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A Compilation of experimental and other data on feeding cottonseed products to beef cattle

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A Compilation of
Experimental and Other
Data on

FEEDING COTTONSEED PRODUCTS TO BEEF CATTLE

Compiled Under the Direction of

C. F. CLARK
Coordinator Research Information

Jointly Representing
Mississippi Agricultural Experiment Station
and
Mississippi State Vocational Board

J. R. Ricks, Director
Mississippi Agricultural Experiment Station
State College, Mississippi

FEEDING COTTONSEED PRODUCTS TO BEEF CATTLE

FOREWORD

The need for a compilation of experimental data relating to cottonseed feed products has been expressed by a great many agricultural workers. This is the first of a series of bulletins dealing with the feeding of cottonseed products to various types of livestock. Since cottonseed meal is one of our most widely used protein feeds it is felt that these publications will meet a definite need in determining the place that cottonseed products should fill in the feeding of livestock.

This bulletin reports certain phases of one of the cooperative studies undertaken in the Project in Research in Universities of the Office of Education. The study is financed under the Emergency Relief Appropriation Act of 1935. Mr. W. A. Ross, Specialist in Subject Matter, U. S. Office of Education, is the Study Coordinator.

This bulletin on, "Feeding Cottonseed Products to Beef Cattle", was compiled under the direct supervision of Mr. O. L. Snowden, now connected with the Agricultural Education Department of Mississippi State College. Mr. Snowden was responsible for compiling parts of all bulletins of this series but this one he is entirely responsible for.

Appreciation is due Mr. H. H. Leveck, Assistant in Animal Husbandry, Mississippi State College, for suggestions in regard to the manuscript and in regard to the index.

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INTRODUCTORY DISCUSSION OF COTTONSEED PRODUCTS AS A LIVESTOCK FEED

VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS

Cottonseed Products have been used extensively for stock feeding in the South for many years. During more recent times their use has become general in many sections outside the Cotton Belt. The demand from foreign countries is strong, despite the fact that these products cost considerably more there than they do in this country. European feeders, as a rule, have placed more value on high-protein feeds than the average American livestock man.

Another reason why cottonseed products are of such great importance, in addition to their high-protein content, is their immense production. Although the production of cotton has shown a slight decrease during the last ten years, the decrease has not been so marked as has been the case with flaxseed, from which linseed meal* is made. Several new protein feeds, like peanut cake, copra cake, and fish meal, have been offered on the market during the last few years, but with the average stockman they have not been received with so much favor as cottonseed meal or linseed meal, due in part to their unknown value. These newer products, however, have some characteristics that are making them of value in livestock feeding.

*This product is also known as "oil meal", and "new process" meal and "old process" meal.

COMPOSITION OF COTTONSEED PRODUCTS

There are a large number of cottonseed products used as livestock feeds. Both concentrates and roughages are included. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly upon the form of manufacture and the thoroughness in separating the hulls. Among the more common cottonseed products used as feeds are cottonseed, cottonseed meal and cake, and cottonseed hulls. Table I gives analyses representing these products, which have been put on the market by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

Table 1—Composition of Cottonseed Products†
(Pounds of nutrients in 100 Pounds)

	Water	Ash	Carbohydrates			Fat (ether extract)
			Crude Protein	Fiber	Nitrogen free extract	
	%	%	%	%	%	%
Cottonseed	9.1	4.0	19.6	18.9	28.3	20.1
Cottonseed meal and cake:						
41 per cent protein	7.1	5.7	41.7	10.0	28.4	7.1
38.6 per cent protein	6.9	5.9	38.8	12.2	29.4	6.8
36 per cent protein	7.3	5.8	36.8	13.5	30.0	6.6
Cold-pressed cottonseed	6.9	4.2	27.5	24.2	30.2	7.0
Cottonseed hulls	8.7	2.6	3.5	46.2	38.0	1.0

†Furnished by the Bureau of Chemistry, United States Department of Agriculture.

GRADES AND CLASSES OF COTTONSEED PRODUCTS

Formerly cottonseed (uncrushed) was used quite extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes has greatly decreased the amount fed in the form of seed. Cottonseed products have taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble from this source.

Cottonseed contains about 20 per cent each of fat or oil and crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about three times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products:‡

	Pounds
Linters or short fiber	110
Hulls	514
Cake or meal	954
Crude oil	303
Dirt and loss in manufacture	119
Total	2,000

‡Average for the five years 1914-15 to 1918-19 as compiled by the Bureau of Markets, United States Department of Agriculture, from Bureau of Census figures and etimates.

Cottonseed cake is made from the residue which remains after the oil has been extracted from the seed. Ordinarily the greater part of the hull is removed before the oil is extracted. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of prime quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls gives the cake a dark appearance. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has the distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and because the cake is better adapted for feeding alone or on the ground. Ocean freight rates also are lower for the cake than the meal.

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread upon the ground. If meal was used, the loss in feeding in this manner would be very large.

There are many grades and classes of cottonseed products sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein. Cottonseed meal shall be graded and classed as follows:

1. **Cottonseed meal, prime quality.** Cottonseed meal, prime quality, must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellowish not brown or reddish, free from excessive lint, and shall contain not less than 36 per cent of protein. It shall be designated and sold according to its protein content. Cottonseed meal, with 36 per cent of protein shall be termed "36 per cent protein cottonseed meal, prime quality," and higher grades similarly designated (as "43 per cent protein cottonseed meal, prime quality"), etc.

2. **Cottonseed meal, off quality.** Cottonseed meal not fulfilling the above requirements as to color, odor, and texture shall be graded "36 per cent protein cottonseed, off quality," and higher grades similarly designated.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold pressed cottonseed is the product obtained from the subjection of the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil and includes the entire cottonseed less the oil extracted.

Ground cold-pressed cottonseed is the product obtained by grinding cold-pressed cottonseed.

Cottonseed hulls are the roughage product of the cottonseed-oil manufacture. The hulls are removed from the cottonseed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

Reference: U. S. D. A. Farmer's Bulletin 1179, pages 1, 2 and 3, Table I, Washington, D. C. "Feeding Cottonseed Products To Livestock".

SECTION A—COTTONSEED MEAL AS A CONCENTRATE

1—COTTONSEED MEAL VERSUS CORN

I

Cottonseed Meal Versus Shelled Corn for Finishing Beef Calves at State College, Mississippi, 1915-16.

The object of this test was to make a comparative study of cottonseed meal and of shelled corn as concentrates to be used in finishing calves which are fed silage as a principle roughage and a small amount of alfalfa hay.

The calves used in this test were from 7 to 8 months old, were a mixed lot of Shorthorn, Hereford and Angus, and were of unusually good quality, and would have sold as choice stockers.

The cottonseed meal used in this test was of good quality, analyzing from 7½ to 8 per cent ammonia, (38-41 per cent protein). **The corn** was of good quality, being matured and sound. **The silage** was of good quality having been cut at the proper stage and carrying considerable grain. **The alfalfa** was of rather low grade as it had been damaged by a heavy dew.

The lots were fed as follows:

Lot 1. Cottonseed meal, corn silage, alfalfa hay.

Lot 3. Shelled corn, corn silage, alfalfa hay.

Details of the experiment are shown in the following table.

Table 2—Cottonseed Meal Versus Shelled Corn For Finishing Beef Calves At State College, Mississippi.

November 12th, 1915 to April 16th, 1916. (156 Days)

Ration	Lot 1 C. S. Meal Corn silage Alfalfa hay	Lot 3 Shelled Corn Corn silage Alfalfa hay
Av. initial wt., lbs.	430.	434.
Av. final wt., lbs.	701.	714.
Av. gain per steer, lbs.	271.	280.
Av. daily gain per steer, lbs.	1.74	1.8
Av. daily ration fed, lbs.:		
Cottonseed meal	3.69	
Shelled corn		8.78
Corn silage	22.87	13.80
Alfalfa hay	4.65	4.49
Feed required per 100 lb. gain, lbs.:		
Cottonseed meal	213.	
Shelled corn		489.
Corn silage	1318	769
Alfalfa hay	268	250

Note: The dressing percentage as reported by the slaughter pen indicated that the ration containing corn produced fatter carcasses than those containing cottonseed meal.

Reference: Mississippi Agricultural Experiment Station Bulletin 183, "Baby Beef and Calf Feeding," September 1917, State College, Miss.

Suggestive: What was the total gain made in Lot 1? In Lot 3? Under average farm conditions in your locality, which ration proved most economical if each of the roughages were produced on the farm and the concentrates bought at prevailing prices?

II

Cottonseed Meal Versus Ground Corn as a Fattening Feed for Beef Cattle at Manhatten, Kansas, 1924-25.

The object of this experiment was to test the feeding value of cottonseed meal and ground corn meal when fed under the same conditions.

Light weight yearling steers were used. One lot was fed cottonseed meal as the concentrated portion of the ration; the other 1 pound of cottonseed meal per head per day and enough ground corn to make the corn and 1 pound of cottonseed meal equal the amount of cottonseed meal in the other lot.

Method of feeding. The cattle in lot 1 receiving cottonseed meal as a basal ration were started on 5 pounds of cottonseed meal and those in lot 2 on 4 pounds of corn and 1 pound of cottonseed meal. The cottonseed meal was gradually increased until a maximum daily allowance of 15 pounds was fed during the last few days. Whenever the cottonseed meal allowance was increased in lot 1, the corn allowance was increased a like amount in lot 2. The same amounts of silage and alfalfa hay were fed each lot each day of the experiment.

Table 3—Cottonseed Meal Versus Ground Corn as a Fattening Feed for Beef Cattle at Manhatten, Kansas, Winter of 1924-25. 140 day test.

Lot No.	1	2
Basal Ration	C. S. Meal	Ground Corn
No. of days on feed	140	140
Initial weight, lbs.	546	552
Final weight, lbs.	880	892
Total gain, lbs.	334	340
Average daily gain, lbs.	2.39	2.43
Average daily ration: lbs.		
Corn	----	10.04
Cottonseed meal	11.04	1.00
Alfalfa hay	2.01	2.01
Silage	20.00	20.00
Feed required per 100 lbs. gain, lbs.:		
Corn	----	413.47
Cottonseed meal	462.81	41.18
Alfalfa hay	84.13	82.65
Silage	838.32	823.53

Note: The yearlings receiving cottonseed meal as a basal ration showed a bit more finish, better coats of hair, and more bloom than the yearlings receiving a basal ration of ground corn and outsold them by 25 cents per hundredweight. The cattle seemed to be normal in every respect at the end of the test.

