds	.339	.337	.353	.313	.319	.361	.230	.171	.....
Average daily ration:									
Grain, pounds	1.34	1.39	1.43	1.39	1.48	1.72	1.33	.....	* .521
Cottonseed meal, pounds	.149	.154	.159	.154	.164	.191	.57	.584	(1) .191
Roughage, pounds	1.29	1.29	1.31	1.28	1.31	2.12	2.09	2.61	1.32
Total feed consumed per head:									
Grain, pounds	94.14	97.25	100.35	97.25	103.50	120.20	93.25	.....	*36.53
Cottonseed meal, pounds	10.46	10.81	11.15	10.81	11.50	13.56	39.96	40.89	13.37
Roughage, pounds	90.60	90.45	91.53	89.80	91.83	148.70	146.62	182.73	92.29
Feed required per 100 lbs. gain:									
Grain, pounds	334	342	327	351	361	415	377	.....	*209
Cottonseed meal, pounds	37	38	36	39	40	46	162	188	76
Roughage, pounds	321	318	299	324	320	513	593	842	528
Cost of feed per 100 pounds gain	$ 14.44	$ 12.67	$ 12.04	$ 12.96	$ 11.05	$ 14.89	$ 12.16	$ 8.36	$ 7.51
Financial statement:									
Initial cost per head at 10 cents per pound	$ 6.62	$ 6.49	$ 6.58	$ 6.68	$ 6.62	$ **7.14	$ 7.67	$ 8.15	$ 4.68
Cost of feed per head	$ 4.07	$ 3.61	$ 3.68	$ 3.60	$ 3.17	$ 4.31	$ 3.01	$ 1.82	$ 1.31
Interest, labor, selling, shipping charges per head	$ 1.15	$ 1.15	$ 1.15	$ 1.15	$ 1.15	$ 1.15	$ 1.15	$ 1.15	$ 1.15
Total cost per head	$ 11.84	$ 11.25	$ 11.41	$ 11.43	$ 10.94	$ 12.60	$ 11.83	$ 11.12	$ 7.14
Price received per head	$ 13.95	$ 13.72	$ 14.03	$ 13.76	$ 13.50	$ 13.74	$ 12.99	$ 13.08	.....
Price necessary to break even, per 100 pounds	$ 13.16	$ 12.71	$ 12.61	$ 12.88	$ 12.36	$ 11.00	$ 12.75	$ 11.90	.....
Selling price per 100 pounds, market weights	$ 15.50	$ 15.50	$ 15.50	$ 15.50	$ 15.25	$ 12.00	$ 14.00	$ 14.00	.....
Profit per head	$ 2.11	$ 2.47	$ 2.62	$ 2.33	$ 2.56	$ 1.14	$ 1.16	$ 1.96	.....

*Cottonseed.
**Wethers at 8 cents per pound.
(1)Cottonseed meal added after first 14 days.
†Yearling wethers.

out the 70-day period was considered satisfactory. This pen of lambs which were sheared at the beginning of the test carried a fairly good finish, as is indicated by the slaughter record in Table 13; however, they were very growthy, did not possess the bloom that a fat lamb should show, and sold at 1.5 cents per pound less on the market than the lambs receiving grain, cottonseed meal, and alfalfa hay. The Lot 9 lambs, which received whole cottonseed, were an uneven lot, some of them being far from finished. The packers did not desire this lot for killing purposes; hence it was not possible to secure the killing data on them.

That it is far less economical to feed wethers than lambs is well illustrated by a comparison of Lots 5 and 6 in Table 8. The wethers required 15 per cent more grain, 15 per cent more cottonseed meal, and 60 per cent more alfalfa hay to produce 100 pounds of gain than did the lambs fed a similar ration in Lot 5. The average daily gains were practically the same for each lot; however, the daily feed requirement was so much higher for the wethers that they failed to make economical gains.

Marketing Data

The lambs constituting Lots 1, 2, 3, and 4, receiving ground shelled corn, ground threshed milo, ground threshed feterita, and ground threshed kafir, respectively, sold at $15.50 per hundred pounds liveweight; the Lot 5 lambs receiving ground milo heads brought $15.25; while Lots 7 and 8 receiving ground milo heads, cottonseed meal, and cottonseed hulls, and cottonseed meal and hulls, respectively, went over the scales at $14.00. The yearling wethers constituting Lot 6, sold at $12.00 per hundred pounds.

The average dressed yields for the respective lots in the 1924-25 test were as follows:

	Per cent
Lot 1, receiving ground shelled corn	48.5
Lot 2, receiving ground threshed milo	49.8
Lot 3, receiving ground threshed feterita	49.5
Lot 4, receiving ground threshed kafir	49.2
Lot 5, receiving ground milo heads	48.5
Lot 6, receiving ground milo heads (wethers)	50
Lot 7, receiving ground milo heads, cottonseed meal, cottonseed hulls	51
Lot 8, receiving cottonseed meal and cottonseed hulls	44.3

SUMMARY OF FIVE YEARS' WORK

The importance of summarizing the five lamb-feeding tests conducted by this Station, in which a comparison between corn and the grain sorghums was made, is obvious. In all, five groups of lambs were used in carrying this work to the present stage. There are as yet several phases of this general problem upon which no study has been made. The primary object in planning the study of a comparison of corn and the grain sorghums was to secure some reliable information which

might be made available to farmers and stockmen interested in the production and feeding of the grain sorghums, which are so well adapted to West Texas conditions. At the time the first experiment was planned in the fall of 1919, milo (which is the most extensively grown grain sorghum in Texas) was selling on the Texas market at a price twenty per cent lower than that of corn, a figure which according to investigations previously conducted by the Texas Station* represented a loss to the producers of grain sorghums of approximately 13 per cent of what should have been the actual market value of these feeds. Previous to beginning this project, only a limited amount of experimental work had been done by the Kansas, Oklahoma, and Texas Stations. However, this work only included one or two of the grain sorghums.

The first 90-day experiment, which was reported in Texas Station Bulletin No. 269, was conducted during the feeding season 1919-20. It was begun November 26, 1919, and closed February 24, 1920. Six lots of 20 lambs each were fed upon the following rations:

Lot 1, ground milo heads, cottonseed meal, and alfalfa hay.
Lot 2, ground threshed feterita, cottonseed meal, and alfalfa hay.
Lot 3, ground shelled corn, cottonseed meal, and alfalfa hay (standard lot).
Lot 4, ground threshed milo, cottonseed meal, and alfalfa hay.
Lot 5, ground feterita heads, cottonseed meal, and alfalfa hay.
Lot 6, ground threshed kafir, cottonseed meal, and alfalfa hay.

The second 90-day experiment (reported in Texas Station Bulletin No. 285) was begun November 29, 1920, and closed February 27, 1921. Nine lots, seven of which included 20 lambs and two lots 15 each, were fed upon the following rations:

Lot 1, ground milo heads, cottonseed meal, and alfalfa hay.
Lot 2, ground threshed feterita, cottonseed meal, and alfalfa hay.
Lot 3, ground shelled corn, cottonseed meal, and alfalfa hay (standard lot).
Lot 4, ground threshed milo, cottonseed meal, and alfalfa hay.
Lot 5, ground feterita heads, cottonseed meal, and alfalfa hay.
Lot 6, ground threshed kafir, cottonseed meal, and alfalfa hay.
Lot 7, ground kafir heads, cottonseed meal, and alfalfa hay.
Lot 8, ground threshed milo, whole cottonseed, and alfalfa hay.
Lot 9, ground threshed milo, cottonseed meal, and sumac fodder (sorghum hay).

