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COLORADO DRYLAND FATTENING RATIONS FOR LAMBS

By H. B. OSLAND, E. J. MAYNARD and J. F. BRANDON

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COLORADO DRYLAND FATTENING RATIONS FOR LAMBS

By H. B. OSLAND, E. J. MAYNARD and J. F. BRANDON

Altho the lamb-feeding industry has not occupied a primary place in Eastern Colorado's agriculture, the extensive development in production of grain and forage crops offers good opportunities for feeding livestock. The non-irrigated sections of Colorado produce 91 percent of the corn, 94 percent of the winter wheat, 69 percent of the spring wheat and 72 percent of the barley which is grown within the state. In addition to these grains, East Central and Northwestern Colorado produce about 129,000 acres of millet. Approximately two-thirds of this acreage is cut for hay or pastured, the remainder being harvested for seed.

Carbonaceous forage crops such as cane, corn, millet and sudan grass provide the surest crops for Eastern Colorado. These roughages and grains produced in the non-irrigated section are carbohydrate feeds and therefore comparatively low in protein content. Alfalfa which forms the backbone of Colorado lamb-feeding industry cannot be grown in any large amounts in Eastern Colorado. However, some good protein supplement is necessary to produce the cheapest gains on both growing and fattening stock, and at the present time, there is no dependable source of home-grown protein among the feeds produced in non-irrigated Eastern Colorado. Sudan grass and a few other minor crops which are comparatively high in protein provide a possibility as a partial substitute for alfalfa; however, it appears as tho shipped-in standard protein concentrates are necessary to balance Eastern Colorado fattening rations. Flax, soybeans and pinto beans are grown in that section of Colorado and chemically they contain a sufficient percentage of protein to balance the ration but experience has taught us their shortcomings.

Pinto beans analyzing 19.47 percent protein, were fed to lambs at the Colorado Experiment Station. It was found that they were very unpalatable to the lambs especially when fed alone. The test showed that beans should be mixed with other grain when fed to lambs. It was also found that they are apt to cause scouring, especially when first fed.

Experimental work at the Ontario Station has shown that the protein in beans is of low quality and not readily utilized by the body. The Illinois Station reports that soybeans are a good supplement for growing and fattening lambs. Soybeans contain 33.2 percent protein. The Illinois Station found no advantage in grinding the soybeans and also stated that ground or whole soybeans are not as palatable as soybean oilmeal.

Climatic conditions appear favorable for growing soybeans in Eastern Colorado but only moderate success has been had with them. They do not germinate in cold soil; the season is none too long for present known varieties; they are very susceptible to hail injury; and jack rabbits, if present in the region, cause heavy pasturing damage.

Flax, which contains 20.6 percent protein, has not been used to any great extent as a protein supplement in the fattening ration because of its relatively high market value and also because of the care which is necessary in feeding it to avoid digestive disturbances. Furthermore, flax is not widely adapted over Northeastern Colorado except on newly turned sod land. Some success with the crop on old land is being had in Northern Weld County at the higher altitudes. Flax, however, does offer a possibility as a protein supplement and the Colorado Experiment Station is trying to determine its value in the 1931-32 experimental line-up.

Sudan grass is well adapted for growing in the Northeastern Colorado region. Recent chemical analyses of sudan grass cut green up to the heading stage and cured without leaching show approximately 12 percent protein (unpublished data at Colorado Experiment Station, Agronomy Department). Sudan grass, therefore, offers possibilities as a partial protein supplement for feeding operations in Northeastern Colorado.

Cottonseed meal and linseed oilmeal are very efficient high-protein feeds and fit well into the lamb-fattening rations. These protein feeds can usually be depended upon to decrease production cost if used correctly in the ration. Only small amounts of these feeds need to be fed because of their high protein concentration.

Results secured in fattening pigs would seem to indicate that certain mixtures of protein feeds are more economical than a single protein concentrate. The same may be true when they are used for fattening lambs and it may be possible to substitute some of the commercial protein concentrates with home-grown feeds.

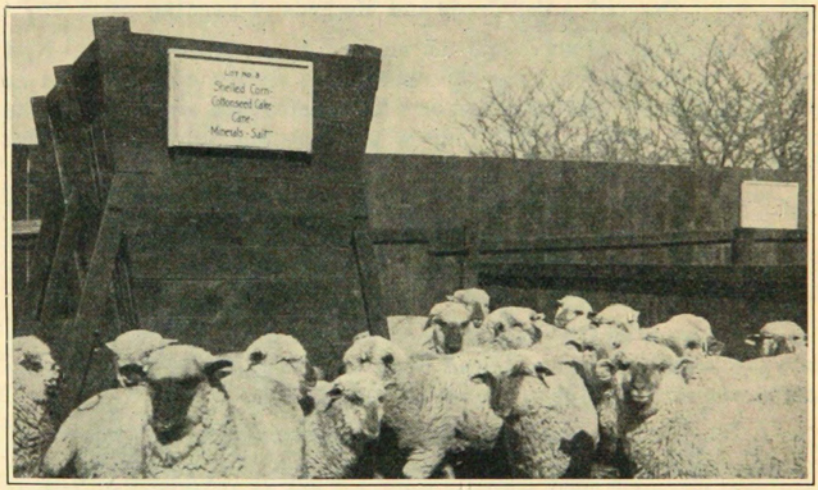
REPORT OF LAMB-FEEDING TEST

December 13, 1928, to April 12, 1929

Objects of the Experiment

1. To compare (1) shelled corn, (2) hog millet* (ground) and (3) a ground mixture of corn and hog millet for fattening lambs.