Reference: Kansas Agricultural Experiment Station Circular 128, pages 8, 9 and 10, Table IV, "Cattle Feeding Investigations, 1924-25," October, 1926, Manhatten, Kansas.

Suggestive: What is the average daily gain in Lot 1? In Lot 2? Which lot required the greatest amount of concentrate per 100 pounds gain? Which concentrate would you feed under your conditions?

2—COTTONSEED MEAL VERSUS SOYBEANS

I

Soybeans Versus Cottonseed Meal as a Supplement to Corn for Fattening Two Year Old Cattle at Lafayette, Indiana, 1925-27.

Object—In order to determine the relative feeding value of whole soybeans and cottonseed meal for fattening two year old cattle, the Indiana Experiment Station conducted two trials, one in 1925-26, and another in 1926-27.

The cattle used in the 1925-26 trial were two year old steers which were a mixture of reds and roans with fairly good heads of medium quality and in fair flesh.

The cattle used in the 1926-27 trial were two year old steers which were purchased in Chicago. They were of medium to good quality grade Shorthorns in fair flesh. They were fed corn silage, and clover hay until the experiment started on November 17.

The feeds used in these trials were as follows:

The corn silage was locally grown and contained more moisture than is normally found in corn at such seasons of the year. None of the corn could be graded No. 3. However, it was reasonably free from damaged grain. **The clover hay** was a good quality, but some years it contained some Timothy. The corn silage was made from well matured corn.

The ration fed each lot was as follows:

Lot 1. Shelled corn, soybeans, corn silage, clover hay and salt.

Lot 2. Shelled corn, cottonseed meal, corn silage, clover hay and salt.

Results of the experiment are given in the following table.

Table 4—Cottonseed Meal Versus Soybeans for Fattening Two Year Cattle at Lafayette, Indiana, 1925-27. An Average of Two Experiments. Average Length of Experiment, 150 Days.

Ration	Lot 1 Shelled Corn Soybeans Silage Clover Hay Salt	Lot 2 Shelled Corn Cottonseed Meal Silage Clover Hay Salt
No. of steers per lot	10	10
Av. initial wt. per steer, lbs.	897.0	896.7
Av. final wt. per steer, lbs.	1273.7	1239.5
Av. gain per steer, lbs.	376.7	342.8
Av. daily gain, lbs.	2.51	2.29
Av. total feed consumed, lbs.:		
Shelled corn	1851.75	1844.25
Supplement	342.65	342.95
Silage	3619.20	3930.30
Hay	524.25	553.75
Salt	6.75	7.65
Av. daily feed per head, lbs.:		
Shelled corn	12.35	12.30
Supplement	2.28	2.29
Silage	24.13	26.20
Hay	3.50	3.69
Av. feed required per 100 lb. gain, lbs.:		
Shelled corn	492	538
Supplement	91	100
Silage	961	1146
Hay	139	162

Note: The cattle fed soybeans attained a higher finish than those receiving cottonseed meal according to the judgment of the committee of commission men and packer buyers.

Reference: Indiana Agricultural Experiment Station Bulletin 330, pages 8, Table I, "Cattle Feeding," January, 1929, Lafayette, Indiana.

Suggestive: What is the difference in the ration fed Lot 1 and the ration fed Lot 2? How much more total gain did the cattle make in Lot 2 than those in Lot 1? To what can this difference in gain be attributed? How much difference is there between the feed consumed in the two lots? Using the present feed prices, determine which ration gave the most economical gain?

II

Cottonseed Meal Versus Whole Soybeans as a Supplement to Corn for Fattening Calves at Lafayette, Indiana. 1925-28.

Object—In order to determine the relative feeding value of cottonseed meal and whole soybeans as a protein feed for calves, a series of trials were conducted at the Purdue University Experiment Station during the years 1925-26, 1926-27, 1927-28.

The calves used during the 1925-26 trial were raised in White County, Indiana. They were the product of grade Hereford range cows that had been brought from

the range in the fall before the calves were dropped in the spring. The sires were evidently pure-bred Hereford bulls. The calves ran with their dams on grass until November 12, 1925, when they were trucked to the experimental lot and started on the test.

The calves used in the 1926-27 trial were bred in the Sand Hill section of Nebraska. They were high-grade Hereford of choice quality in medium feeder condition with good size bones.

The calves used in the 1927-28 trial were purchased at a near-by town from a feeder who had shipped them in from Sterling, Colorado. They were of good to choice quality grade Herefords, rather small and in fair degree of flesh. On October 20, 1927, they were brought to a pasture near Lafayette where they grazed and learned to eat oats. On November 7, they were placed in the feed lots and fed oats, clover hay and corn silage until the experiment started November 16.

The feeds used in these trials were described as follows:

The corn silage was locally grown and contained more moisture than is normally found in corn at such seasons of the year. None of the corn could be graded No. 3. However, it was reasonably free from damaged grain. The clover hay was a good quality, but some years it contained some Timothy. The corn silage was made from well matured corn.

The lots were fed the following rations:

Lot 1. Shelled corn, cottonseed meal, corn silage and clover hay.

Lot 2. Shelled corn, whole soybeans, corn silage and clover hay.

Each lot was fed salt as a mineral supplement.

Table 5—Cottonseed Meal Versus Whole Soybeans as a Supplement to Rations for Fattening Calves at Purdue University. 1925-26, 1926-27, 1927-28. An Average of 3 Trials. Average Length of Each Trial, 237 Days.

Ration	Lot 1 Shelled Corn C. S. Meal Corn Silage Clover Hay Salt	Lot 2 Shelled Corn Soybeans Corn Silage Clover Hay Salt
No. of animals in lot	15	14
Av. initial wt. per calf, lbs.	399.1	400.8
Av. final wt. per calf, lbs.	898.7	895.2
Av. gain per calf, lbs.	499.6	494.4
Av. daily gain, lbs.	2.10	2.08
Av. total feed consumed, lbs.:		
Shelled corn	3076	2821
Supplement	443	408
Corn silage	3963	3390
Clover hay	1166	1044
Salt	11	13
Av. daily feed, lbs.		
Shelled corn	8.55	8.55
Supplement	1.23	1.24
Corn silage	10.93	9.82
Clover hay	3.16	3.19
Av. feed per 100 lb. gain, lbs.		
Shelled corn	408	412
Supplement	59	59
Corn silage	523	500
Clover hay	152	153

Note: The finish of the cattle measured by the actual selling value and appraisal at the market, was not influenced by the supplement used in the ration. In each of the three years, both lots of cattle were appraised and sold at the same price. In no year, was any difference in degree of finish noticeable.

Reference: Indiana Agricultural Experiment Station Bulletin 330, pages 4, 5, 6 and 10, Table II, "Cattle Feeding," January, 1929, Lafayette, Indiana.

Suggestive: Which ration gave the larger gain per calf? How much more feed did Lot 1 consume than Lot 2 per 100 pound gain? If cottonseed meal and soybeans were the same price per ton which ration would be more economical? Calculated with the current feed prices, which ration is more economical per 100 pound gain?

III

Ground Soybeans Versus Cottonseed Meal as a Supplement to Corn for Fattening Beef Cattle at Lafayette, Indiana, 1919.

The actual feeding value of ground soybeans as a substitute for cottonseed meal in rations for fattening cattle has been tested at this station in a series of three trials with two and three-year-old cattle fed shelled corn, corn silage, and cured roughage. Two similar lots of cattle were fed the same ration, except that one lot received cottonseed meal and the other lot ground soybeans as supplements to the ration. Supplement was fed at the rate of 2.5 pounds daily per 1,000 pounds weight.

Table 6—Ground Soybeans Versus Cottonseed Meal for Fattening Beef Cattle at Lafayette, Indiana—Summary of three trials.

	Lot 1 Ground Soybeans Lbs.	Lot 2 Cottonseed Meal Lbs.
Animals per lot	10	10
Average initial weight	992.4	994.2
Average final weight	1382.4	1399.1
Average total gain	390.0	404.9
Average daily gain	2.32	2.41
Average daily feed consumed:		
Shelled corn	13.37	13.80
Cottonseed meal	----------	2.95
Ground soybeans	2.92	----------
Cured roughage	1.07	2.08
Corn silage	23.65	25.86
Average required per 100 lbs. gain:		
Shelled corn	576.25	57.56
Cottonseed meal	----------	121.39
Ground soybeans	125.85	----------
Cured roughage	46.12	86.30
Corn silage	1019.31	1072.93

The ground soybeans had a marked laxative effect. The cattle were too loose at all times. During the second trial, the laxative effect of the soybeans increased as the feeding period advanced, but in the other two trials the effect was rather uniform during the time the cattle were on feed. The laxative effect was less pronounced in the third trial than in either of the others. This effect of the soybeans was doubtless due to the large percentage of fat contained therein.

The palatability of the ground soybeans was somewhat variable. During the third trial, the cattle ate the beans with relish throughout the entire feeding period. In the other two trials, the cattle ceased after about three months on feed to have the keen, eager appetites desirable in fattening stock. After the cattle had once lost their appetites and came back on feed, extreme care was necessary to prevent them from again going "off feed". This was especially marked during the last half of the second trial when the cattle had a decided aversion to soybeans and were very sensitive to every factor affecting their appetites. Although the steers in one trial maintained their appetites throughout the feeding period, it is perfectly obvious that soybeans are not usually palatable to fattening cattle after they have been fed for ninety to one hundred days.

Reference: Purdue University Agricultural Experiment Station Bulletin No. 237, Pages 4, 5, Table 2, "Ground Soybeans for Fattening Cattle," March, 1920, Lafayette, Indiana.

Suggestive: What was the average total gain in Lot 1? In Lot 2? What was the difference in cost per 100 lbs. gain in the two lots? Which meal would be more practical to feed?

IV

Feeding Cottonseed Meal to Fattening Steers in a Winter Ration at Lafayette, Indiana, 1922-23.

The object of the trials were to determine the relative value of cottonseed meal, soybean oilmeal, whole soybeans, and whole soybeans and a mineral mixture in rations of shelled corn, clover hay and corn silage, and to determine the value of cottonseed meal in the ration.