The third experiment of 105 days' duration (reported in Texas Station Bulletin No. 306) was begun November 20, 1921, and closed March 5, 1922. Ten lots of 20 lambs each received the following rations:

*Texas Station Bulletins Nos. 170 and 203.

Lot 1, ground shelled corn, cottonseed meal, and alfalfa hay.*
Lot 2, ground threshed milo, cottonseed meal, and alfalfa hay.
Lot 3, whole threshed milo, cottonseed meal, and alfalfa hay.
Lot 4, ground milo heads, cottonseed meal, and alfalfa hay.
Lot 5, ground threshed feterita, cottonseed meal, and alfalfa hay.
Lot 6, ground feterita heads, cottonseed meal, and alfalfa hay.
Lot 7, ground threshed kafir, cottonseed meal, and alfalfa hay.
Lot 8, ground kafir heads, cottonseed meal, and alfalfa hay.
Lot 9, ground threshed darso, cottonseed meal, and alfalfa hay.
Lot 10, ground threshed sorgo (sumac), cottonseed meal, and alfalfa hay.

The fourth and fifth experiments which were conducted during the feeding seasons 1922-23 and 1924-25, and which extended over periods of 90 and 70 days, respectively, are reported in full in this Bulletin.

Average Gains and Feeds Consumed

The average daily gains and the amount of feed consumed by the respective lots are presented in Table 9. In analyzing these data, weighted averages were used in calculating the average gains and daily rations for the respective lots. A comparison of the average daily gains made by the lambs which received corn, ground threshed milo, feterita, kafir, and ground milo heads respectively in five tests, is also graphically illustrated by the horizontal bar chart in Figure 10. An illustration of the average daily gains made by the lots receiving corn, ground threshed

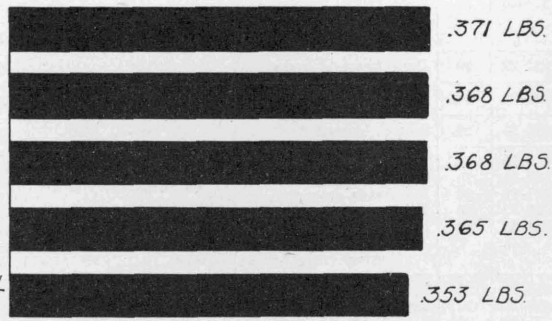

Fig. 10. Comparison of average daily gains made by lambs receiving ground shelled corn, ground threshed milo, ground threshed kafir, ground threshed feterita, or ground milo heads, supplemented with cottonseed meal and alfalfa hay, during five tests, 1919-1925.

milo and milo heads, ground threshed feterita and feterita heads, and ground threshed kafir and kafir heads, respectively, over a period of three tests—1920-21, 1921-22, and 1922-23—is presented graphically in Figure 11.

*All lots received chopped sumac fodder during first few days.

Table 9.—General summary, average daily ration and average daily gains. Five tests at Substation No. 7.

Year	No Lambs	Kind of Grain	Pounds	Cotton-seed Meal, Pounds	Alfalfa Hay, Pounds	Average Daily Gain, Pounds	Average Initial Weight, Pounds	Average Final Weight, Pounds
1919-20	20	Corn, ground shelled.....	1.08	.14	1.89	.39	60	95
1920-21	20	Corn, ground shelled.....	.88	.16	1.47	.31	50	78
1921-22	20	Corn, ground shelled.....	.95	.14	1.63	.36	55	92
1922-23	20	Corn, ground shelled.....	.95	.17	1.55	.40	50	86
1924-25	20	Corn, ground shelled.....	1.34	.15	1.29	.40	66	94
		Average (weighted)...	1.03	.15	1.58	.371	56	89
1919-20	20	Milo, ground threshed....	1.08	.14	1.89	.39	60	95
1920-21	20	Milo, ground threshed....	.88	.16	1.47	.31	50	79
1921-22	20	Milo, ground threshed....	.95	.14	1.62	.35	54	91
1922-23	20	Milo, ground threshed....	.98	.17	1.50	.38	50	85
1924-25	20	Milo, ground threshed....	1.39	.15	1.29	.41	65	93
		Average (weighted)...	1.04	.15	1.57	.368	56	89
1921-22	20	Milo, whole threshed.....	.95	.14	1.63	.33	56	91
1922-23	20	Milo, whole threshed.....	.99	.17	1.55	.40	50	86
		Average (weighted)...	.97	.15	1.59	.364	53	88
1919-20	20	Feterita, ground threshed..	1.08	.14	1.89	.36	59	91
1920-21	20	Feterita, ground threshed..	.88	.16	1.48	.31	51	79
1921-22	20	Feterita, ground threshed..	.95	.14	1.63	.33	56	91
1922-23	20	Feterita, ground threshed..	.99	.17	1.56	.41	48	85
1924-25	20	Feterita, ground threshed..	1.43	.16	1.31	.44	66	96
		Average (weighted)...	1.05	.15	1.59	.365	56	88
1919-20	20	Kafir, ground threshed....	1.08	.14	1.89	.37	59	92
1920-21	20	Kafir, ground threshed....	.88	.16	1.48	.32	51	79
1921-22	20	Kafir, ground threshed....	.95	.14	1.63	.35	55	92
1922-23	20	Kafir, ground threshed....	.99	.17	1.58	.41	49	85
1924-25	20	Kafir, ground threshed....	1.39	.15	1.28	.40	67	95
		Average (weighted)...	1.04	.15	1.59	.368	56	89
1921-22	20	Darso, ground threshed...	.95	.14	1.62	.334	55	90
1921-22	20	Sorgo, ground threshed....	.95	.14	1.63	.326	56	90
1922-23	20	Schrock, ground threshed..	.99	.17	1.61	.385	50	85
1919-20	20	Milo heads, ground.....	1.08	.14	1.89	.36	59	92
1920-21	20	Milo heads, ground.....	.88	.16	1.48	.31	51	79
1921-22	20	Milo heads, ground.....	.95	.14	1.61	.32	56	89
1922-23	20	Milo heads, ground.....	.99	.17	1.54	.38	49	84
1924-25	20	Milo heads, ground.....	1.48	.16	1.31	.41	66	95
		Average (weighted)...	1.05	.15	1.58	.353	56	88
1919-20	20	Feterita heads, ground....	1.08	.14	1.89	.34	60	90
1920-21	20	Feterita heads, ground....	.88	.16	1.47	.29	50	76
1921-22	20	Feterita heads, ground....	.95	.14	1.62	.31	56	88
1922-23	20	Feterita heads, ground....	.99	.17	1.58	.36	50	83
		Average (weighted).....	.97	.15	1.64	.325	54	85
1920-21	20	Kafir heads, ground.....	.88	.16	1.45	.28	50	76
1921-22	20	Kafir heads, ground.....	.95	.14	1.63	.30	55	86
1922-23	19	Kafir heads, ground.....	.99	.17	1 52	.35	48	80
		Average (weighted)...	.94	.15	1.59	.308	51	80

The average initial weight of the lambs included in the five tests was about 56 pounds. The average daily feed consumption throughout the feeding periods was grain 1 pound, cottonseed meal .15 pound, and alfalfa hay 1.6 pounds. It will be observed by reference to Table 9 that *only one test was made in a comparison of darso, schrock-kafir,* and sorgo with corn. In other instances the number of tests ranged from two to five. Accordingly, then, the reader is reminded when making comparisons between the various lots that the record made by darso, for example, in 1921-22 is comparable only to the 1921-22 test covering corn and the other grain sorghums studied during that particular year.