2. To determine the relative value as a protein supplement of cottonseed meal alone, and of cottonseed meal and No. 2 alfalfa meal (mixed equal parts by weight): (a) When fed with grain and cane (sorgo) fodder to fattening lambs; (b) when fed with millet hay and a mineral mixture to growing ewe lambs.



Type of lambs used in the experiment

Lambs Used

Grade Hampshire lambs from the flock at the United States Government Experiment Station at Akron were used in the feeding experiment.

Four lots of 10 lambs each that averaged 53.5 pounds in weight were used in the fattening experiment.

Two lots of 10 ewe lambs each that averaged 67.8 pounds in weight were used in a winter growing-out experiment.

Lambs of uniform size, weight and condition were sorted into the different lots and were started on the feeding experiment December 13, 1928.

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*Hog millet is known locally in Colorado as "hershey."

Fattening Rations Fed

Lot 1. Shelled corn, cottonseed meal, cane (sorgo) fodder.
Lot 2. Shelled corn, cottonseed meal, alfalfa meal, cane (sorgo) fodder.
Lot 3. Hog millet (ground), cottonseed meal, alfalfa meal, cane (sorgo) fodder.
Lot 4. One-half corn, one-half hog millet (ground), cottonseed meal, alfalfa meal, cane (sorgo) fodder.

Growing Rations Fed

Lot 5. Cottonseed meal, millet hay.
Lot 6. Cottonseed meal, alfalfa meal, millet hay.

Description of Feeds and Methods of Feeding

Cane (sorgo) fodder was of medium-fine texture and of good quality. It was grown near the experiment station and was used as roughage for the fattening lambs. The lambs had access to all the cane (sorgo) fodder which they would consume during the entire feeding experiment. Like all cane and sorgo fodder, it was very low in protein, cane (sorgo) fodder usually containing less than 1 percent.

Millet hay was also produced near the station and was of good quality. Millet hay contains about 8 percent protein. It was self-fed to the growing ewe lambs.

Cottonseed meal (guaranteed 43 percent protein) was fed at the rate of one-half pound per head daily to both fattening and growing lambs when used as the only protein supplement.

A No. 2 alfalfa meal (guaranteed 13 percent protein) was mixed equal parts by weight with cottonseed meal to furnish a mixed protein supplement. This mixture was also fed at the rate of one-half pound per head per day to both growing and fattening lambs in comparison with the straight cottonseed meal.

Shelled corn and hog millet were grown locally. These grains were hand-fed twice daily to the fattening lambs. Starting with about one-tenth pound per head daily the grain allowance was very gradually increased to 1 pound per head daily which was considered a full feed. The corn was a No. 2 grade, weighing 53.2 pounds per bushel. The hog millet, a yellow variety, was plump and of good quality.

Analysis of Grain Fed

				Carbohydrate			
	Water	Ash	Crude Protein	Fiber	N.-Free Extract	Fat	No. of Analysis
Corn	14.7	1.4	9.6	1.8	67.9	4.7	2
Hog millet	9.6	3.5	12.0	8.3	63.4	3.3	2

Table based on one average lamb

Lot Number	1	2	3	4	5	6
Ration fed	Sh. Corn Alf. Meal C. S. Meal Cane Fodder	Sh. Corn C. S. Meal Cane Fodder	Gr. Hog Millet Alf. Meal C. S. Meal Cane Fodder	Gr. Corn Gr. Hog Millet Alf. Meal C. S. Meal Cane Fodder	Millet Hay C. S. Meal Mineral Mixture	Millet Hay C. S. Meal Alf. Meal Mineral Mixture
Salt in all lots						
Weight at start—lbs	54.6	52.8	52.1	54.3	67.5	68.0
Final feedlot weight	102.1	100.2	95.3	99.5	96.7	97.0
Total feedlot gain	47.5	47.3	43.2	45.2	29.2	29.0
Daily gain	.40	.39	.36	.38	.24	.24
Average daily feed						
Shelled or ground corn	.76	.76		.38		
Ground hog millet			.76	.38		
Alfalfa meal	.21		.21	.21		.21
Cottonseed meal	.21	.41	.21	.21	.43	.21
Cane (sorgo) fodder	2.23	2.21	2.27	2.22		
Millet hay					2.14	2.17
Salt	.02	.02	.03	.03	.01	.01
Minerals					.003	.002
Feed required per cwt. feedlot gain						
Shelled or ground corn	193.0	193.9		101.5		
Ground hog millet			212.2	101.5		
Alfalfa meal	51.8		57.0	54.5		88.7
Cottonseed meal	51.8	104.1	57.0	54.5	176.2	88.7
Cane (sorgo) fodder	562.1	533.5	629.6	588.7		
Millet hay					879.2	897.8
Salt	3.7	5.1	6.9	8.8	5.1	5.4
Minerals					1.2	1.0
Feed cost per cwt. feedlot gain	$ 6.70	$ 7.40	$ 6.60	$ 6.78	$ 8.86	$ 7.66
Selling price per cwt.	15.25	15.25	15.25	15.25		
Dressing percentage	49.47	48.91	50.00	48.94		
Carcass grade in cooler	96.00	97.78	96.67	97.78		