The steers were divided into lots equal in size, condition, quality and thriftiness. Each lot of steers occupied similar quarters, which consisted of an uncovered, concreted lot 20x28 feet and an open shed 16x28 feet on the west. The sheds were kept well bedded. The winter was open with little snow. The lots were kept reasonably clean at all times.

The cattle were fed under cover. Water was supplied in galvanized iron troughs adjacent to the open lots, care being taken to keep the water fresh in these troughs. No method of heating was used, but the ice accumulating in the throughs was removed twice a day. The cattle had water before them at all times.

The method of feeding was the same in all lots. Silage was distributed in the troughs: corn, when fed, was poured over the silage, and cottonseed meal sprinkled over the other feed in the troughs. Hay was fed twice daily in racks. Feeding was begun at 6 A. M. and 4:30 P. M. and completed in about an hour and a half.

The amount of hay and silage was governed by the appetites of the cattle. Supplement in lots where used was fed at the rate of 2.5 pounds daily per 1000 pounds live weight. Corn in Lots 1, 2, 3, 4 and 7 was fed according to appetite after the cattle had been brought to a full feed. The cattle in Lots 5 and 6 received no corn for 90 days, after which time they were brought to a full feed in about thirty days. Salt was kept before all lots except Lot 3, which had before it a mineral mixture consisting of equal parts of salt, acid phosphate and pulverized limestone.

The cattle were purchased on the Chicago market November 14, 1922, before the trial started November 22, 1922. They were of medium quality and rather thin in flesh. The cattle in Lots 5 and 6 were thinner than those in the other lots. Five steers in each of Lots, 1, 2, 3, 4 and 7 showed a preponderance of Hereford blood. The others were grade Shorthorns.

Corn used in these trials was sound and of good quality. The cottonseed meal was of choice grade containing 41 per cent crude protein. The soybean oilmeal was choice and contained 40 per cent crude protein. The soybeans were grown locally and were plump and sound. The hay was pure clover but of medium quality. The silage was well kept and made from corn yielding about 35 bushels per acre, cut when ripe enough to shock and watered.

The cattle received all the corn silage and clover hay they would eat when the trial began. Lots 1, 2, 3, 4 and 5 were started on six pounds of supplement the first day of the trial and gradually raised to 2½ pounds daily per 1000 pounds live weight at the end of twenty days. In Lots 1, 2, 3, 4 and 7 corn was fed at the rate of four pounds daily per head the first day and gradually increased to a full feed within a month. No corn was fed in Lots 5 and 6 for ninety days. It was then fed at the rate of five pounds daily per head and gradually increased to a full feed at the end of a month.

Table 7—Cottonseed Meal Versus Soybean Oilmeal Versus Whole Soybeans Versus Whole Soybeans with Mineral Mixture for Feeding Beef Cattle at Lafayette, Indiana, 1922-23. (An 8 Month Test).

Ration	Lot 1 Shelled Corn, Soybean Oilmeal, Silage, Clover hay, Salt	Lot 2 Shelled Corn, Soybeans, Silage, Clover hay, Salt	Lot 3 Shelled Corn, Soybeans, Silage, Clover hay, Mineral Mixture	*Lot 4 Shelled Corn, Cottonseed Meal, Silage, Clover hay, Salt
No. of steers per lot	10	10	10	9
Average initial weight, lbs.	945.8	945.0	948.5	946.2
Average final weight, lbs.	1271.5	1282.0	1268.3	1269.7
Average gain per steer, lbs.	325.7	337.0	319.8	323.4
Average daily gain, lbs.	2.17	2.25	2.13	2.16
Total feed consumed, lbs. Av. per steer:				
Shelled corn	1878.5	1884.0	1884.0	1875.9
Supplement	387.4	388.15	388.15	389.5
Corn silage	4429.6	4486.2	4476.5	4561.8
Clover hay	373.0	448.0	500.5	526.7
Daily feed per steer, lbs.:				
Shelled corn	12.52	12.56	12.56	12.51
Supplement	2.58	2.59	2.59	2.60
Corn silage	29.53	29.91	29.84	30.41
Clover hay	2.49	2.99	3.34	3.51
Feed per 100 lb. gain, lbs.:				
Shelled corn	577.0	559.0	589.0	580.0
Supplement	119.0	115.0	121.0	124.0
Corn silage	1360.0	1331.0	1400.0	1410.0
Clover hay	115.0	133.0	157.0	163.0

*9 Steers in Lot 4.

Note: the cattle in Lot 4 during two weeks of the second month did not eat well. They consumed somewhat less corn during this period than the other three lots. Cattle in all the four lots were somewhat slow in consuming their feed during the latter part of the third month. Other than this the cattle ate well at all times. It will be noted in the table that there was a marked uniformity

of appetite in all lots except in Lot 4 during the second and fourth months, in one case this lot being below the other three lots of cattle. On the whole it can be said that the supplement fed the cattle had no marked influence on their appetites. The cattle in all lots made highly satisfactory gains during the first two months but during the last three months failed to make gains that are to be expected from cattle under such conditions.

Table 8—The Feeding Value of Cottonseed Meal When Added to a Ration Containing Silage For Fattening Steers, Lafayette, Indiana, 1922-23. (8 Months Test).

Rations	*Lot 4 Shelled Corn, Cottonseed Meal, Silage, Clover hay, Salt	Lot 7 Shelled Corn, Silage, Clover hay, Salt	*Lot 5 Silage, Cottonseed Meal, Clover hay 90 days. Full feed shelled corn added, 150 days, salt	Lot 6 Silage, Clover hay 90 days, full feed shelled corn added 150 days, salt
No. of steers per lot	9	10	9	10
Average initial weight, lbs.	946.22	947.7	765.0	766.3
Average final weight, lbs.	1269.67	1235.0	1263.3	1213.0
Average gain per steer, lbs.	323.4	287.3	501.2	446.7
Average daily gain, lbs.	2.16	1.92	2.09	1.86
Total feed consumed per steer, av., lbs.:				
Shelled corn	1875.9	1884.0	1885.33	1891.0
Cottonseed meal	389.4	----	571.4	----
Corn silage	4561.7	4683.0	7268.8	7507.3
Clover hay	526.7	405.5	776.1	1028.0
Daily feed per steer, lbs.:				
Shelled corn	12.51	12.56	7.86	7.88
Cottonseed meal	2.60	----	2.38	----
Corn silage	30.41	31.22	30.29	31.28
Clover hay	3.51	2.70	3.23	4.28
Feed per 100 lb. gain, lbs.:				
Shelled corn	580.0	656.0	376.0	423.0
Cottonseed meal	124.0	----	114.0	----
Corn silage	1410.0	1630.0	1450.0	1681.0
Clover hay	163.0	141.0	155.0	231.0

* 9 steers in Lots 4 and 5.

Reference: Indiana Agricultural Experiment Station Bulletin 281, pages 4, 5, 6, 7, 8, 9, 10, and 14, Tables IV and VIII, "Cattle Feeding—Winter Steer Feeding," June, 1924, Lafayette, Indiana.

Suggestive: Do the results of this test indicate that soybeans have a higher feeding value than cottonseed meal? Which would be more economical to feed in your locality, soybeans or cottonseed meal? In each case where cottonseed meal was fed in the ration with silage, did the increase in gain justify the cost of the meal? (Use current prices). Which of the rations would be considered "balanced"?

3—COTTONSEED MEAL VERSUS OATS

I

Cottonseed Meal Versus Whole Oats Versus Ground Oats in Rations for Fattening Two Year Old Cattle at Purdue University, Lafayette, Indiana, 1926-1928.

The purpose of this experiment was to determine the value of cottonseed meal, ground oats and whole oats for fattening two year old cattle. In order to make such determinations, the Indiana Experiment Station conducted two trials, one in 1926-1927, the other in 1927-1928.

The cattle used in the 1926-27 test were bought in Chicago. They were of medium to good quality grade Shorthorns in fair flesh. They were fed corn silage and clover hay until the experiment started November 17.

The cattle used in the 1927-28 trial were two year olds purchased in Chicago. They were grade Shorthorns of medium to good quality in good feeder flesh. They were fed oat straw and corn silage from their arrival at Purdue farm until started on their experiment November 16.

In both trials the cattle were quartered in Purdue experimental lots in open sheds similar in size and equipment and were treated the same in every way with the exception of the rations fed.

The feeds used in this experiment were described as follows:

The corn was locally grown and contained more moisture than was normally found in corn at such seasons of the year. None of the corn would have graded No. 3. However, it was reasonably free from damaged grain. **The cottonseed meal** was choice grade containing 41 per cent protein. **The clover hay** was a good quality and contained some Timothy. **The corn silage** was made from well matured corn.

The ration fed each lot was as follows:

Lot 1. Shelled corn, cottonseed meal, corn silage, clover hay and salt.

Lot 2. Shelled corn, whole oats, corn silage, clover hay and salt.

Lot 3. Shelled corn, ground oats, corn silage, clover hay and salt.

Results of the experiment are given in the following table.

Table 9—Cottonseed Meal Versus Whole Oats Versus Ground Oats in Rations For Fattening Two Year Old Cattle at Purdue University. 1926-28. Average of Two Experiments. Average Length of Each Experiment, 150 Days.

Ration	Lot 1 C. S. Meal	Lot 2 Whole oats	Lot 3 Ground oats
No. of steers per lot	10	10	10
Av. initial wt. per steer, lbs.	928.5	925.8	924.8
Av. final wt. per steer, lbs.	1296.0	1250.0	1274.9
Av. gain per steer, lbs.	367.9	324.2	350.1
Av. daily gain lbs.	2.45	2.16	2.33
Av. total feed consumed, lbs.			
Shelled corn	1821.35	1471.20	1471.20
Oats	----	729.85	729.85
Cottonseed meal	341.35	----	----
Silage	4441.50	3711.75	4051.5
Clover hay	425.50	407.50	358.00
Salt	7.15	8.00	5.75
Av. daily feed per head, lbs.			
Shelled corn	12.14	9.81	9.81
Oats	----	4.87	4.87
Cottonseed meal	2.28	----	----
Silage	29.61	24.75	27.01
Hay	2.84	1.36	1.19
Av. feed required per 100 lb. gain, lbs.:			
Shelled corn	495.	454.	420.
Oats	----	225.	209.
Cottonseed meal	93.	----	----
Silage	1207.	1145.	1157.
Hay	116.	126.	102.