One of the most outstanding facts presented in Table 9 is that the average daily gains made by the lambs in the series of experiments were in the main uniform and quite consistent. In the series of five feeding

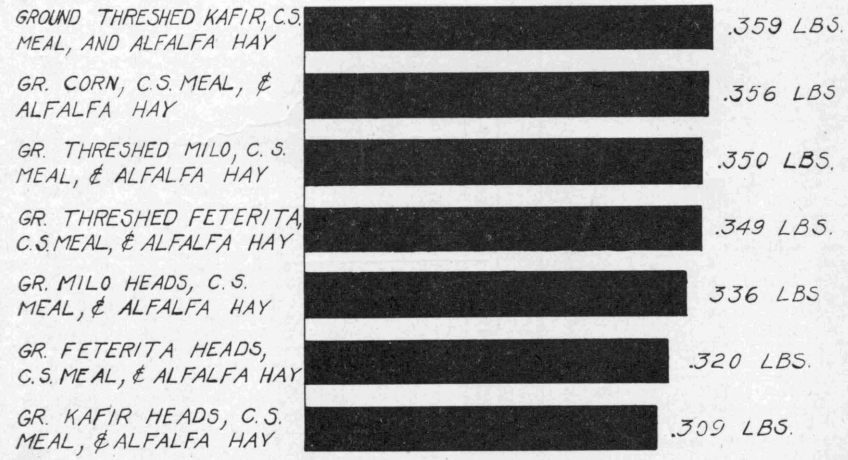

Fig. 11. Comparison of average daily gains made by lambs receiving ground threshed kafir, ground shelled corn, ground threshed milo, ground threshed feterita, ground milo heads, ground feterita heads, or ground kafir heads, supplemented with cottonseed meal and alfalfa hay, during three tests, 1920-21, 1921-22, and 1922-23.

tests, the lot receiving ground threshed milo stood first with the highest average daily gain per head in the 1919-20 test; the lots receiving ground threshed kafir stood first with the highest average daily gains in the 1920-21 and 1922-23 tests, respectively; the lot receiving ground shelled corn stood first in point of gain in the 1921-22 test; and the lot receiving ground threshed feterita stood first with highest honors in 1924-25. Figured on the basis of the weighted average daily gains including the five tests, corn ranked first, ground threshed milo and kafir tied for second place, ground threshed feterita ranked third, and ground milo heads fourth.

The standard deviations of the relative gains as shown in Table 10 were calculated and the probable error of the differences between the several lots figured. This analysis showed that there was no likelihood

Table 10.—Average daily gains made by five lots of lambs.

Grain (Kind)	Pounds						Relative Gains Per Cent					
	1919-20	1920-21	1921-22	1922-23	1924-25	Average†	1919-20	1920-21	1921-22	1922-23	1924-25	Average
Corn, shelled ground.	.393	.312	.355	.401	.403	.371	104.5	99.3	104.1	101.2	98.2	101.46 ± .85
Milo, threshed ground	.394	.314	.351	.385	.406	.368	104.8	100.0	102.9	97.2	99.0	100.78 ± .92
Feterita, threshed ground.....	.360	.312	.332	.406	.437	.365	95.7	99.3	97.3	102.5	106.5	100.26 ±1.30
Kafir, threshed ground.....	.372	.321	.352	.406	.396	.368	98.9	102.2	103.2	102.5	96.5	100.66 ± .86
Milo heads, ground..	.362	.311	.317	.383	.410	.353	96.2	99.0	92.9	96.7	100.0	96.96 ± .83
Average.....	.376	.314	.341	.396	.410	.....	.....	.....	.....	.....	.....	.....

†Weighted.

Table 11.—General summary, average amount of feed required per 100 pounds gain, five tests at Substation No. 7.

Year	No. Days on Feed	Grain		Cottonseed Meal, Pounds	Alfalfa Hay, Pounds
		Kind	Pounds		
1919–20	90	Corn, ground shelled	275	36	482
1920–21	90	Corn, ground shelled	281	50	472
1921–22	105	Corn, ground shelled	267	39	458
1922–23	90	Corn, ground shelled	246	42	386
1924–25	70	Corn, ground shelled	334	37	321
		Average	278	41	426
1919–20	90	Milo, ground threshed	274	36	481
1920–21	90	Milo, ground threshed	279	50	468
1921–22	105	Milo, ground threshed	270	40	461
1922–23	90	Milo, ground threshed	254	44	388
1924–25	70	Milo, ground threshed	342	38	318
		Average	282	41	426
1921–22	105	Milo, whole threshed	285	42	490
1922–23	90	Milo, whole threshed	247	42	386
		Average	266	42	437
1919–20	90	Feterita, ground threshed	300	39	526
1920–21	90	Feterita, ground threshed	289	50	473
1921–22	105	Feterita, ground threshed	285	42	490
1922–23	90	Feterita, ground threshed	244	42	384
1924–25	70	Feterita, ground threshed	327	36	299
		Average	286	42	434
1919–20	90	Kafir, ground threshed	290	38	509
1920–21	90	Kafir, ground threshed	273	49	461
1921–22	105	Kafir, ground threshed	270	40	463
1922–23	90	Kafir, ground threshed	244	42	389
1924–25	70	Kafir, ground threshed	351	39	324
		Average	282	41	432
1921–22	105	Darso, ground threshed	283	42	484
1921–22	105	Sorgo, ground threshed	291	43	500
1922–23	90	Schrock, ground threshed	257	44	417
1919–20	90	Milo heads, ground	298	39	523
1920–21	90	Milo heads, ground	282	50	475
1921–22	105	Milo heads, ground	299	44	508
1922–23	90	Milo heads, ground	259	44	401
1924–25	70	Milo heads, ground	361	40	320
		Average	298	43	448
1919–20	90	Feterita heads, ground	319	41	559
1920–21	90	Feterita heads, ground	304	54	511
1921–22	105	Feterita heads, ground	306	45	523
1922–23	90	Feterita heads, ground	271	46	432
		Average	299	46	505
1920–21	90	Kafir heads, ground	310	55	512
1921–22	105	Kafir heads, ground	319	47	546
1922–23	90	Kafir heads, ground	284	49	438
		Average	304	50	499

that any one of the threshed grains fed had any distinct advantage over the others in producing gains. Furthermore, this analysis reveals that the gains to be expected for lambs receiving ground milo heads on a pound for pound basis with threshed grain will nearly always be smaller than for those receiving the threshed grain.

Feed Required per 100 Pounds of Gain

The feed requirement per 100 pounds of gain for the corn lot, which was used as the standard in each of the five comparisons, was as follows:

1919-20 test, corn 275 pounds, cottonseed meal 36 pounds, alfalfa hay 482 pounds.