Feed costs used:

Shelled corn	$27.00 per ton	Cottonseed meal	$50.00 per ton
Ground corn	29.00 per ton	Alfalfa meal	20.00 per ton
Ground hog millet	19.00 per ton	Cane (sorgo) fodder	8.00 per ton
Millet hay	10.00 per ton	Salt	20.00 per ton

Discussion of Results

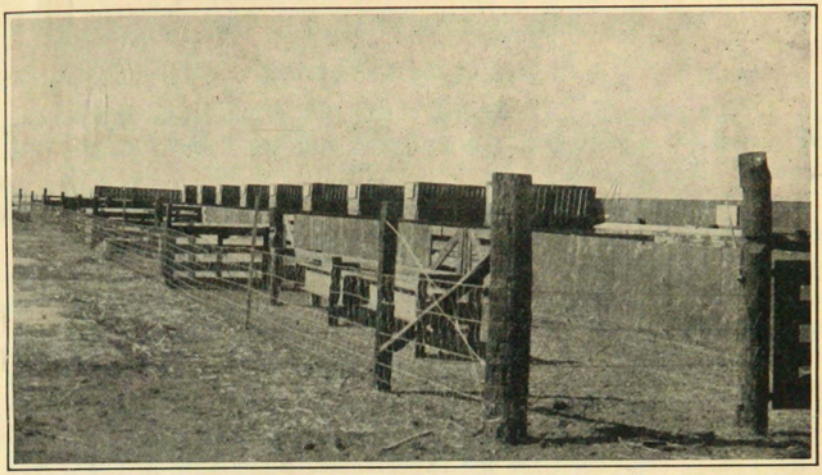
Hog Millet (Ground) vs. Shelled Corn for Fattening Lambs.—Lambs on a full feed of hog millet gained 43.2 pounds while lambs on the same feed of shelled corn gained 47.3 pounds. Hog millet (ground) made a satisfactory feed for fattening lambs and, with shelled corn at $27.00 per ton, was worth $20.00 per ton or in other words, had 74.07 percent the feeding value of shelled corn. A comparison of Lots 1 and 3 shows each ton of shelled corn equal to, or replacing 2,199.0 pounds of ground millet, 53.9 pounds of alfalfa meal, 53.9 pounds of cottonseed meal, 699.5 pounds of cane (sorgo) fodder and 32.2 pounds of salt. A mixture of equal parts by weight of ground corn and hog millet proved to be a more efficient carbonaceous concentrate than millet alone but was not as efficient as corn alone.

Cottonseed Meal vs. Mixture of Equal Parts by Weight of Cottonseed Meal and No. 2 Alfalfa Meal.—A mixture composed of equal parts of cottonseed meal and No. 2 alfalfa meal proved just as efficient and much cheaper than cottonseed meal alone when fed as a protein supplement for both fattening and growing-out lambs. With cottonseed meal at $50.00 per ton and alfalfa meal at $20.00 per ton, the reduction in cost of the protein mixture to $35.00 per ton made a substantial cut in feed cost per unit of gain that would easily justify the labor of making and using such a mixture.

A comparison of Lots 1 and 2 shows that the protein mixture reduced the cost of gain 70 cents per cwt. on the fattening lambs, showing each ton of alfalfa meal when fed with cottonseed meal and compared to cottonseed meal fed alone, replacing 2,019.3 pounds of cottonseed meal, 34.8 pounds of shelled corn and 54.1 pounds of salt but requiring 1,104.3 pounds more cane hay in producing equal gains. At prices of feeds quoted, each ton of alfalfa meal fed replaced other feeds worth $47.07 in fattening the lambs. In other words, alfalfa meal would have to closely approach this price per ton before there would be any doubt of the wisdom of adding it to cottonseed meal in developing a protein mixture for fattening lambs.

A comparison of Lots 5 and 6 shows that the protein mixture reduced the cost of gains $1.20 per cwt. in growing-out ewe lambs and shows each ton of alfalfa meal fed with cottonseed meal and compared to cottonseed meal fed alone replacing 1,970.5 pounds of cottonseed meal, 5.6 pounds of minerals and 8.6 pounds of salt but required 419.2 pounds more millet hay to produce gains. In this comparison each ton of alfalfa meal fed replaced other feeds worth $47.31.