Note: The cattle fed cottonseed meal attained a distinctly better finish according to valuations of the cattle by a committee of commissioners and packer buyers.

Reference: Indiana Agricultural Experiment Station Bulletin 330, pages 4, 5, and 20, Table V, "Cattle Feeding," January, 1929, Lafayette, Indiana.

Suggestive: How does the average gain per steer compare in each lot? Does grinding of oats increase their feeding value enough to make them equal in feeding value to cottonseed meal? Under average farm conditions in your locality, which of the three rations would give the most profit per steer? Which of the rations would more nearly be classed as "balanced?"

4—COTTONSEED MEAL VERSUS VELVET BEANS

I

Velvet Bean-and-Pod Meal, Cottonseed Meal, and Varying Proportions of Corn and Velvet Bean-and-Pod Meal Compared for Fattening Steers at State College, Mississippi, 1917-18.

For the purpose of studying the relative economy of velvet bean-and-pod meal, velvet bean-and-pod meal and corn, and cottonseed meal, when fed with silage to beef steers, the Mississippi Experiment Station in the winter of 1917-18 fed five lots of beef cattle for one hundred and forty days. Corn silage was fed ad libitum to all lots throughout the trial. Cottonseed meal, velvet bean-and-pod meal, and broken ear corn were fed in accordance with the following plan:

Table 10—Concentrates Fed Daily Per Thousand Pounds of Cattle.

Lot	I	II	III	IV	V
First 56 Days					
Cottonseed Meal (lbs.)	5	------	------	------	------
Velvet Bean-and-Pod Meal (lbs.)	------	10.	8.	6.	4.
Broken Ear Corn (lbs.)	------	------	6.25	12.5	18.75
Second 56 Days					
Cottonseed Meal (lbs.)	6.	------	------	------	------
Velvet Bean-and-Pod Meal (lbs.)	------	12.	10.	8.	6.
Broken Ear Corn (lbs.)	------	------	6.25	12.5	18.75
Last 28 Days					
Cottonseed Meal (lbs.)	7.	------	------	------	------
Velvet Bean-and-Pod Meal (lbs.)	------	14.	12.	10.	8.
Broken Ear Corn (lbs.)	------	------	6.25	12.5	18.75
Average for Entire Period (140 da.)					
Cottonseed Meal (lbs.)	5.8	------	------	------	------
Velvet Bean-and-Pod Meal (lbs.)	------	11.6	9.6	7.6	5.6
Broken Ear Corn (lbs.)	------	------	6.25	12.5	18.75

The cattle used in this trial were good to choice grade beef steers bought locally in the fall of 1916. They were grazed through the summer of 1917 and from frost until being put in the feed lots had the run of stalk, pea and velvet bean fields. The breeding of the cattle used in these experiments were Shorthorn, Red Poll, Angus, and Hereford Grades.

Table 11—Cottonseed Meal Versus Velvet Bean-and-Pod Meal Versus Varying Proportions of Broken Ear Corn and Velvet Bean-and-Pod Meal for Fattening Steers at State College, Mississippi, 1917-18. 140 Days.

Lot	1 Cottonseed meal, Silage	2 Velvet Bean-and-pod Meal Silage	3 Velvet Bean-and-Pod Meal, Light corn ration Silage	4 Velvet Bean-and-Pod Meal, Medium Corn ration Silage	5 Velvet Bean-and-Pod Meal, Heavy corn ration, Silage
No. of animals	8.	8.	8.	8.	8.
Initial weight, total (lbs.)	8540.33	8058.	8015.66	7969.66	8125.33
Av. initial weight (lbs.)	1067.54	1007.25	1001.96	996.21	1015.66
Av. final weight (lbs.)	1333.04	1229.46	1228.58	1297.08	1308.04
Av. gain per steer (lbs.)	265.5	222.21	226.62	300.87	292.38
Av. daily gain per steer (lbs.)	1.9	1.59	1.62	2.15	2.09
Feed consumed per steer					
Cottonseed meal (lbs.)	812.				
Velvet Bean-and-Pod Meal (lbs.)		1624.	1342.75	1064.	784.
Broken Ear Corn (lbs.)			875.	1750.	2625.
Silage (lbs.)	10943.75	10083.75	7436.25	5360.	4153.75
Average daily feed per steer					
Cottonseed meal (lbs.)	5.8				
Velvet Bean-and-Pod Meal (lbs.)		11.6	9.59	7.6	5.6
Broken Ear Corn (lbs.)			6.25	12.5	18.75
Silage (lbs.)	78.17	72.03	53.12	38.29	29.67
Feed Required per cwt. of gn.					
Cottonseed meal (lbs.)	305.84				
Velvet Bean-and-Pod Meal (lbs.)		730.85	592.50	353.64	268.15
Broken Ear Corn (lbs.)			386.1	581.64	897.82
Silage (lbs.)	4121.94	4537.99	3281.3	1781.47	1420.69

Reference: Mississippi Agricultural Experiment Station Bulletin 222, pages 6, 7 and 8, Table II, "Steer Feeding Experiments," May 1924, State College, Mississippi.

II

Cottonseed Meal Compared with Dry Velvet Beans and Soaked Velvet Beans When Fed With Corn Silage for Fattening Beef Steers at McNeill, Mississippi, 1920.

Object—In 1920 an experiment on fattening steers was conducted at McNeill, Mississippi, to determine the relative value of cottonseed meal and velvet beans when fed with silage. In the experiment 30 high-grade three or four year old feeder steers of Hereford, Angus, and Shorthorn types, were divided into three groups of ten each as nearly uniform as possible.

The silage was made from fully-matured corn and as a whole was bright and of good quality. **The velvet beans** fed Lot 3 were soaked for 12 hours before feeding. In a preliminary feeding period of two weeks, a limited amount of cottonseed meal and corn silage was fed. During the first period the quantity of silage had to be reduced temporarily because all of the steers were slightly off their feed and were scouring badly.

Table 12—Cottonseed Meal Compared With Dry Velvet Beans and Soaked Velvet Beans for Fattening Beef Cattle at McNeill, Mississippi, 84 Day Test, 1920.

Rations	Lot 1 C. S.Meal and corn silage	Lot 2 Dry velvet beans and corn silage	Lot 3 Soaked velvet beans and corn silage
Number of steers	10	10	10
Average initial weight per steer	810	786	802
Average final weight per steer	988	1021	990
Average total gain per steer	178	235	88
Average daily gain per steer	2.1	2.8	1.04
Average daily feed consumption per steer			
Cottonseed meal	5.1	----	----
Corn silage	50.6	39.8	41.5
Dry Velvet Beans	----	11.9	----
Soaked velvet beans	----	----	11.9
Feed required per 100 lb. gain			
Cottonseed meal	242.8	----	----
Corn silage	2409	1421.2	1886.1
Dry velvet beans	----	424.9	----
Soaked velvet beans	----	----	540.8

Reference: Department of Agricultural Education, Clemson College, S. C. "Agricultural Education" Vol. 12, No. 1, Page 7, 9.

Suggestive: What was the average total gain in Lot 1? In Lot 2? In Lot 3? Which produced the more economical gains, cottonseed meal or dry velvet beans? Did soaking the beans pay?

III

Velvet Beans in the Pods Versus Cottonseed Meal as a Concentrate Part of a Ration for Fattening Steers at Auburn, Alabama, 1916-17.

Object—This experiment was planned with a view of determining the relative feeding values of velvet beans in the pod and cottonseed meal as a concentrate part in the ration of fattening steers.

The steers used in this experiment were grades showing either Angus, Hereford or Shorthorn blood. They were divided into 2 lots of 15 each and were given the following feeds:

Lot 1. Velvet beans in pods, corn silage.

Lot 2. Cottonseed meal, corn silage.

The steers were fed under average farm conditions with the feed lots located in a cedar grove. The cedar grove gave all the protection the steers had during the experiment. The lots had a southern exposure and were well drained. The manure was hauled out of the lots every few days. No bedding was used, but the lots were dry enough so that the steers could lie down comfortably. Pure water from a deep well was kept before the steers at all times. Block salt was kept in the feed throughs continuously.

The steers were fed twice each day. The concentrates and roughages were mixed thoroughly by hand in the feed troughs. The amount of feed was regulated so that it was consumed in a few hours.

As the pastures began to fail in the fall the steers had the run of the stalk fields. They were in the stalk fields during the month of November. Eighteen days previous to going on the experiment the steers were fed, while in the stalk fields, two pounds of velvet beans and twelve pounds of corn silage per head per day. The preliminary feeding was done to accustom them to feeding and handling and to secure a uniform fill.

The beans were fed in the pod and were thoroughly mixed with the silage in the trough so that each steer would get only his share of the beans. After the experiment continued four weeks the beans were soaked in the pod and seemed to assist the steers in masticating the beans.

Details of the experiment are given in the following table.

Table 13—Velvet Beans in the Pod Versus Cottonseed Meal as a Concentrate Feed For Fattening Steers at Auburn, Alabama. December 21, 1916 to April 19, 1917. (119 Days).

Ration	Lot 1 Velvet Beans and Corn Silage	Lot 2 C. S. Meal and Corn Silage
No. of steers per lot	15	15
Av. initial wt. lbs.	773.4	777.7
Av. final wt., lbs.	963.7	963.2
Av. gain per steer, lbs.	190.3	185.5
Av. daily gain per steer, lbs.	1.6	1.55
Av. daily ration consumed, lbs.		
Velvet beans	10.6	
Corn silage	28.5	42.6
Cottonseed meal		5.
Feed required per 100 lb. gain, lbs.		
Velvet beans	670.	
Corn silage	1733.	2811.
Cottonseed meal		327.

Note: Both rations were relished by the steers and at no time during the test was there any trouble due to the steers going off feed.

Reference: Alabama Agricultural Experiment Station Bulletin 198, Part I, "Beef Cattle Feeding Experiments," November, 1917, Auburn, Alabama.

Suggestive: Which lot required the greater amount of corn silage per 100 lb. gain? Under your conditions could you afford to feed 2 pounds of velvet beans in the pod to replace 1 pound of cottonseed meal?

5—COTTONSEED MEAL AS A SUPPLEMENT TO HAY AND PASTURE

I

Cottonseed Meal as a Supplement to Pasture for Fattening Steers in the Black Belt of Alabama. 1927-32.