1920-21 test, corn 281 pounds, cottonseed meal 50 pounds, alfalfa hay 472 pounds.

1921-22 test, corn 267 pounds, cottonseed meal 39 pounds, alfalfa hay 458 pounds.

1922-23 test, corn 246 pounds, cottonseed meal 42 pounds, alfalfa hay 386 pounds.

1924-25 test, corn 334 pounds, cottonseed meal 37 pounds, alfalfa hay 321 pounds.

The average feed requirements per 100 pounds of gain for the five tests were: corn 278 pounds, cottonseed meal 41 pounds, and alfalfa hay 426 pounds. Table 11 shows that the feed requirements of the respective lots that stood first in point of gain during each of the years, were only very slightly below the feed requirement per 100 pounds of gain for the other lots which did not make the best gains. In the 1922-23 test, Lot 4, receiving ground threshed feterita, made only a slightly smaller gain than did Lot 5, which stood first that year in point of gain; yet this lot required 5 pounds less alfalfa hay per 100 pounds of gain than did the Lot 4 lambs.

The standard deviations of the relative amounts of concentrates consumed per 100 pounds of gain by the lots which received ground shelled corn, ground threshed milo, feterita, kafir, and ground milo heads, respectively, in the 1919-20, 1920-21, 1921-22, 1922-23, and 1924-25 tests were calculated from Table 12 and the probable errors of the differences between the several lots figured. This analysis showed that there were no significant differences in the concentrate requirement per 100 pounds of gain between the respective lots receiving ground shelled or threshed grain. The probable error of the difference was lowest between the ground threshed milo and kafir lots, it being only .38 times the difference while the highest, which was between the lots receiving corn and milo heads, showed the difference to be 6.8 times the probable error. The differences in the concentrate requirements between the milo heads lot and those which received ground shelled or threshed grain was significant.

A comparison of the feed requirement per 100 pounds of gain for the lambs receiving corn in the five Texas tests with results reported by

Table 12.—Concentrates consumed per 100 pounds of gain.

Grain (Kind)	Pounds						Percentage*					
	1919–20	1920–21	1921–22	1922–23	1924–25	Av.	1919–20	1920–21	1921–22	1922–23	1924–25	Average
Shelled corn and cottonseed meal	311	331	306	288	371	321.4	95.7	100.1	95.9	98.6	97.4	97.54 ± .56
Threshed ground milo and cottonseed meal	310	329	310	298	380	325.4	95.4	99.5	97.1	102.0	99.7	98.74 ± .77
Threshed feterita and cottonseed meal	339	339	327	286	363	330.8	104.3	102.5	102.4	97.9	95.3	100.48 ±1.13
Threshed kafir and cottonseed meal	328	322	310	286	390	327.2	100.9	97.4	97.1	97.9	102.4	99.14 ± .71
Ground milo heads and cottonseed meal	337	332	343	303	401	343.2	103.7	100.4	107.5	103.7	105.2	104.10 ± .78
Average	325	330.6	319.2	292.2	381							

*Based on average of five respective tests as 100.

Henry and Morrison* covering the work of eight stations with 26 lots including 527 lambs fed an unlimited allowance of shelled corn and either alfalfa or clover hay over periods averaging 90 days, shows that the feed requirement per 100 pounds of gain was 12 per cent larger than it was in the Texas experiments. The average daily gain made by the Texas-fed lambs ranged from .04 to .05 higher per head daily than the Northern-fed lambs, which accounts in part for this difference.

The average gains made by the lambs constituting the several lots in the five experiments and the feed consumed in producing them during the 70- to 105-day periods are shown in Table 13. A good feeder lamb receiving a properly balanced ration should gain between .3 and .4 pound daily throughout the entire feeding period. This table shows that the total gains ranged between 17.5 pounds (made by the small lambs fed cottonseed and cottonseed hulls in the 1924-25 test) and 37 pounds. The total gain made during the 90-day periods by lambs fed grain, cottonseed meal, and alfalfa hay averaged around 33 pounds per head, feed-lot basis.

The feed required to produce a gain of 28 to 35 pounds according to these tests ranged from 79 to 100 pounds of grain, 10.5 to 15 pounds of cottonseed meal, and 90 to 170 pounds of alfalfa hay. With the exception of the 1919-20 test, when the waste hay was not deducted, the amount of alfalfa hay represented in Table 13 is that which was actually consumed. In all other instances the waste, or rejected hay which averaged 3 to 27 pounds per lamb during the feeding period, was deducted from the original amount fed.

Ground Heads and Ground Threshed Sorghum Grain Compared

The prospective feeder is frequently confronted with the question as to whether the ground threshed grain or the ground grain sorghum heads can be most economically utilized in his lamb-feeding operations. Since there is approximately 33 per cent more grain in a ton of threshed milo, for example, than in a ton of well matured milo heads, the price per ton for the threshed grain should figure about 33 per cent above the actual value of a ton of milo heads, provided the pomace is quite worthless. As an illustration, if threshed milo is worth $40 per ton, the headed grain should not be priced higher than $30.

In the five tests conducted by this Station, the average total amount of feed consumed by the lambs receiving ground milo heads was 789 pounds as compared with 749 pounds by the lot receiving ground threshed milo per 100 pounds of gain. The lambs fed milo heads consumed approximately 5 per cent more grain including pomace; however, if 25 per cent, which is the approximate amount of head steams or pomace, is deducted from the total weight of ground milo heads consumed per 100 pounds of gain, it will be observed that the lambs re-

*Feeds and Feeding, by Henry & Morrison, 18th Edition, page 550.

Table 13.—General summary showing average amount of feed consumed per lamb in making gains ranging from 17 pounds to 37 pounds during feeding periods of 70 to 105 days, at Substation No. 7.