It is interesting to note that in both cases where the protein mixture was fed there was a greater consumption of carbonaceous hay and slightly larger gains were produced. This may be a result of the de-



Lamb-feeding yards at the Experiment Station

velopment of a more palatable ration. This experiment indicates very clearly the benefits that may be derived from the use of a simple home-made protein mixture for lambs.

The feed cost of lamb-fattening rations at the Colorado Agricultural Experiment Station during this same season ranged from $9.46 to $14.08 for each 100 pounds of gain produced. Apparently well-balanced fattening and growing rations are as cheap and efficient in non-irrigated sections as in irrigated sections of Colorado.

REPORT OF LAMB-FEEDING TEST

December 20, 1929, to April 12, 1930

Objects of the Experiment

1. To compare (1) shelled corn, (2) ground and whole hog millet and (3) a ground mixture of corn and hog millet for fattening lambs.

2. To determine the relative value of cottonseed meal alone, of cottonseed meal and No. 2 alfalfa meal (mixed equal parts by weight) and of cottonseed meal and sudan meal (mixed equal parts by weight).

3. To determine comparative costs of fattening western and native lambs.

Lambs Used

Grade range lambs (Hampshire, Suffolk, Rambouillet cross) were purchased as feeders on the Denver market and were sorted into 7 pens of 20 head each for the experiment. Lambs in all pens were vigorous and thrifty and the different pens of lambs were uniform in size, weight, type and condition when the experiment started.

Rations Fed

Lot 1. Shelled corn, cottonseed meal, cane (sorgo) fodder.
Lot 2. Shelled corn, cottonseed meal, alfalfa meal, cane (sorgo) fodder.
Lot 3. Shelled corn, cottonseed meal, sudan meal, cane (sorgo) fodder.
Lot 4. Ground hog millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder.
Lot 5. Ground corn, ground hog millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder.
Lot 6. Ground hog millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder, (Natives).
Lot 7. Whole hog millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder, (Natives).

Description of Feeds and Methods of Feeding

All grain was hand-fed twice daily, early morning and late afternoon. Shelled corn was fed in all lots except in Lot 6 where a ground mixture of corn and hog millet was used. Hog millet was ground finely for the lambs except in Lot 7. Roughages were available to the lambs at all times. Protein supplements were hand-fed along with the grain twice daily.

Corn was a No. 5 yellow and was grown locally.

Hog millet, yellow Manitoba variety, weighed 56 pounds per bushel and was plump, clean and of excellent quality. All millet was ground finely for the test.

20 lambs per lot fed December 20, 1929, to April 12, 1930—113 days
Table based on one average lamb

Lot Number	1	2	3	4	5	6	7
Ration fed	Sh. Corn C. S. Meal Cane Fodder	Sh. Corn C. S. Meal Alf. Meal Cane Fodder	Sh. Corn C. S. Meal Sudan Meal Cane Fodder	Gr. Hog Millet C. S. Meal Alf. Meal Cane Fodder	Gr. Corn Gr. Hog Millet C. S. Meal Alf. Meal Cane Fodder	Gr. Hog Millet C. S. Meal Alf. Meal Cane Fodder "Natives"	Wh. Hog Millet C. S. Meal Alf. Meal Cane Fodder "Natives"
Salt in all lots							
Weight at start—lbs.	63.8	63.0	62.5	61.9	63.3	62.6	62.2
Final feedlot weight	100.9	101.5	99.2	103.6	99.9	100.8	100.5
Total feedlot gain	37.1	38.6	36.7	41.7	36.6	38.1	38.3
Daily gain	.33	.34	.32	.37	.32	.34	.34
Average daily feed							
Shelled or ground corn	1.12	1.07	1.07		.54		
Ground or whole hog millet				1.07	.54	1.08	1.14
Alfalfa meal		.20		.20	.21	.21	.22
Cottonseed meal	.42	.20	.20	.20	.21	.21	.22
Sudan grass meal			.20				
Cane fodder	2.48	2.44	2.17	2.54	2.32	2.17	2.79
Salt	.02	.01	.02	.02	.02	.02	.02
Feed required per cwt. feedlot gain							
Shelled or ground corn	341.6	314.3	330.5		167.3		
Ground or whole hog millet				290.6	167.3	321.3	335.2
Alfalfa meal		59.5		55.0	63.4	60.8	63.5
Cottonseed meal	129.3	59.5	62.6	55.0	63.4	60.8	63.5
Sudan grass meal			62.6				
Cane fodder	755.9	714.5	667.6	688.3	716.4	644.1	822.9
Salt	5.5	4.3	5.4	4.8	4.9	4.9	4.7
Feed cost per cwt. feedlot gain	$10.54	$9.05	$8.72	$8.69	$9.77	$9.16	$9.79
Selling price per cwt.	8.35	8.50	8.37	8.37	8.37	8.50	8.43

Feed costs used:

Shelled corn	$25.00 per ton	Alfalfa meal	$28.00 per ton
Ground corn	27.00 per ton	Sudan-grass meal	12.00 per ton
Whole hog millet	24.40 per ton	Cottonseed meal	52.00 per ton
Ground hog millet	26.40 per ton	Cane fodder	7.50 per ton
		Salt	30.00 per ton

Cottonseed meal (guaranteed 43 percent protein) was fed at the rate of one-half pound per head daily when used as the only protein supplement. Mixed with alfalfa meal or sudan-grass meal, it was fed at the rate of one-fourth pound per head daily.