In the spring of 1927, through a cooperative arrangement, an experiment was started on Kirkwood plantation, Faunsdale, Alabama, with the object of determining the affects of feeding cottonseed meal to steers that were being finished on pasture for the July market. After the experiment had been conducted for about three years the plan was expanded and another group of steers

was added. The added objective was to compare two systems of management; namely, the feeding of cottonseed meal to steers on pasture and selling the steers in July versus the fattening of steers on pasture alone and selling them in September.

All steers used in these experiments were two-year-old, high grade Herefords. They were raised on the farm where the experiments were conducted or on adjoining farms in the community. These steers were strong and thrifty at the beginning of the experiments. They were weighed individually on three consecutive days at the beginning and at the close of the experiment. The average of the three weights was taken as the initial and the final weights, respectively.

Each group of steers was turned into a large Black Belt pasture where there was an abundance of grazing at all times. The pastures were composed mostly of black medic, Dallis grass, white clover, and Bermuda grass. Steers in Lot 1 received in addition to the pasture an average allowance of 4.69 pounds of 37 per cent protein cottonseed meal per head daily. Steers in Lot 2 (check lot) were on pasture with no supplement. Both lots were sold in July. Steers in Lot 3 (during the last three years of the experiment) were on pasture with no supplement and were sold in September.

The steers which received cottonseed meal made fairly uniform gains during each of the six years, while the gains made by the steers on pasture alone were much less uniform. This condition was probably due to the fact that the steers in Lot 2 were dependent entirely on pasture for feed and they were affected more by the variation in seasons than those in Lot 1.

Table 14—The Effect of Cottonseed Meal on Gains of Steers When on Pasture at Auburn, Alabama, 1927-32. (A Six Year Average)*

Ration	Lot 1 Pasture and C. S. Meal	Lot 2 Pasture Only
No. of steers	17.5	16
Days on pasture	84	84
Av. initial weight, lbs.	600	600
Av. final weight, lbs.	805	757
Total gain per steer, lbs.	205	157
Daily gain per steer, lbs.	2.47	1.92

*Average obtained by adding six years' results and dividing by six (6).

Note: The average daily meal allowance per steer was 4.69 pounds.

Although the steers on pasture alone made very cheap gains they were not finished sufficiently in 70 to 90 days to meet the demands of the butcher. The question naturally arose as to which would be better practice, to feed steers cottonseed meal on pasture and market them in July (apparently there would be very little virtue in feeding meal and selling the steers in September because the main object in feeding meal is to increase the rate of gain and get the cattle ready for the early market when grass-fat cattle are not plentiful) or to fatten them on pasture alone and sell them in September.

In order to compare these two systems of management, a third group of steers, Lot 3, was added to the experiment in the spring of 1930. This group was managed similarly to that of Lot 2 with the exception that they were continued on pasture until September.

Table 15—Pasture Supplemented with Cottonseed Meal Versus Pasture Alone for Finishing Steers for the July Market at Auburn, Alabama, 1930-32. (A Three Year Average)†

Ration	*Lot 1 Pasture and C. S. Meal	*Lot 2 Pasture Only	Lot 3** Pasture Only
No. of steers	23.67	20.67	18.33
Days on pasture	90.33	90.33	154
Av. initial weight, lbs.	627	629	627
Av. final weight, lbs.	844	796	885
Av. total gain per steer, lbs.	217	167	258
Av. daily gain per steer, lbs.	2.42	1.89	1.67

†Average obtained by adding three years' results and dividing by three (3).
*Steers sold in July. **Steers sold in September.

Reference: Alabama Agricultural Experiment Station Circular 72, pages 4, 5, 7 and 8, Tables I and V, "Cottonseed Meal as a Supplement to Pasture for Fattening Steers in the Black Belt of Alabama," March, 1935, Auburn, Alabama.

Suggestive: What effect did the feeding of cottonseed meal have on the rate of gain? With cottonseed meal and beef figured at current prices, was the feeding of cottonseed meal to cattle on pasture justified?

II

Cottonseed Meal and Johnson Grass Hay Versus Johnson Grass Hay Alone for Wintering Steers in Johnson Grass Hay Fields.

Seventeen steers were wintered in Johnson grass hay fields where they had access to hay stacked in the field during the winter of 1931. No cottonseed meal or other supplements were fed and no shelter was provided. These steers made an average gain of 78 pounds in 140 days.

In 1932, twenty steers were fed and managed as described above and they made an average gain of 10 pounds in 125 days. The average gain per steer for the two-year period was 41 pounds. It was not practicable to keep a record of the hay eaten by these steers because the hay was self-fed from the stacks.

Table 16—Cottonseed Meal and Johnson Grass Hay Versus Johnson Grass Hay Alone For Wintering Steers in Johnson Grass Hay Fields. Auburn, Alabama, 1931-32. (125 Days)

Ration	Lot 1 Johnson Grass Hay Fields with free access to stacked hay	Lot 2 Johnson Grass Hay Fields with free access to stacked hay and 1 lb. cottonseed meal per head daily
Year	1932	1932
No. of steers wintered	20	20
Av. wintering period (days)	125	125
Av. initial wt. per steer, lbs.	548.00	549.20
Av. final wt. per steer, lbs.	558.00	649.75
Av. gain per steer, lbs.	10.00	100.55
Av. daily gain per steer, lbs.	.08	.80
Av. daily feed per steer, lbs.		
Johnson grass hay	15.00	15.00
Cottonseed meal	----	1.00
Feed required per 100 lb. gain, lbs.		
Johnson grass hay	18750	1865
Cottonseed meal	----	124

Reference: Alabama Experiment Station Circular 71, pages 2, 3, 4, 5, 6 and 7, Tables I, II and III, "Wintering Steers in the Black Belt of Alabama", February, 1935, Auburn, Alabama.

Suggestive: What effect did cottonseed meal have on the average daily gain by the steers? On an average, would you expect steers to gain or lose weight on ration of Johnson grass hay during the winter? Would you feed one or two pounds of cottonseed meal per day with Johnson grass hay for wintering steers?

III

The Value of Cottonseed Meal When Fed with Native Hay for Wintering Range Calves at Laramie, Wyoming, 1922-23.

The object of this test was to ascertain the value of cottonseed meal when fed with native hay for wintering range calves.

Cattle used—Twenty head of average range calves, with Hereford breeding predominating, were loaned to the Station for this test. They had just been weaned, were quite uniform in type and size, and would grade as fair feeder calves. When placed on experiment they averaged 444.99 pounds.

The calves were divided into two groups of ten each, so that each group was representative of the whole, and placed in lots 25x125 feet. Each lot had access to a shed, open on the south side which after being thoroughly cleaned was covered with dry sand at the beginning of the trial.

The hay was fed in large racks, the silage and cottonseed meal in bunks. The calves quickly became accustomed to the cottonseed meal, cleaning it up shortly after being fed. Salt was provided in the form of blocks under each shed.

The hay was grown northwest of Laramie and baled from the stack before delivery. It was only fair in quality, consisting mainly of wheat grasses and Baltic rush.

Table 17—Native Hay Versus Native Hay and Cottonseed Meal When Fed to Wintering Range Calves at Laramie, Wyoming. 168 Days, November 22, 1922 to May 9, 1923.

	Lot 1 Native Hay	Lot 2 Native Hay cottonseed meal
Number of calves per lot	10	10
Average initial weight (lbs.)	448.16	441.33
Average final weight (lbs.)	508.0	570.83
Average gain per calf (lbs.)	59.84	129.5
Average daily gain per calf (lbs.)	.35	.77
Daily ration consumed (lbs):		
Native hay	10.	5.
Cottonseed meal	———	1.125
Feed consumed per 100 lbs. gain (lbs.):		
Hay	2877.6	648.6
Cottonseed meal	———	145.9

Reference: Wyoming Agricultural Experiment Station, Bulletin 134, Pages 3, 10, 11, 12, Table 5, "Wintering Range Calves," May, 1923, Laramie, Wyoming.

Suggestive: What was the total gain per calf in each lot? Were the additional gains made in lot 2 sufficient to pay for the cottonseed meal? (Calculate on basis of current prices.)

IV

Johnson Grass Hay and One Pound of Cottonseed Meal Versus Johnson Grass Hay and Two Pounds of Cottonseed Meal at Auburn, Alabama. 1929-31.

During the winters of 1929, 1930, and 1931 the efficiency of one pound of cottonseed meal per head daily was compared with the efficiency of two pounds of cottonseed meal per head daily as supplements to Johnson grass hay for wintering steers. The hay was self-fed from racks in a barn, although both groups of steers had access to permanent pasture plots of approximately 10 acres. There were 34 steers in each group during the first year, 15 in each group during the second year, and 17 in each group during the third year; the length of the different wintering periods was 119 days, 133 days, and 140 days, respectively.

Table 18 One Pound Versus Two Pounds of Cottonseed Meal per Head Daily as a Supplement to Johnson Grass Hay for Wintering Steers at Auburn, Alabama, 1929-31. (131 Days Average Each Year).

Ration	Lot III Johnson grass hay self-fed from racks, and 1 lb. cottonseed meal per head daily.				Lot IV Johnson grass hay self-fed from racks, and 2 lbs. cottonseed meal per head daily.			
Year	1929	1930	1931	3 yr. av.	1929	1930	1931	3 yr. av.
No. of steers wintered	34	15	17	22	34	15	17	22
Av. wintering period (days)	119	133	140	127.6	119	133	140	127.60
Av. init'l wt. per steer (lbs.)	502.0	636.0	553.0	545.0	495.0	642.0	554.0	543.0
Av. final wt. per steer (lbs.)	533.0	651.0	663.0	593.0	508.0	663.0	675.0	586.0
Av. gain per steer (lbs.)	31.0	15.0	110.0	48.0	13.0	21.0	121.0	42.0
Av. daily gain per steer (lbs)				.36				.32
Av. daily feed per steer (lbs.)								
Cottonseed meal	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00
Johnson grass hay	13.60	14.27	10.84	12.98	12.67	14.02	12.43	12.92
Feed consumed per 100 lb. gain, (lbs.)								
Cottonseed meal				277.77				625.0
Johnson grass hay				3605.45				8075.0

Note: Both lots of steers made much greater gains in 1931 than during the two previous winters. This was due, no doubt, to the very mild winter of 1931. There was only one freeze recorded in Alabama during that winter.