Year	No. Days on Feed	Grain		Cotton-seed Meal, Pounds	Roughage		Average Gain Per Lamb, Feed-lot Basis, Lbs.
		Kind	Pounds		Kind	Pounds	
1919–20	90	Ground shelled corn	97	13	Alfalfa hay	170	35
1920–21	90	Ground shelled corn	79	14	Alfalfa hay	132	28
1921–22	105	Ground shelled corn	100	15	Alfalfa hay	171	37
1922–23	90	Ground shelled corn	89	15	Alfalfa hay	139	36
1924–25	70	Ground shelled corn	94	10	Alfalfa hay	91	28
1919–20	90	Ground threshed milo	97	13	Alfalfa hay	170	35
1920–21	90	Ground threshed milo	79	14	Alfalfa hay	132	28
1921–22	105	Ground threshed milo	100	15	Alfalfa hay	170	37
1922–23	90	Ground threshed milo	88	15	Alfalfa hay	135	35
1924–25	70	Ground threshed milo	97	11	Alfalfa hay	90	28
1921–22	105	Whole threshed milo	100	15	Alfalfa hay	171	35
1922–23	90	Whole threshed milo	89	15	Alfalfa hay	139	36
1919–20	90	Ground threshed feterits	97	13	Alfalfa hay	170	32
1920–21	90	Ground threshed feterita	79	14	Alfalfa hay	133	28
1921–22	105	Ground threshed feterita	100	15	Alfalfa hay	168	35
1922–23	90	Ground threshed feterita	89	15	Alfalfa hay	140	37
1924–25	70	Ground threshed feterita	100	11	Alfalfa hay	92	31
1919–20	90	Ground threshed kafir	97	13	Alfalfa hay	170	34
1920–21	90	Ground threshed kafir	79	14	Alfalfa hay	133	29
1921–22	105	Ground threshed kafir	100	15	Alfalfa hay	171	37
1922–23	90	Ground threshed kafir	89	15	Alfalfa hay	142	37
1924–25	70	Ground threshed kafir	97	11	Alfalfa hay	90	28
1921–22	105	Ground threshed darso	100	15	Alfalfa hay	170	35
1921–22	105	Ground threshed sorgo	100	15	Alfalfa hay	171	34
1922–23	90	Ground threshed schrock	89	15	Alfalfa hay	144	35
1919–20	90	Ground milo heads	97	13	Alfalfa hay	170	33
1920–21	90	Ground milo heads	79	14	Alfalfa hay	133	28
1921–22	105	Ground milo heads	100	15	Alfalfa hay	169	33
1922–23	90	Ground milo heads	89	15	Alfalfa hay	138	34
1924–25	70	Ground milo heads	104	12	Alfalfa hay	92	29
1919–20	90	Ground feterita heads	97	13	Alfalfa hay	170	30
1920–21	90	Ground feterita heads	79	14	Alfalfa hay	133	26
1921–22	105	Ground feterita heads	100	15	Alfalfa hay	170	32
1922–23	90	Ground feterita heads	89	15	Alfalfa hay	142	33
1920–21	90	Ground kafir heads	79	14	Alfalfa hay	131	26
1921–22	105	Ground kafir heads	100	15	Alfalfa hay	171	31
1922–23	90	Ground kafir heads	89	15	Alfalfa hay	137	31
1920–21	90	Ground threshed milo	33	55*	Alfalfa hay	134	31
1922–23	90	Ground threshed milo	52	53*	Alfalfa hay	132	35
1920–21	90	Ground milo heads	74	14	Sorghum hay	127	23
1924–25	70	Ground milo heads**	120	14	Alfalfa hay	149	29
1924–25	70	Ground milo heads	93	40	Cottonseed hulls	147	25
1924–25	70			41	Cottonseed hulls	183	22
1924–25	70	Cottonseed	37	13	Cottonseed hulls	92	17

*Cottonseed.
**Yearling wethers.

ceiving the ground threshed milo consumed 33 per cent more actual grain than did the lambs which received the milo heads.

In the feeding of grain sorghums to fattening lambs, these experiments herein reported point to the conclusion that milo heads finely ground can be more economically utilized than the ground threshed grain. The lambs receiving ground feterita heads and kafir heads failed to make as economical a gain as those which received the milo heads but did better in proportion to the actual amount of grain they received than did the corresponding lots which received the ground threshed feterita and the ground threshed kafir. These results indicate clearly that the ground head stem or pomace has considerable actual feeding value. Whether that is due entirely to the feed nutrients in the pomace, or partly to the action of the ground pomace in improving the physical character of the ration, or to other causes may still be open to speculation.

Shrinkage and Slaughter

Table 14 shows that the shrinkage of the lambs in shipment from Spur to Fort Worth, a distance of about 343 miles, varied from 9.7 to 12.6 per cent at the conclusion of the 1922-23 test. The shrinkage during shipment of the lambs fed in 1924-25 varied from 4.7 to 9.4 per cent. This difference is attributed to the fact that the 1922-23 lambs were late in arriving on the market and were sold and weighed before they had an opportunity to take a fill, while on the other hand the 1924-25 lambs arrived in time to take a good fill. The yearling wethers in the 1924-25 test shrank only 3.1 per cent in shipment. Of the lambs in the 1922-23 test, the lot which received ground threshed milo had the smallest shrinkage in shipment while the ground kafir head lot shrank the highest. Of those in the 1924-25 test, the corn-fed lot had the lowest shrinkage, while the cottonseed meal and hull lot shrank the heaviest in shipment.

The standard deviations of the relative shrinkages of the lots which received corn, ground threshed milo, feterita, kafir, and ground milo heads, respectively, in the 1920-21, 1921-22, 1922-23, and 1924-25 tests were calculated from Table 15 and the probable errors of the differences between the several lots figured. This analysis showed that there did not seem to be any tendency for any group receiving any kind of threshed or shelled grain to shrink any more than any other in shipment to market.

The dressing percentages of the respective groups are also shown in Table 14. The lambs in the 1922-23 test which received ground threshed kafir and ground threshed feterita dressed 49.3 and 47.9 per cent, respectively. These two lots tied for second place in the grading of the carcasses of all lots—Lot 1, which received ground threshed milo, standing first according to the packer's rating. The lambs which received ground kafir heads showed the lowest dressing record among the lots fed in 1922-23. In the 1924-25 test, the lambs which received

Table 14.—Shrinkage in transit and slaughter data. Four years' experiments.

Grain	Year	Shrinkage in Shipment		Average Weight Dressed Carcasses, Pounds	Dressing, Per Cent		Average Weight Internal Fat, Lbs.	Average Weight Pelts, Pounds
		Per Head, Pounds	Per Cent		Basis Feed-lot Weights	Basis Market Weights		
Ground shelled corn	1920–21	4.33	5.53	32.4	41.4	43.8	.....	.....
Ground shelled corn	1921–22	6.97	7.58	41.1	44.7	48.3	.....	.....
Ground shelled corn	1922–23	9.52	11.07	37.7	43.8	49.3	.....	.....
Ground shelled corn	1924–25	4.46	4.7	43.6	46.1	48.4	2.45	14.90
Ground threshed milo	1920–21	7.63	9.7	31.1	39.6	43.8	.....	.....
Ground threshed milo	1921–22	6.83	7.48	40.2	44.0	47.6	.....	.....
Ground threshed mio	1922–23	8.21	9.66	37.56	44.2	48.9	.....	.....
Ground threshed milo	1924–25	4.85	5.2	44.1	47.2	49.8	2.15	14.50
Whole threshed milo	1921–22	6.87	7.52	42.6	46.6	50.4	.....	.....
Whole threshed milo	1922–23	10.06	11.76	37.16	43.4	49.2	.....	.....
Ground threshed feterita	1920–21	4.57	5.82	32.3	41.1	43.6	.....	.....
Ground threshed feterita	1921–22	8.77	9.66	40.0	44.1	48.8	.....	.....
Ground threshed feterita	1922–23	10.1	11.90	35.80	42.2	47.9	.....	.....
Ground threshed feterita	1924–25	5.92	6.1	44.8	46.5	49.5	2.15	16.75
Ground threshed kafir	1920–21	3.98	5.01	32.9	41.4	43.6	.....	.....
Ground threshed kafir	1921–22	5.40	5.84	43.5	47.1	50.0	.....	.....
Ground threshed kafir	1922–23	10.08	11.81	37.07	43.4	49.3	.....	.....
Ground threshed kafir	1924–25	5.78	6.1	43.7	46.2	49.2	2.10	15.75
Ground threshed darso	1921–22	8.37	9.31	38.5	42.8	47.2	.....	.....
Ground threshed sorgo	1921–22	9.2	10.2	38.6	42.8	47.6	.....	.....
Ground threshed schrock	1922–23	10.38	12.19	35.89	42.2	48.0	.....	.....
Ground milo heads	1920–21	5.63	7.16	31.1	39.6	42.6	.....	.....
Ground milo heads	1921–22	9.03	10.14	38.0	42.7	47.5	.....	.....
Ground milo heads	1922–23	9.34	11.14	35.89	42.8	48.2	.....	.....
Ground milo heads	1924–25	6.36	6.7	42.9	45.2	48.5	2.00	14.90
Ground milo heads, yr. wethers	1924–25	3.68	3.1	57.3	48.5	50.0	2.68	17.05
Ground feterita heads	1920–21	5.43	7.1	30.0	39.3	42.3	.....	.....
Ground feterita heads	1921–22	7.83	8.86	37.5	42.5	46.6	.....	.....
Ground feterita heads	1922–23	10.24	12.30	35.11	42.2	48.1	.....	.....
Ground kafir heads	1920–21	4.70	6.21	34.4	45.4	48.5	.....	.....
Ground kafir heads	1921–22	6.37	7.42	36.1	42.0	45.4	.....	.....
Ground kafir heads	1922–23	10.00	12.54	32.89	41.2	47.2	.....	.....
Ground threshed milo and cottonseed	1920–21	7.61	9.41	33.2	41.0	45.3	.....	.....
Ground threshed milo and cottonseed	1922–23	8.56	10.18	37.80	45.0	50.1	.....	.....
Milo heads, cottonseed meal and sorghum hay	1920–21	4.60	6.28	29.5	40.3	43.0	.....	.....
Ground milo heads and cottonseed hulls	1924–25	8.62	8.5	48.1	47.4	51.8	2.47	10.50
Cottonseed meal and hulls	1924–25	9.74	9.4	41.4	40.1	44.3	1.59	17.58