No. 2 alfalfa meal (guaranteed 13 percent protein) was mixed equal parts by weight with cottonseed meal and fed as a protein supplement. This mixture was fed at the rate of one-half pound per head daily.

Sudan grass was grown locally. A chemical analysis showed a 9 percent protein content. It was ground, with a hammer mill, handled and fed in the same manner as alfalfa meal.

Cane (sorgo) fodder was of medium texture and of good quality. It was grown near the experiment station and was self-fed whole to the lambs.

Salt was kept before the lambs at all times. It was a No. 4 sheep salt.

Analysis of Feeds Used

				Carbohydrates			
	Water	Ash	Crude Protein	Fiber	N.F.E.	Fat	No. Analysis
Shelled corn	19.25	1.48	10.51	2.74	62.77	3.25	2
Hog millet	13.85	3.76	12.78	8.19	57.96	3.46	2
Cottonseed meal	8.20	5.40	40.60	10.80	26.70	8.30	2
Alfalfa meal	9.40	7.01	14.33	37.07	30.32	1.87	2
Sudan meal	9.89	9.36	9.02	34.15	35.84	1.74	2

Discussion of Results

Hog Millet (Ground) vs. Shelled Corn.—In this second year's test, using a No. 5 grade corn and a high-grade hog millet, lambs on a ration of millet (Lot 4) gained 41.7 pounds per head while lambs on the same feed of corn (Lot 2) gained only 38.6 pounds per head. Millet fed in this test not only produced a greater rate of gain but also produced cheaper unit gains. That is, for each hundred pounds of gain produced, the cost was 36 cents less where ground hog millet was fed instead of corn. Each ton of shelled corn was equal to or replaced 1,849.2 pounds of ground hog millet and 3.2 pounds of salt but required 28.6 pounds more alfalfa meal, 28.6 pounds more cottonseed meal and 166.7 pounds more cane fodder to produce equal gains. In other words, good plump hog millet was worth 116 percent the value of No. 5 corn.

A mixture of equal parts by weight of ground corn and hog millet did not prove as efficient as either corn or ground hog millet alone.

Hog Millet (Whole) vs. Hog Millet (Ground).—Altho the rate of gain was no greater in Lot 6 fed on ground hog millet than Lot 7 which was fed on whole hog millet, the amount of feed necessary to

produce unit gains was decidedly less where ground millet was fed. Ground hog millet reduced the cost 63 cents per cwt. gain on the lambs. Each ton of ground hog millet in this test replaced 2,086.5 pounds of whole millet, 16.8 pounds of alfalfa meal, 16.8 pounds of cottonseed meal and 1,113.0 pounds of cane fodder but required 1.2 pounds more salt. In other words, ground hog millet had 128.2 percent the feeding value of whole hog millet.

This test seems to indicate that sheep are unable to grind the hard-shelled millet grains efficiently for most complete digestion and utilization. The saving of $5.89 in feed value of the millet justified this added cost of grinding which, taking all costs into consideration, is $2.00 per ton.

Cottonseed Meal vs. a Mixture of Equal Parts by Weight of Cottonseed Meal and No. 2 Alfalfa Meal.—A comparison of Lots 1 and 2 shows that a mixture of equal parts of cottonseed meal and alfalfa meal produced about the same rate of gain as cottonseed meal alone. The mixture also decreased the cost of gain $1.49 per cwt., with prices of feeds used in this experiment. This and previous work seems to indicate that with a large spread in price between cottonseed meal and alfalfa meal, it is a good and profitable practice to use a mixture of equal parts of cottonseed and alfalfa meal to supply the necessary protein in a lamb-fattening ration.

Cottonseed Meal vs. a Mixture of Equal Parts by Weight of Cottonseed Meal and Sudan-Grass Meal.—Sudan grass, a home-grown product containing a fair amount of protein, when used in a mixture to replace one-half the cottonseed meal in a lamb-fattening ration, gave very favorable results by decreasing the cost $1.72 per cwt. gain. With cottonseed meal at $52.00 per ton and sudan-grass meal at $12.00 per ton, a half-and-half protein mixture of these feeds costs $32.00 per ton. This lower cost of protein supplement and the fact that this mixture proved slightly more efficient than cottonseed meal alone make sudan-grass meal very desirable to use in a lamb-fattening ration.

Sudan-Grass Meal vs. Alfalfa Meal in a Protein Mixture.—In this year's test, each ton of sudan-grass meal replaced 1,901.0 pounds of alfalfa meal and 1,498.4 pounds of cane but required 99.0 pounds more cottonseed meal, 517.6 pounds more corn and 35.1 pounds more salt or had a feed-replacement value of $17.70 per ton. This indicates that sudan-grass meal had 63.3 percent the feeding value of alfalfa meal in this experiment, whereas its market price was only 42.8 percent the value of alfalfa meal.