Reference: Alabama Agricultural Experiment Circular 71, pages 5, 6, Table 2, "Wintering Steers in the Black Belt of Alabama," February 1935, Auburn, Alabama.

V

The Value of Johnson Grass Hay for Wintering Steers, When Fed Alone and in Combination With a Small Amount of Cottonseed Meal, at Auburn, Alabama, 1926-32

In the fall of 1926 experiments were started with the object of obtaining information on the value of Johnson grass hay for wintering steers, when fed alone and in combination with a small amount of cottonseed meal. The experiments were conducted on the Kirkwood Plantation, Faunsdale, Alabama, and were continued over a period of seven years. They were divided into three series as follows:

(1) Johnson grass hay versus Johnson grass hay and cottonseed meal.

(2) Johnson grass hay and one pound of cottonseed meal versus Johnson grass hay and two pounds of cottonseed meal.

(3) Johnson grass hay fields with free access to stacked hay.

Johnson Grass Hay Versus Johnson Grass Hay and Cottonseed Meal.

Cattle used—A total of 45 grade Hereford steers were wintered for 112 days on Johnson grass hay alone during the winters of 1926, 1927, and 1928. The hay was self-fed from racks in a barn and the steers were allowed free access to a ten-acre permanent pasture. There were 10 steers on this ration during the first two winters and 25 steers during the third winter.

The gains and losses in the weight of the steers varied considerably in both lots during the different winters. This may have been due largely to a difference in the age and condition of the animals at the beginning of the wintering period. The steers used in 1926 and 1927 were two year old and were thin in flesh while those used in 1928 were long yearlings and were in good flesh. A difference in weather conditions may have also influenced the results although weather records show that several freezes occurred during each of the three winters.

The details of the results of this experiment are given in Table 19.

Table 19—Johnson Grass Hay Alone Versus Johnson Grass Hay and Cottonseed Meal for Wintering Steers at Auburn, Alabama, 1926-28. (Average 112 days each year)

	Lot 1 Johnson grass hay, self-fed from racks				Lot 2 Johnson grass hay, self-fed from racks and cottonseed meal			
	1926	1927	1928	3 yr. av.	1926	1927	1928	3 yr. av.
No. steers wintered	10	10	25	15	10	10	25	15
Av. wintering period (days)	112	112	112	112	112	112	112	112
Av. init'l wt. per steer (lbs.)	474.00	602.0	600.0	512.44	485.0	619.0	608.0	583.11
Av. final wt. per steer (lbs.)	508.0	578.0	513.0	526.33	545.0	686.0	606.0	610.22
Av. gain or loss per steer (lbs.)	34.0	-24.0	-87.0	-46.11	60.0	67.0	-2.0	27.0
Av. daily gain or loss (lbs.)	.....	.....	.....	-.41	.....	.....	.....	.24
Av. daily feed per steer (lbs.)								
Cottonseed meal	.....	.....	.....	.....	2.0	2.12	1.75	1.89
Johnson grass hay	19.24	22.42	13.41	16.71	19.21	20.58	13.18	16.16
Feed consumed per 100 lb. gain, lbs.								
Cottonseed meal	.....	.....	.....	.....	.....	.....	.....	787.51
Johnson grass hay	.....	.....	.....	.....	.....	.....	.....	6733.39

Reference: Alabama Experiment Circular 71, pages 1, 4, Table 1, "Wintering Steers in the Black Belt of Alabama," February 1935, Auburn, Alabama.

VI

Range Alone Versus Range Plus Half Ration of Cottonseed Meal and Hulls for Wintering Steers in Sumter County, Alabama. 1909-1910.

The object of this test was to ascertain the value of cottonseed meal and hulls for beef cattle when running on the range. The steers used were two and three year old grades of the Hereford, Shorthorn, Aberdeen-Angus and Red Poll breeds.

They were poor in quality and small in size. Many of them were only half-breed, while some even carried a predominance of scrub blood. They would be classed as common stockers on the market.

The Character of the Range—The cattle were kept in enclosed fields which had been used for growing cotton and corn with some of the range consisting of waste land upon which had been grown native grasses. Crab grass and some Johnson grass had grown up between the rows and furnished some grazing. The corn had been snapped from the stalk and the entire stalk was left in the fields. No cane brakes were available and the cattle which were not fed, had to depend entirely upon the stalks in the cultivated fields and the native grasses.

The cottonseed meal was of 38 per cent protein.

The cattle ran in the enclosed field at all times and were not penned at any time of the day or night. No shelter was provided for them, but during the bad weather they sought natural shelter consisting of plum thickets, rows of hedge trees and hillside nooks which gave them protection from the winter.

The feed was placed in feed-troughs. The cattle were fed once each day just before sundown. Salt was given the animals at feeding time to induce them to come more readily to the feed.

The lots were fed as follows:

Lot 1. Range alone.

Lot 2. Range plus half ration cottonseed meal and hulls.

Details of the experiment are given in the following table.

Table 20—Range Versus Range and Half Ration of Cottonseed Meal and Hulls for Wintering Steers in Sumter County, Alabama, December 8, 1909 to March 9, 1910. 91 Days.

Ration	Lot 1 Range Alone	Lot 2 Range plus half ration C. S. Meal and Hulls
No. Steers per lot	33	15
Av. initial weight, lbs.	637	633
Av. final weight, lbs.	531	676
Av. gain or loss per steer	-106	43
Av. daily gain, lbs.	-1.16	.47
Av. daily ration fed, lbs.		
Cottonseed meal		2.4
Cottonseed hulls		8.9
Av. pounds feed required per 100 lb. gain, lbs.		
Cottonseed meal		510.62
Cottonseed hulls		1893.56

Note: The winter of 1909-10 was a severe one and being much colder than the average winter in Sumter County, with a great deal of rain and one hard sleet during December which covered everything with ice for two days. Cold rains and winds made it hard upon the steers.

Reference: U. S. D. A. Bulletin 110, pages 4, 5, 6 and 7, Tables I and II, "Fattening Cattle in Alabama," August, 1914, Washington, D. C.

Suggestive: Was the feeding of cottonseed meal justified in this experiment.

6—THE ADDITION OF COTTONSEED MEAL TO VARIOUS RATIONS

I

The Value of Cottonseed Meal in a Ration Containing Corn Silage, Shelled Corn and Clover Hay for Fattening Two Year Old Steers at Lafayette, Indiana, 1917-18.

The object of this trial was to determine the value of cottonseed meal in a ration containing large amounts of corn silage and shelled corn for fattening two year old steers. **The cattle used** in this test were selected from a large drove which had been pastured for several months previous. As selected, they were very uniform in weight, quality, age, condition and thrift. Practically all were of Shorthorn breeding. They were divided into lots of 10 steers and fed the following ration:

Lot 4. Cottonseed meal, corn silage, clover hay, shelled corn.

Lot 7. Corn silage, clover hay, shelled corn.

Each lot of steers occupied similar quarters which consisted of an uncovered concreted lot 20x28 feet and an open shed 16x28 feet on the west side. These sheds were kept as well bedded as possible. Owing to the severe winter, with large amounts of ice and snow, the spring thaw caused the open lots to become very sloppy. At all times, however, the cattle had dry beds in the sheds.

The cattle were fed under cover. Water was supplied in galvanized iron troughs adjacent to the pen lots, care being taken to keep the water fresh in these troughs. No method of heating was used but the ice accumulating in the troughs was removed regularly twice daily. The cattle had water before them at all times.

The method of feeding in each lot was practically the same, however, in lot 4, the corn with the cottonseed meal sprinkled over it was fed the first thing in the morning and evening at approximately 6 A. M. and 4:30 P. M. The silage was placed in the troughs after the corn had been consumed. In lot 7, the corn was fed first. The hay was fed once daily, being placed in the hay manger in the morning.

The amount of silage fed in all lots was governed by the appetite of the cattle, the intention was to furnish all the cattle would consume in two hours after being placed in the troughs. The amount of hay was determined by the need of the cattle for dry roughages and their appetite for the hay. Only enough was fed so that the cattle would consume the hay without waste or leaving any appreciable amount.

Salt was given to all lots at as frequent intervals as was required. The cattle were started on feed in the following manner:

At the beginning of the feeding period, the silage was increased as rapidly as the cattle would consume the added amount. The cottonseed meal was fed at the rate of one pound per steer daily and gradually increased until at the end of 10 days the cattle were consuming 2.5 pounds daily per 1000 lbs. live weight. The shelled corn was increased gradually.

Details of the experiment are given in the following table.

Table 21—The Value of Cottonseed Meal in a Ration of Corn Silage, Shelled Corn and Clover Hay for Fattening Two Year Old Steers at Purdue University December 13, 1917 to April 12, 1918. (120 Days).

Ration	Lot 4 C. S. Meal Silage Hay Shelled Corn	Lot 7 Silage Hay Shelled Corn
No. of steers per lot	10	10
Av. initial wt., lbs.	1047	1044
Av. final wt., lbs.	1335	1259
Av. gain per steer, lbs.	288	215
Av. daily gain per steer	2.40	1.79
Av. daily ration, lbs.:		
Shelled corn	10.73	11.65
Cottonseed meal	2.9	
Corn silage	38.29	37.02
Clover hay	4.30	4.27
Feed required per 100 lb. gain, lbs.:		
Shelled corn	448	650
Cottonseed meal	121	
Corn silage	1598	2067
Clover hay	179	238

Note: The cattle that were fed cottonseed meal brought a better price than the cattle that received no cottonseed meal because of a better finish.

Reference: Indiana Agricultural Experiment Station 220, pages 5, 6, 7, 8 and 21, Table XIII, "Winter Steer Feeding," 1917-18, Lafayette, Indiana.

Suggestive: How much shelled corn was saved per 100 lbs. by adding cottonseed meal to the ration? How much corn silage was saved per 100 lb. gain? How many more pounds of gain did Lot 4 make than Lot 7? Was the feeding of cottonseed meal justified in this experiment? Which of the two rations would more nearly be classed as a "balanced" ration?

II

The Effect of Cottonseed Meal on the Rate of Gain per Steer When Added to a Ration of Shelled Corn, Silage and Soybean Hay, Purdue University, Lafayette, Indiana, 1931-32.