Table 15.—Shrinkage during shipment to market.

Grain (Kind)	Shrinkage Per Head					Relative Shrinkage, Per Cent				
	1920-21	1921-22	1922-23	1924-25	Average	1920-21	1921-22	1922-23	1924-25	Average
Corn, shelled	4.33	6.97	9.52	4.46	6.32	83	94	101	81	89.75 ±3.18
Milo, ground	7.63	6.83	8.21	4.85	6.88	146	92	87	89	103.5 ±9.58
Feterita, ground	4.57	8.77	10.1	5.92	7.34	87	119	107	108	105.25 ±4.49
Kafir, ground	3.98	5.40	10.08	5.78	6.31	76	73	107	106	90.5 ±6.25
Milo heads, ground	5.63	9.03	9.34	6.36	7.59	108	122	99	116	111.25 ±3.37
Average	5.228	7.4	9.45	5.474	.....	.....	.....	.....	.....	.....

ground threshed milo dressed 49.8 per cent, while the cottonseed meal and hulls group only dressed 44.3 per cent. The cross bred lambs which received ground milo heads, cottonseed meal, and cottonseed hulls showed a dressing record of 51.8 per cent, but this is not comparable with the other lots owing to the fact that this was a lighter-pelted group, since they were sheared at the beginning of the feeding test. The yearling wethers dressed 50 per cent. The dressed yield of the respective lots with the exception of the lot which received ground threshed feterita in 1922-23 were remarkably uniform in the 1922-23 and 1924-25 tests. The weight of internal fat, comprising caul and ruffle, were recorded for the first time in the 1924-25 test. In this test the lambs which received corn carried 14 per cent more internal fat than those fed on ground threshed milo and feterita, respectively. These data including pelt weights are recorded in Table 14. The heavier weight of the pelts of the lambs fed cottonseed meal and cottonseed hulls over those from the yearlings is accounted for by the fact that the lambs were dropped not later than February, 1924, and were carrying approximately 12 months' growth of wool, whereas the yearling wethers were carrying only approximately nine months' fleeces.

Productive Energy Values of Sorghum Grain

The productive values of the grain used in this series of five lamb-feeding experiments were calculated by Dr. G. S. Fraps, Chief of the Division of Chemistry. According to Fraps,* the productive value of a feed is the best measure so far devised of the net value of a feed for the production of fat, heat, energy, or similar purposes. Rations have heretofore most generally been calculated under the assumption that all digestible nutrients of the same group have the same value to the animal regardless of the origin of the material. It is now known, however, that the net energy value of a feed may vary widely from its value based upon the digestible nutrients and that the value of a feed for the purpose of producing energy is best measured by its productive value. As an illustration, one pound of digested material from corn is worth more to an animal than one pound of digested material from alfalfa hay.

The productive value of the grain sorghums was expressed in terms of fat in the first lamb-feeding test;† however, in the later trials these values have been expressed in therms.

To ascertain the productive value of a feed from feeding experiments, it is necessary to take one feed as a standard, to calculate the productive value of the other feeds compared with this feed, and to assume a definite maintenance requirement for the animal. In these lamb feeding experiments, corn was taken as the unit. The productive values of cottonseed meal and alfalfa hay were calculated, the coefficients used being those given in "Principles of Agricultural Chemistry" by Fraps, page 434,

*Principles of Agricultural Chemistry, page 434.
†Texas Station Bulletin 269.

Texas Station Bulletins Nos. 185, 203, and 329, and the maintenance requirements given in Armsby's "Principles of Animal Feeding." Although the above assumptions may be claimed to lead to some uncertainty, yet comparative results should be secured since these figures are also used in comparing other feeds with a standard. This is especially true if there is little difference between the quantity of the additional feeds fed, and no significant difference in the average weights of the animals used.

A comparison of the productive energy values secured in the five feeding experiments with lambs at Substation 7, Spur, is given in Table 16. The "calculated" values in this table were calculated from the actual chemical composition of the feeds fed and the production coefficients given in Texas Station Bulletins Nos. 185 and 329. The calculated productive values based on the composition of the feeds used in these experiments are shown for each year in the column to the left of those showing the therm values actually found from the experiments. These calculated values were based upon the average results found in digestion experiments, and we can expect to find variations from these averages in individual cases, especially since the average is made up from deviating figures. The feeding tests herein described give us data to correct the calculated values, and to ascertain how nearly they represent the correct figures. In other words, the production* coefficients secured by digestion experiments can be tested by feeding trials and corrected if necessary.

The method of calculation of the productive energy of the grain sorghum used in the 1922-23 experiment is given in Table 17. The maintenance requirement of the lambs was assumed (after Armsby) as .933 therms per 100 pounds of average live weight. The therms required for one pound of gain in weight in Lot 1, which received ground shelled corn, were 2.294. The therms required for one pound of gain in weight for the corn lot in the 1924-25 test were 2.63.

The productive values calculated for the grain sorghums utilized in the 1922-23 test were quite consistent for the ground threshed grain but somewhat inconsistent for the ground grain sorghum heads.

Statistical analyses by Fisher's† modified method were employed in a study of the productive values of the grain fed as calculated by Dr. Fraps from the actual feed-lot gains. These analyses showed that the productive values calculated for the same feed in different experiments were slightly more consistent than were either the daily gains or the feed required per hundred pounds of gain. This seems to show that the productive value is a more accurate indicator of the real feeding worth of a feed than is either the daily gain or the economy of gain, this in spite of the admitted fact that several assumptions in regard to main-

*Certain corrections based on the results of these feeding tests have been published in Texas Station Bulletin No. 329 entitled "Energy Production Coefficients of American Feeding Stuffs" by Fraps.