Apparently sudan-grass meal makes a satisfactory feed when used in a protein mixture thru cheapening feed costs per unit gain when it replaces one-half of the cottonseed meal or all of the alfalfa meal in a half-and-half mixture of alfalfa and cottonseed meal.

Native vs. Western Lambs.—The western lambs showed a predominance of Hampshire, Suffolk and Rambouillet blood and the natives in this test were high-grade Hampshire lambs. This experiment indicated that western feeder lambs made slightly larger gains in the feedlot and also produced unit gains with a little less feed than native lambs. This is, however, only a one year's comparison and differences are not significant enough to warrant any final conclusions.

REPORT OF LAMB-FEEDING TEST

December 28, 1930, to April 7, 1931

Object of the Experiment

1. To compare (1) shelled corn, (2) ground and whole hog millet and (3) a ground mixture of corn and hog millet for fattening lambs.

2. To determine the relative value of cottonseed meal alone, of cottonseed meal and No. 2 alfalfa meal (mixed equal parts by weight) and of cottonseed meal and sudan-grass meal (mixed equal parts by weight).

3. To compare the relative value of cane (sorgo) fodder and millet hay in a lamb-fattening ration.

4. To determine comparative costs of fattening western and native lambs.

5. To compare gains and cost of gains on wethers and ewes fattened in separate pens on the same ration.

Lambs Used

Two hundred grade range lambs were purchased on the Denver market. They were Hampshire, Suffolk and Rambouillet crosses. These lambs were allotted according to type, breeding, sex and condition into eight lots. Thirty high-grade Hampshire lambs were selected from a native flock according to sex and similarity in type and condition. These lambs were divided according to sex into two pens.

Rations Fed

Lot 1. Shelled corn, cottonseed meal, cane (sorgo) fodder.

Lot 2. Shelled corn, cottonseed meal, alfalfa meal, cane (sorgo) fodder.

Lot 3. Shelled corn, cottonseed meal, sudan-grass meal, cane (sorgo) fodder.

Lot 4. Ground hog millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder.

Lot 5. Ground corn, ground millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder.

Lot 6. Whole hog millet, cottonseed meal, alfalfa meal, cane (sorgo) fodder.

Lot 7. Ground hog millet, cottonseed meal, alfalfa meal, millet hay.

Lot 8. Ground hog millet, cottonseed meal, sudan-grass meal, millet hay.

Lot 9. Shelled corn, cottonseed meal, cane (sorgo) fodder. Native wethers.

Lot 10. Shelled corn, cottonseed meal, cane (sorgo) fodder. Native ewes.

Description of Feeds and Method of Feeding

Corn was a No. 1 yellow, weighing 55.5 pounds per bushel. It was locally grown corn and contained an average of 13.64 percent moisture thruout the feeding period. The corn was fed ground in Lot 5 and shelled in all other lots.

Hog millet, a yellow variety, weighed 59 pounds per bushel and contained 10.28 percent moisture. There is no government grade standard available for this grain but the millet was plump, clean and of excellent quality. All the hog millet fed was ground finely with a hammer mill except in Lot 6 where whole hog millet was fed.

Cottonseed meal, (guaranteed 43 percent protein) was fed at the rate of .28 pounds per head daily when used as the only protein supplement. In the protein mixtures, one-half of that amount was fed.

No. 2 alfalfa meal, (guaranteed 13 percent protein) was mixed equal parts by weight with cottonseed meal and was fed as a protein-supplement mixture at the rate of .28 pounds per head daily.

Sudan-grass meal was grown locally and ground thru a hammer mill. It was fed in the same manner as alfalfa meal. A chemical analysis showed it to contain 7.03 percent protein.

Cane hay was of coarse texture but of good quality. It was grown locally and was self-fed whole to the lambs.

Millet hay was also grown locally, was of good quality and pretty mature in character. It was self-fed to the lambs.

Salt was kept before the lambs at all times. It was a No. 4 sheep salt.

Analysis of Feeds Used

				Carbohydrates			
	Water	Ash	Crude Protein	Fiber	N.F.E.	Fat	No. Analysis
Corn	13.64	1.50	9.87	2.25	68.93	3.84	2
Hog millet	10.28	4.43	9.17	10.52	61.80	3.81	2
Sudan meal	9.90	9.33	7.03	36.89	35.18	1.67	2
Alfalfa meal	10.22	10.08	13.95	45.30	19.02	1.43	2