The cattle used in the trial were grade Montana Herefords, purchased on the Chicago market October 15, 1931. They were grazed on stubble fields containing a good growth of mixed clover and timothy until November 10, when they were brought to the feed lots and allotted according to rations.

The corn and hay fed was of good quality and representative of these feeds as grown in Indiana. **Cottonseed meal** was guaranteed to contain 41 per cent protein. **Silage** was well kept but contained less corn than normal silage. It had been harvested at early corn cutting time.

A ration of corn, soybean hay and silage showed some interesting results when compared with a similar ration containing cottonseed meal, viz: a ration of corn, cottonseed meal, silage and clover hay. The rate of gain was slightly below those fed cottonseed meal, and the value of the cattle was also slightly lower than when the cattle were fed the supplementary concentrates; but the cost of

gain was lower and the finish was so nearly the same that the net returns from the cattle were greater where the soybean hay was depended on to furnish the necessary protein to balance the ration of corn and silage. This confirms a trial conducted in the winter of 1925-26, comparing hay, corn and silage with a similar ration containing cottonseed meal. In this previous trial, the rate of gain was slightly lower but the cost of gain was also low enough to overcome any additional gains made by adding cottonseed meal to the ration.

Table 22 Soybean Hay and Cottonseed Meal for Fattening Cattle.

	Lot 3 Shelled Corn Silage Soybean hay Salt	Lot 4 Shelled Corn Cottonseed Meal Silage Clover Hay Salt	Lot 5 Shelled Corn Cottonseed Meal Silage Soybean Hay Salt
Number animals in lot	10	10	10
Av. initial weight, lbs.	920.0	929.3	930.4
Average final weight, lbs.	1257.3	1274.3	1280.0
Average total gain, lbs.	337.3	345.0	349.6
Average daily gain, lbs.	2.25	2.30	2.33
Total feed consumed, lbs.:			
Shelled corn	21705.	19075.	19080.
Supplements		3472.	3472.
Corn Silage	35610.	35610.	35610.
Roughage	6535.	6865.	6945.
Average daily feed, lbs.:			
Shelled corn	14.47	12.72	12.72
Supplements		2.31	2.31
Corn silage	23.74	23.74	23.74
Roughage	4.36	4.58	4.63
Feed per 100 lbs. gain, lbs.:			
Shelled corn	643.49	552.90	545.77
Supplements		100.64	99.31
Corn silage	1055.74	1032.17	1018.59
Roughage	194.74	198.99	198.66

Reference: Indiana Agricultural Experiment Station Bulletin 296, pages 3 and 4, Table I, "Cattle Feeding," March, 1935, Lafayette, Indiana.

Suggestive: How much average gain did the steers make in each lot? To what can this difference in gain be attributed? Which lot of cattle had the best finish? Which of the rations would be considered as "balanced?"

III

The Effects of Different Proportions of Shelled Corn and Cottonseed Meal on Gains of Beef Steers, Moultrie, Georgia, 1932-33.

Object—In order to study the results of replacing a large percentage of the corn in the fattening ration for cattle with cottonseed meal, feeding experiments were carried on in 1933 by the Experiment Station in cooperation with the United States Department of Agriculture and with the help of Swift and Company at Moultrie, Georgia. Three comparable groups of high grade native yearling steers, 32 head each, were fed. These were mostly Herefords but a number of Angus also were used in this test.

The rations of the three lots consisted of shelled white Georgia corn, cottonseed meal (42 per cent protein), good quality Georgia cowpea hay, steamed bone meal, mineral mixture, and block salt. The mineral mixture was fed only during

the first 28 days of the test and was then replaced with steamed bone meal; it contained ground limestone, hardwood ashes, steamed bone meal, and salt in equal amounts.

Table 23—The Effects of Different Proportions of Shelled Corn and Cottonseed Meal on Gains of Beef Steers, Moultrie, Georgia, 140 Day Test. November 16, 1932 to April 5, 1933

	Lot 1 1 part c. s. meal to 6 parts corn	Lot 2 1 part c. s. meal to 3 parts corn	Lot 3 2 parts c. s. meal to 3 parts corn
Av. starting weights, lbs.	462.7	461.3	460.1
Av. finishing weights, lbs.	753.8	751.8	740.1
Av. gain per steer, lbs.	291.1	290.5	279.9
Av. daily gain per steer, lbs.	2.079	2.075	2.000
Av. daily feed consumption per steer, lbs.			
Shelled corn	11.22	10.77	8.15
Cottonseed meal	1.89	3.59	4.94
Cowpea hay	4.11	3.86	4.37
Salt, bone meal, and minerals	0.16	0.16	0.16
Av. feed consumed per 100 lbs. gain, lbs.			
Shelled corn	539.78	518.99	407.50
Cottonseed meal	90.67	173.07	246.98
Cowpea hay	197.87	185.91	218.61
Salt, bone meal, and minerals	0.768	0.764	0.804

Note: The results indicate that the heavier rate of cottonseed meal feeding produces as good gains as the lighter rates for a short feeding period (first 12 weeks of test) but that the heavier rate does not give equal results after that time. Previous work has indicated that the unfavorable results from heavy cottonseed meal feeding is partly due to vitamin A deficiency. This could be overcome by allowing yellow corn, some grazing, or hay of green color.

Note: Those steers receiving the heaviest proportion of cottonseed meal failed to develop as good quality, as indicated by the selling price at the close of the experiment, as did those in the two lots receiving the lower proportions of cottonseed meal.

Reference: Georgia Experiment Station, Bulletin 184, Pages 45, 46, 47, Table 6, Experiment, Georgia.

Suggestive: What was the total gain made per steer in each lot? Using the present prices of feeds used in the test, what is the cost per 100 lbs. of gain in Lot 1? Lot 2? Lot 3?

Which combination of cottonseed meal and shelled corn proved to be most profitable?

IV

The Effect of Cottonseed Meal in the Ration for Fattening Two Year Old Cattle at Lafayette, Indiana. 1925-1926.

Object—In order to obtain data on the value of cottonseed meal in a ration of shelled corn, soybean hay, corn silage and salt, the Indiana Experiment Station conducted one trial with two year old cattle under the conditions described below.

The cattle used were two year old steers which were a mixture of reds and roans with fairly good heads, of medium quality and in fair flesh. They were purchased on the Chicago market and fed low grade soybean hay until the test started.

The feeds used: Locally grown corn which contained more moisture than is normally found in corn at such seasons of the year. None of the corn would be graded No. 3. However, it was reasonably free from damaged grain. The cottonseed meal was 41 per cent choice grade. The soybean hay was of good quality with the exception of the last two months when it was course and dark. The soybean hay was made from a Manchu variety grown locally. The corn silage was made from well matured corn.

The ration fed each lot was as follows:

Lot 1. Shelled corn, cottonseed meal, soybean hay, corn silage and salt.

Lot 2. Shelled corn, soybean hay, corn silage and salt.

The following table gives the details of the results obtained during this trial.

Table 24—The Effect of Cottonseed Meal in the Ration for Fattening Two Year Old Cattle at Lafayette, Indiana. November 18, 1925, to April 7, 1926. 140 Days.

Ration	Lot 1 C. S. Meal	Lot 2 No C. S. Meal
No. steers per lot	10	10
Av. initial wt. per steer, lbs.	846.3	854.3
Av. final wt. per steer, lbs.	1208.7	1195.3
Av. gain per steer, lbs.	362.4	341.0
Av. daily gain, lbs.	2.59	2.44
Av. total feed consumed, lbs.		
Shelled corn	1773.	1977.
Supplement	333	----------
Corn silage	3276	3426
Hay	607	617
Salt	8	9
Av. daily feed per head, lbs.		
Shelled corn	12.66	14.12
Supplement	2.37	----------
Corn Silage	23.40	24.47
Hay	4.34	4.41
Av. feed required per 100 lb. gain, lbs.		
Shelled corn	489.	580
Supplement	91	----------
Corn Silage	904	1005
Hay	167	181

Note: It was observed that the appetites of the cattle were not materially affected by the addition of the cottonseed meal. After the first two months on feed the cattle receiving corn alone ate enough more corn than those fed both corn and cottonseed meal to equal the latter in total quantity of concentrate consumed. The finish of the cattle was the same in both lots, a fact usually expected in such a comparison.

Reference: Indiana Agricultural Experiment Station Bulletin 330, pages 3, 4 and 15, Table III, "Cattle Feeding," January, 1929, Lafayette, Indiana.

Suggestive: Is the addition of cottonseed meal in the ration of the cattle in Lot 1 justified by the increased gain?

V

The Value of Cottonseed Meal When Used as a Supplement to a Corn, Hay, and Silage Ration for Fattening Two Year Old Steers at Lafayette, Indiana, 1906-08.

The purpose of this experiment was to determine the value of cottonseed meal for the supplement to rations composed of shelled corn, clover hay and corn silage when fattening two year old steers.

The cattle used during 1906-07, were classed as good, heavy, fleshy steers. They were plain, not so blocky and compact as desirable, and showed a tendency to coarseness. They were of common cows and largely sired by Shorthorn bulls, though there were a few Angus and Hereford grades among them.

The cattle used during the 1907-08 test were of the same general type and breeding as those used in 1906-07, but averaged about 110 pounds per steer heavier.

Method of Feeding—The shelled corn was fed at 6 A. M. and 4:30 P. M. in troughs in the open lots. The cottonseed meal was mixed with the grain. After the cattle had cleaned the grain ration thoroughly, which usually required from one-half to three-fourths of an hour, they were fed the roughage in mangers in the open lot. The hay was fed in the morning and the silage in the evening. All fed was limited to such quantities as would be cleaned up readily. Salt was supplied at regular intervals.

The lots in which the cattle were fed were 40x50 feet with an open shed 12x40 feet on the west side of each lot. No bedding was used in the lots. The sheds were kept dry by use of straw. The lots were muddy throughout a greater part of the time covered by the experiment.

The feeds used—The quality of corn used in 1906-07 was fairly good and would be graded No. 3. There was a large amount of rotten grain which was impossible to avoid.

The corn used the second year was inferior in quality, at times very soft and contained a large per cent of moisture. Extreme care was necessary at all times to keep it from heating in the bin.

The cottonseed meal was guaranteed to contain 41 per cent protein.