†Statistical Methods for Research Workers.

Table 16.—Comparison of productive values of sorghum grain expressed in therms of net energy per 100 pounds of feed.

(Calculated from composition of feeds used and actual gains made in lamb-feeding tests.)

	Therms												Productive Value found Compared with Corn as 100
	1919—20		1920—21		1921—22		1922—23		1924—25		Average		
	Calculated	Found from Test	Calculated	Found from Test	Calculated	Found from Test	Calculated	Found from Test	Calculated	Found from Test	Calculated	Found from Test	
Ground shelled corn	87.82	.....	86.35	.....	87.74	.....	86.07	.....	86.11	.....	86.8	.....	100
Ground threshed milo	76.3	88.25	76.0	87.21	78.8	86.91	79.1	84.28	79.3	82.66	77.9	85.9	99
Ground threshed feterita	81.7	77.11	79.7	86.30	83.3	83.12	83.7	84.85	84.2	86.29	82.5	83.5	96
Ground threshed kafir	80.5	80.53	79.7	88.92	81.1	87.55	81.4	84.44	86.7	81.94	81.9	84.7	98
Whole threshed milo	.....	.....	.....	.....	85.0	82.7	84.1	80.05	.....	.....	84.5	81.4	94
Ground threshed darso	.....	.....	.....	.....	87.7	81.77	.....	.....	.....	.....	87.7	81.8	94
Ground threshed schrock	.....	.....	.....	.....	.....	.....	80.0	79.39	.....	.....	80.0	79.4	91
Ground threshed sorgo	.....	.....	.....	.....	79.5	80.28	.....	.....	.....	.....	79.5	80.3	92
Ground milo heads	76.7	77.11	75.2	86.07	78.1	77.95	77.7	80.51	79.2	77.97	77.4	79.9	92
Ground feterita heads	76.6	70.68	75.8	79.46	77.7	75.42	76.3	74.85	.....	.....	76.6	75.1	87
Ground kafir heads	.....	.....	67.0	77.29	68.1	70.88	66.3	70.40	.....	.....	67.1	72.8	84

Table 17.—Calculation of productive values of grain sorghums used in 1922-23 feeding experiment with lambs.

	Corn Chops, Lot 1	Whole Milo, Lot 2	Milo Chops, Lot 3	Feterita Chops, Lot 4	Kafir Chops, Lot 5	Schrock Chops, Lot 6	Ground Milo Heads, Lot 7	Ground Feterita Heads, Lot 8	Ground Kafir Heads, Lot 9
Initial weight A	49.96	49.50	50.28	48.34	48.77	50.48	49.39	50.38	48.46
Final weight F	86.02	85.56	84.96	84.85	85.33	85.13	83.84	83.24	79.78
Total weight A+F=C	135.98	135.06	135.24	133.19	134.10	135.61	133.23	133.62	128.24
Average for period C÷2=W	67.99	67.53	67.62	66.60	67.05	67.81	66.61	66.81	64.12
Average daily gain G	0.401	0.401	0.385	0.406	0.406	0.385	0.383	0.365	0.348
Average daily ration:									
Grain N	0.98	0.99	0.98	0.99	0.99	0.99	0.99	0.99	0.99
Cottonseed meal	0.168	0.169	0.168	0.169	0.169	0.169	0.169	0.169	0.169
Alfalfa hay	1.54	1.55	1.50	1.56	1.58	1.60	1.54	1.58	1.52
Productive energy therms—Grain E	0.85								
Productive energy C. S. Meal R	0.125	0.126	0.125	0.126	0.126	0.126	0.126	0.126	0.126
Productive energy Alfalfa Hay U	0.58	0.58	0.56	0.59	0.60	0.60	0.58	0.59	0.57
Total productive value E+R+U=T	1.55								
Productive value of supplement R+U=S	0.70	0.71	0.68	0.72	0.73	0.73	0.71	0.72	0.70
Maintenance requirement W×H=M	0.63	0.63	0.63	0.62	0.63	0.63	0.62	0.62	0.60
Productive balance standard ration (available for gain) T—M=B	0.92								
Therms for 1 pound gain B÷G=K	2.29								
Therms for daily gain K×G=L		0.92	0.88	0.93	0.93	0.88	0.88	0.84	0.80
Total value of ration in therms M+L=O		1.55	1.51	1.55	1.56	1.51	1.50	1.46	1.40
Value of grain in therms O—S=X		0.84	0.83	0.83	0.83	0.78	0.79	0.74	0.70
Productive value 100 pounds gain, therms, X÷N×100		85.05	84.29	84.85	84.44	79.39	80.51	74.85	70.40

H=0.00933 therms.

tenance requirement, composition of the increase, etc., must be made in order to calculate net energy values by Dr. Fraps' method.

LAMB-FATTENING HINTS FOR BEGINNERS

The most desirable weight of feeder lambs at the time of being placed in the feed lot ranges between 55 and 65 pounds. Since normal feeder lambs will gain around 10 pounds per month or 30 pounds during a 90-day feeding period, the inexperienced feeder should, before purchasing his lambs, take an inventory of his feed supply. If an ample supply of feed is available to carry the lambs over a period of 90 to 100 days on full feed, the feeder should endeavor to purchase lambs averaging around 55 pounds. There is a tendency on the part of the consuming public to discriminate against heavy-weight lambs; therefore, the safest plan for the beginner to pursue is to figure on placing the finished lambs on the market at a weight averaging not over 85 pounds. When the lambs average 90 pounds and upwards there is a general tendency for the buyers to discriminate against them, in such instances paying $1.00 to $2.00 per hundred pounds liveweight under the price paid for the more desirable lighter weights.

The Type of Feeder Lamb Desired

Since the finewool breeds (Rambouillets and Delaines) constitute upwards of 90 per cent of all sheep within the State of Texas, the finewool type of feeder lamb will be considered. The most desirable feeder type is comparatively free from skin folds or wrinkles. Feeder buyers and packer buyers discriminate against a type of lamb with many skin folds because as a general rule these dress out a lower percentage of carcass due (1) to the heavy pelt, and (2) to the fact that this heavy-folded type does not usually finish as highly as do the smoother-bodied, lighter-pelted kinds.

Time Required to Fatten

The length of the fattening period will vary, depending upon two main factors: (1) the size and general condition of fleshing of the lambs at the time they are placed on feed, and (2) the ability of the feeder to supply a ration that will produce maximum gains upon the lambs over the feeding period, whether it be 40 days or 90 days. Inexperienced feeders are inclined to confuse size and finish. Many of them are inclined to mistake an 85-pound half-fat lamb as being more nearly ready for the killer than the highly finished one weighing between 70 and 75 pounds. Finish is indicated by depth and uniformity of fleshing over the ribs and back. In handling the back and ribs of the half-fat or unfinished lamb, it will be readily observed that there is but very little fleshing between the hide and the ribs and backbone. The successful lamb feeder has learned to distinguish between a lamb that is ready for the shambles and one that is only well warmed up. He has had this to do since ultimate success or failure in the lamb-feeding business depends

very largely upon knowing when the lambs are ready to sell. Lambs marketed 30 or 40 days before they are ready for the killer most usually entail a loss of $1.50 to $2.50 per hundred pounds liveweight based on current market quotations.