Table based on one average lamb

Lot Number	1	2	3	4	5	6	7	8	9	10
Ration fed	Sh. corn C. S. Meal Cane Fodder	Sh. Corn C. S. Meal Alf. Meal Cane Fodder	Sh. Corn C. S. Meal Sudan-Grass Meal Cane Fodder	Ground Millet C. S. Meal Alf. Meal Cane Fodder	Gr. Corn Gr. Hog Millet C. S. Meal Alf. Meal Cane Fodder	Wh. Hog Millet C. S. Meal Alf. Meal Cane Fodder	Gr. Hog Millet C. S. Meal Alf. Meal Millet Hay	Gr. Hog Millet C. S. Meal Sudan-Grass Meal Millet Hay	Sh. Corn C. S. Meal Cane Fodder Native Wethers	Sh. Corn C. S. Meal Cane Fodder Native Ewes
Salt in all lots										
Weight at start—lbs.	63.2	64.1	64.5	63.6	63.9	63.0	64.0	63.9	58.0	57.2
Final feedlot weight	91.7	90.3	89.0	87.9	90.3	82.7	84.0	86.9	86.1	81.4
Total feedlot gain	28.5	26.2	24.6	24.3	26.4	19.7	19.9	23.0	28.1	24.3
Daily gain	.28	.26	.25	.24	.26	.20	.20	.23	.28	.24
Average daily feed										
Shelled or ground corn	.77	.76	.76		.38				.75	.75
Whole or ground hog millet				.77	.38	.77	.77	.77		
Alfalfa meal		.16		.16	.16	.16	.16			
Cottonseed meal	.32	.16	.16	.16	.16	.16	.16	.16	.32	.32
Sudan-grass meal			.16					.16		
Cane fodder	2.18	2.17	1.93	2.18	2.48	2.14			1.91	1.72
Millet hay							1.69	1.59		
Salt	.03	.02	.02	.02	.02	.02	.02	.02	.02	.02
Feed required per cwt. feedlot gain										
Shelled or ground corn	268.8	288.9	307.9		145.2				267.3	309.6
Whole or ground millet				315.7	145.2	389.4	385.3	333.4		
Alfalfa meal		62.2		66.3	61.0	81.8	80.9			
Cottonseed meal	113.1	62.2	66.3	66.3	61.0	81.8	80.9	70.0	112.5	130.4
Sudan-grass meal			66.3					70.0		
Cane fodder	765.5	830.1	785.4	899.0	938.2	1088.7			681.9	709.1
Millet hay							851.0	692.4		
Salt	8.8	9.3	7.6	7.2	6.7	9.2	8.9	8.3	7.3	10.1
Feed cost per cwt. feedlot gain	$6.18	$6.25	$5.92	$6.42	$6.45	$7.48	$7.28	$5.67	$5.95	$6.74
Selling price per cwt.	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60

Feed costs used:

Shelled corn	$17.00 per ton
Ground corn	19.00 per ton
Ground hog millet	15.00 per ton
Whole hog millet	13.00 per ton
Alfalfa meal	$22.00 per ton
Cottonseed meal	37.00 per ton
Sudan-grass meal	6.50 per ton
Cane fodder	4.50 per ton
Salt	20.00 per ton

Discussion of Results

Hog Millet (Ground) vs. Shelled Corn.—The lambs in Lot 2 receiving shelled corn gained 26.2 pounds during the feeding period while lambs on the same feed of millet gained only 24.3 pounds per head. Each ton of corn fed replaced 2,185.5 pounds of millet, 28.4 pounds of cottonseed meal, 28.4 pounds of alfalfa meal and 477.0 pounds of cane fodder but required 14.5 pounds more salt. With corn at $17.00 per ton, the ground hog millet was worth $14.00 per ton or in other words had 82.4 percent the feeding value of corn. These results check very closely with those found during the first trial where a No. 2 corn was compared to a slightly poorer grade of millet than was used in the last two trials. The corn used in this third trial was a No. 1 and the millet a top grade, plump, excellent quality grain. In the second trial a No. 5 grade corn was compared to the same high grade of millet as in the third test. This probably explains to a great extent the high feed-replacement value for millet during the second year's work.

Ground Millet vs. Whole Millet.—Lot 4, fed a ration of ground millet, cottonseed meal, alfalfa meal and cane fodder, not only made greater daily gains but also produced unit gains for less feed than Lot 6 fed the same ration with the exception of whole instead of ground hog millet. Grinding the millet saved $1.06 for each hundred pounds of gain produced. This test shows that each ton of ground hog millet replaced 2,466.9 pounds of whole millet, 98.2 pounds of cottonseed meal, 98.2 pounds of alfalfa meal, 1,201.8 pounds of cane fodder and 12.7 pounds of salt. In other words, grinding the millet saved $8.76 in feed-replacement value. This indicates that it will pay well to grind hog millet very fine for feeding to lambs.

Cottonseed Meal vs. a Mixture of Equal Parts by Weight of Cottonseed Meal and No. 2 Alfalfa Meal.—A half-and-half mixture of cottonseed meal and alfalfa meal (Lot 2) produced slightly less gain than cottonseed meal alone (Lot 1) when fed with shelled corn and cane fodder. In this test the mixture did not produce cheaper gains than cottonseed meal alone because of the small spread in price between the two protein feeds. This substantiates previous results which indicated that with a large spread in price between alfalfa and cottonseed meal it is advisable to use alfalfa as half of the protein supplement and thereby cheapen production cost. However, if only a relatively small spread in price between the two feeds exists, it is more economical to use cottonseed meal alone.

Cottonseed Meal vs. a Mixture of Equal Parts by Weight of Cottonseed Meal and Sudan-Grass Meal.—A sudan-grass and cottonseed-meal mixture produced smaller gains on the lambs than cottonseed meal alone but this mixture produced each hundred pounds of gain

26 cents cheaper. Each ton of sudan-grass meal fed replaced 1,411.8 pounds of cottonseed meal and 36.2 pounds of salt but required 1,179.5 pounds more corn and 600.3 pounds more cane, or each ton of sudan-grass meal was worth $15.00 using above quoted prices. Altho sudan-grass meal was not equal to cottonseed meal pound for pound in feed-replacement value, it made a very desirable substitute for part of the cottonseed meal in a lamb-fattening ration due to its much lower cost.

Sudan-Grass Meal vs. Alfalfa Meal in a Protein Mixture.—Comparing Lots 3 and 2 in this third experiment, we find that the grains were quite similar with only a slight advantage in favor of Lot 2, fed alfalfa meal instead of sudan-grass meal with a ration of corn, cottonseed meal and cane fodder. Production costs per unit of gain are, however, 33 cents less per cwt. where the sudan grass replaced the alfalfa meal in the ration. Each ton of sudan-grass meal fed replaced 1,879.3 pounds of alfalfa meal, 1,348.4 pounds of cane and 51.28 pounds of salt but required 123.7 pounds more cottonseed meal and 573.2 pounds more corn or had a feed-replacement value of $17.05 per ton.

The relative feed value of alfalfa meal and sudan-grass meal when fed with millet hay (Lots 7 and 8) was even more in favor of sudan-grass meal than in a ration where cane fodder was used. The lot fed sudan-grass meal not only produced unit gains for $1.61 less but also showed a greater rate of gain.

Millet Hay vs. Cane Hay.—Millet hay did not prove as satisfactory a roughage as cane hay when fed with a ration of corn, cottonseed and alfalfa meal. Each ton of millet hay replaced 2,112.8 pounds of cane hay but required 163.6 pounds more millet, 34.3 pounds more alfalfa meal, 34.3 pounds more cottonseed meal and 4.0 pounds more salt or, with present prices, was worth $2.48 per ton. The market value of this roughage was $4.50 per ton.

Native vs. Western Lambs.—The western lambs used in this experiment showed a predominance of Hampshire, Suffolk and Rambouillet blood and the natives in this test were high-grade Hampshire lambs. Comparing native wethers in Lot 9 with 24 western wethers and 1 western ewe in Lot 1, the results indicate that the rate of gain is the same for both types of lambs. The native lambs produced unit gains for 23 cents less per hundredweight. Comparing these figures with those obtained the previous year, indications are that there is no outstanding difference between fattening natives or westerns.

Wether vs. Ewe Lambs.—The lambs used in this comparison were sired by the same Hampshire ram out of a high-grade Hampshire flock of ewes. This experiment indicated that wether lambs not only produced greater gain but also cheaper gain. However, no definite conclusions can be drawn because this study involves only one experiment.

General Conclusions

1. Proso or hog millet did not prove as efficient as corn in a fattening ration for lambs.

2. In an average of three fattening tests with lambs, each ton of ground hog millet replaced 1,945.5 pounds of shelled corn but required 11.7 pounds more cottonseed cake, 11.7 pounds more alfalfa meal, 269.3 pounds more cane fodder and 3.9 pounds more salt.

3. Complete and thoro grinding is very essential to insure complete utilization by the lambs.

4. An average of two fattening tests with lambs showed that each ton of ground hog (proso) millet replaced 2,275.0 pounds of whole millet, 57.1 pounds cottonseed meal, 57.1 pounds alfalfa meal, 1,157.0 pounds of cane fodder and 5.7 pounds of salt.

5. Proper protein supplements are very essential to balance rations composed largely of carbonaceous home-grown grains and roughages.

6. Cottonseed meal proved a good protein supplement, with a ration of shelled corn and cane fodder.

7. Alfalfa, altho not a home-grown product of Eastern Colorado, proved a valuable substitute as part of the cottonseed meal because it cheapened the cost of the protein supplement and at the same time this half-and-half mixture produced approximately the same rate of gain as cottonseed meal alone. Indications are that alfalfa meal will prove most valuable when a big spread in price exists between alfalfa and cottonseed meal.

8. Taking cost into consideration, sudan-grass meal proved just as efficient as alfalfa meal, as a partial substitute for cottonseed meal in a ration of hog millet and cane fodder.

9. Cane fodder seems to be a palatable and good roughage for fattening lambs.

10. Mature millet hay did not prove as satisfactory a roughage as cane fodder with a ration of corn and a half-and-half mixture of cottonseed and alfalfa meal. Each ton of millet hay replaced 2,112.8 pounds of cane fodder but required 163.6 pounds more millet, 34.3 pounds more alfalfa meal, 34.3 pounds more cottonseed meal and 4.0 pounds more salt.

11. In 2 year's fattening tests a comparison of native lambs vs. westerns seemed to indicate that there is little if any difference in their ability to fatten.

12. One year's test indicated that wether lambs produced slightly greater and also cheaper gains than ewe lambs.