Supplementary Grazing

Experienced lamb feeders have achieved considerable success in giving the feeder lambs access to the corn or grain sorghum field during the first several weeks of the fattening period. This method can well be practiced by those who are familiar with the best methods of managing the lambs in the fields, but it is not recommended that this method be followed on a large scale—at least by the beginner—until the most successful methods of management have been more fully determined. Feeder lambs will make some very economical as well as substantial gains in the grain sorghum field providing a suitable high protein supplement is supplied. In the corn belt soy beans or peas which have been planted between the rows supply the necessary protein. However, the practice of planting these legumes between the grain sorghum rows has not yet become at all general in West Texas, and possibly will not unless a drouth-resistant variety can be developed. Pea-size cottonseed cake should by all means be supplied to lambs having access to the grain sorghum fields, the average daily allowance per head being between .15 and .25 pound. Shelter should be provided to protect the flock from inclement weather, during which time the flock should not have access to the fields.

Method of Adjusting Ration

In fattening lambs on dry lot it has always been the practice of the Texas Station to feed them on a minimum amount of concentrates during the first ten days of the feeding period, at the same time supplying them with all the hay they will consume. Then after being on a preliminary ration for a week or ten days, the concentrates are gradually increased in accordance with the appetite as the feeding period progresses. Ordinarily, cottonseed meal should constitute approximately 12 per cent of the concentrates when a leguminous kind of roughage such as alfalfa hay is being fed; however, when a non-leguminous kind such as kafir, milo, or feterita stover is being fed, the proportion of cottonseed meal should constitute 15 to 20 per cent of the concentrate portion of the ration. Cottonseed meal should not constitute the entire concentrate feed, but should always be supplemented preferably with grain sorghums or corn in order to get the best results. Oats may be fed in limited quantities during the early part of the feeding period and especially if the lambs are stunted or undersized. However, oats cannot be recommended as a substitute for corn or the grain sorghums for fattening purposes and these last-named feeds should entirely replace the oats during the last 50 days of a feeding period. The lambs should be fed concentrates twice daily at regular intervals. They will clean up their

grain in a period of 20 minutes to one-half hour. Any lambs that fail to go to the trough are probably off feed and the feeder should not fail to be observant as to the number that do not eat their grain. Overfeeding is likely to be one of the causes of this condition.

The feeding yards should be located on sloping land in order to afford good drainage. Figure 3 is an illustration of a feeding plant that will accommodate 2000 lambs and will perhaps serve a useful purpose as a guide for prospective feeders in planning their feeding yards. Those who plan to feed only one hundred to two hundred and fifty lambs need not go to much expense in fitting up a feeding yard. The chief item of expense in such an instance would be the construction of grain

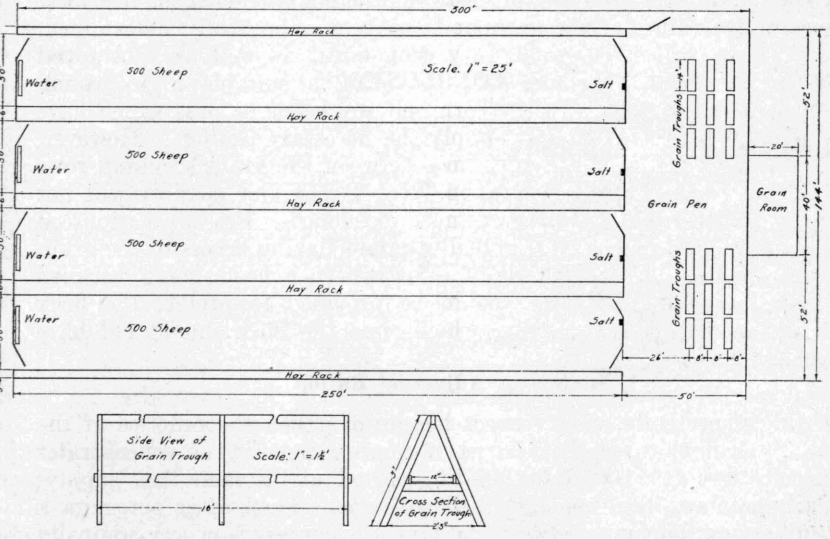

Fig. 12. Sample plan of feeding yards and grain troughs adapted for two thousand lambs. One pen at a time is given access to the troughs for 15 or 20 minutes, the approximate time required for the lambs to consume the concentrate feed.

roughs. Ordinarily one linear foot is allowed per lamb when figuring upon the number of grain troughs to make. A trough twelve or fourteen inches wide and 20 feet long will accommodate 40 lambs. In instances where a large number of lambs are fed, the grain feeding pen as illustrated in Figure 12 need only be of sufficient size to accommodate, for example, 500 lambs at one time, since the customary plan is to alternately give the lambs from the respective hay lots access to the grain lot. The hay racks, which need not be more than three feet in height, may be constructed of inexpensive material with sufficient space between the two lower boards to allow the lambs to put their heads through to get access to the hay. The hay which should be accessible at all times should be pushed toward the racks by the feeder several times a day. An ample

supply of fresh water should be accessible at all times. Salt should also be available throughout the entire feeding period.

ACKNOWLEDGMENTS

The authors are appreciative of the efficient service rendered by Mr. J. H. Jones, now of Swift & Company, Fort Worth, Texas, in the feeding of the lambs in the 1922-23 experiment; the helpful assistance rendered by our colleague, Dr. J. L. Lush, in the statistical analyses of feeds involved; the assistance given by Professor A. K. Mackey of the Department of Animal Husbandry in helping to summarize the five experiments; and the helpful contribution of Dr. G. S. Fraps, Station Chemist, in the analyses of feeds used and in the calculation of the productive values of the grain fed.

CONCLUSIONS

1. Ground shelled corn, ground threshed milo, ground threshed kafir, and ground threshed feterita utilized in the five tests had approximately the same feeding value. Figured on the basis of average daily gains the grains ranked in the following order: corn first with an average daily gain of .371 pound; ground threshed milo and ground threshed kafir tied for second place with an average daily gain of .368 pound; while ground threshed feterita ranked next with an average daily gain of .365 pound.

2. Ground milo heads ranked highest among the ground head grains, producing an average daily gain of .353 pound per head over the five-year period; ground feterita heads and kafir heads stood second and third, respectively, with respect to rate of gains produced.

3. Ground threshed milo when compared with whole threshed milo in two tests (1921-22 and 1922-23) proved slightly superior, the average daily gain per head made by the lambs receiving the ground grain being .367 pound as compared with .364 pound per head daily made by those receiving whole threshed milo. This phase of the study must be continued further.

4. The lambs receiving corn gained .79 per cent more than those fed ground threshed milo, .86 per cent more than those fed ground threshed kafir, 1.53 per cent more than those fed ground threshed feterita, and 5.05 per cent more than those fed ground milo heads.

5. The lambs receiving the ground threshed or shelled grain made on the average larger daily gains than those receiving the ground heads. However, in the 1924-25 experiment when the ground milo heads were fed in accordance with appetite, the lambs receiving the ground milo heads made a slightly larger gain than those receiving corn, ground threshed milo, and ground threshed kafir.

6. Although the lambs receiving ground heads required more pounds of both ground heads and roughage to produce 100 pounds of gain than did the lots receiving the ground shelled or threshed grain, after the