The clover hay used during the first trial was free from weeds and other grasses, but had been damaged in the stack, frequently showing a streak of white mold, but on the whole a very good quality. In the second test it was impossible to obtain pure clover so a mixture of clover with blue grass and Timothy was fed, estimated at practically two-thirds clover and one-third foreign grasses. The corn silage was an excellent quality during both tests.

The rations fed:

Lot 1. Shelled corn, cottonseed meal, clover hay and corn silage.

Lot 2. Shelled corn, clover hay and corn silage.

Details of the experiment are given in the following table.

Table 25—The Value of Cottonseed Meal as a Supplement to Shelled Corn, Clover Hay and Corn Silage for Fattening Two Year Old Steers at Lafayette, Indiana. 1906-08. Average of 2 Trials. Average Length of Each Trial—165 Days.

Ration	Lot 1 C. S. Meal	Lot 2 No C. S. Meal
No. of steers per lot	10	10
Av. initial weight, lbs.	1066	1069
Av. final weight, lbs.	1501	1372
Av. gain per steer, lbs.	434	302
Av. daily gain, lbs.	2.63	1.82
Av. daily ration, lbs.:		
Shelled corn	17.8	16.8
Cottonseed meal	2.8	----------
Clover hay	4.4	4.5
Corn silage	15.5	15.5
Av. feed required per 100 lb. gain, lbs.		
Shelled corn	675.	950.
Cottonseed meal	110.	----------
Clover hay	175.	250.
Corn silage	585.	820.

Note: The cattle receiving cottonseed meal attained a higher finish, distributed fat more evenly over the carcass, and had a higher market value than those that did not receive cottonseed meal.

Reference: Indiana Agricultural Experiment Station Bulletin 129, pages 236, 238, 265 and 266, Table VIII, "Winter Steer Feeding," October, 1908, Lafayette, Indiana.

Suggestive: Was there any difference in total gain per steer in the two lots? Which lot required the most shelled corn per 100 lb. gain? Which ration would net the greater return per steer?

VI

The Value of Cottonseed Meal When Used as a Supplement to Shelled Corn and Clover Hay for Fattening Two Year Old Steers at Lafayette, Indiana, 1907-09.

The object of this trial was to ascertain the value of cottonseed meal in a corn and hay ration for fattening two year old steers.

The cattle used in this trial were of good, heavy, fleshy feeder type. They were plain, fairly compact and showed a tendency to coarseness. They were from common cows and largely sired by Shorthorn bulls, though there were a few Angus and Hereford grades among them.

Method of feeding—The shelled corn was fed at 6 A. M. and at 4:30 P. M. in troughs in the open lots. The cottonseed meal was mixed with the grain. After the cattle had cleaned up the grain ration they were fed the clover hay in mangers in the open lot in the morning. All feeds were limited to such quantities as would be cleaned up readily. Salt was supplied at regular intervals.

Feeds used—The corn used in 1907-08 was inferior in quality, at times very soft and contained a large per cent of moisture. In 1908-09, the quality of corn was exceptionally good. It was free from mould and chaff, and would have graded No. 2.

The cottonseed meal used in 1907-08 and 1908-09 was guaranteed to contain 41 per cent protein.

The clover hay used in 1907-08 was not pure. It contained a mixture of two-thirds clover and one-third foreign grasses. The clover hay used in 1908-09 was of very good quality, free from weeds and foreign grasses and of good color.

The lots in which the cattle were fed were 40x50 feet with an open shed on the west side of each lot. No bedding was used in the lots, but the sheds were kept dry by means of straw. The lots were muddy throughout a greater part of the experiment.

The ration fed each lot was as follows:

Lot 1. Shelled corn and clover hay.

Lot 2. Shelled corn, cottonseed meal and clover hay.

Details of the experiment are given in the following table.

Table 26—The Value of Cottonseed Meal as Supplement to Corn and Clover Hay for Fattening Two Year Old Steers at Lafayette, Indiana. An Average of Two Trials. Average Length of Each Trial—166 Days.

Ration	Lot 1 Shelled Corn Clover Hay	Lot 2 Shelled Corn Clover Hay C. S. Meal
No. of steers per lot	10	10
Av. initial weight, lbs.	1042	1048
Av. final weight, lbs.	1356	1448
Av. gain per steer, lbs.	314	400
Av. daily gain, lbs.	1.89	2.43
Av. daily ration, lbs.		
Shelled corn	19.08	18.52
Clover hay	9.90	9.62
Cottonseed meal	.....	2.81
Average feed required per 100 lb. gain, lbs.		
Shelled corn	1002.	758
Clover hay	518	392
Cottonseed meal	.....	116

Note: The cattle receiving cottonseed meal attained a higher finish, distributed fat more evenly over the carcass, and had a higher market value than those that did not receive cottonseed meal.

Reference: Indiana Agricultural Experiment Station Bulletin 129, pages 236, 237, 238, 271, Table IX, "Winter Steer Feeding," October, 1908, Lafayette, Indiana.

Suggestive: How much more average gain was made per steer in Lot 2 than in Lot 1? Was the feeding of cottonseed meal in Lot 2 justified? Which of the rations would be considered to be more nearly a "balanced" ration?

VII

Cottonseed Meal Combined with Various Rations for Fattening Beef Calves at Stillwater, Oklahoma, 1927-28.

Cattle used—Fifty high grade Hereford calves were secured from the Matador Land & Cattle Company ranch in Texas and were delivered in Stillwater on November 8th. These calves were carefully sorted as to size, weight, conformation and quality and were placed on feed on November 16th.

The primary objects of this test were as follows:

1st. To study various rations when combined with cottonseed meal for fattening steer calves.

2nd. To determine the amount of cottonseed meal that can be used profitably and safely in the fattening ration for calves.

3rd. To determine the advisability of adding ground limestone to the ration.

4th. To determine if it is advisable to substitute prairie hay for alfalfa hay when a heavy ration of meal and limestone is used.

5th. To determine the advisability of substituting cottonseed meal pound for pound for corn.

The 50 head of steer calves were divided into five lots of ten each and to be continued on feed for 200 days on daily rations as follows:

Lot 1. Ground corn, cottonseed meal 1½ lbs., alfalfa hay, and ground limestone 2% of grain ration.

Lot 2. Ground corn, cottonseed meal 2½ lbs., alfalfa hay and ground limestone 2% of grain ration.

Lot 3. Ground corn, cottonseed meal 3½ lbs., alfalfa hay and ground limestone 2% of grain ration.

Lot 4. Ground corn, cottonseed meal 2½ lbs., alfalfa hay.

Lot 5. Ground corn, cottonseed meal 2½ lbs., prairie hay and ground limestone 2% of grain ration.

Table 27—Effect of Various Rations With Cottonseed Meal Compared for Fattening Beef Calves, Stillwater, Oklahoma. Nov. 16, 1927 to June 3, 1928. (200 Days).

Lot	I	II	III	IV	V
No. steers per lot	9*	10	10	10	10
Av. initial weight	314.2	310.8	309.3	317.5	326.1
Av. final weight	718.8	678.	705.	695.	703.
Av. daily gain	2.02	1.83	1.98	1.89	1.88
Total concentrates per steer	9.43	9.40	9.43	9.52	9.43
Average Daily Ration:					
Ground corn	8.15	7.39	6.66	7.5	7.39
Cottonseed meal	1.28	2.01	2.77	2.02	2.04
Alfalfa hay	4.3	4.29	4.29	4.27	
Prairie hay					4.28
Ground limestone	.16	.15	.14		.15
Feed per 100 lbs. gain:					
Grain	576.2	631.2	586.3	607.6	616.9
Hay	194.	211.3	211.3	203.4	194.1
Dressing Percentage	55.5	57.7	56.3	56.4	55.9

*Steer No. 14, Lot 1, died from pneumonia on February 15th.

Note: The steers in all the lots were light weight at the beginning and did not make the daily gains in the early part of the period that would have been possible had these steers been 50 pounds heavier at the start.

The steers in all lots were fed according to appetite. As the amount of cottonseed meal was increased, the amount of corn was held down in proportion. Therefore, the total amount of concentrates remained approximately the same in each lot.

Reference: Oklahoma Agricultural Experiment Station Bulletin 179, pages 1, 2 and 6, "Beef Cattle Feeding Investigations," June 1928, Stillwater, Oklahoma.

Suggestive: How much did calves in Lot 1 gain? What is the average gain per steer in Lots 4 and 5? What difference is there in the rations of Lots 4 and 5? Which of the five lots required the least amount of feed to make 100 lbs. of gain? Which ration would you feed to fattening calves?

VIII

Cottonseed Meal Fed in Varying Amounts to Steer Calves at Stillwater, Oklahoma, 1930-31.

The primary objects of this test were to study various rations when combined with cottonseed meal for fattening steer calves; to determine the amount of cottonseed meal that can be used profitably in the fattening ration for calves; to determine the advisability of adding ground limestone to the ration; to determine the advisability of feeding ground shelled corn and prairie hay without a protein supplement; and to determine the advisability of substituting cottonseed meal, pound for pound, for corn.

The calves for this experiment were carefully sorted as to size, weight, conformation and quality, and were placed on feed November 17, 1930. The calves were divided 10 to each lot.

The rations fed:

Lot 1. Ground shelled corn, full fed; cottonseed meal, 1½ lbs.; prairie hay; and ground limestone, 2% of the grain ration.

Lot 2. Ground shelled corn, full fed; cottonseed meal, 2½ lbs.; prairie hay; and ground limestone, 2% of the grain ration.

Lot 3. Ground shelled corn, full fed; cottonseed meal, 3½ lbs.; prairie hay; and ground limestone, 2% of the grain ration.

Lot 4. Ground shelled corn, full fed; cottonseed meal, 2½ lbs.; prairie hay.

Method of feeding: The steers in all lots were fed according to appetite. As the amount of cottonseed meal was increased, the amount of corn was held down in proportion. Therefore, the total amount of concentrate remained approximately the same in the first four lots.

Table 28—Results of Feeding Cottonseed Meal to Fattening Steers in Varying Amounts at Stillwater, Oklahoma, 1930-31.

Ration	Lot 1 1½ lbs. C. S. Meal	Lot 2 2½ lbs. C. S. Meal	Lot 3 3½ lbs. C. S. Meal	Lot 4 2½ lbs. C. S. Meal
No. of steers per lot	10	10	10	10
Av. initial weight, lbs.	399	399	397.5	398.5
Av. final weight, lbs.	759.8	763.08	773.06	754.38
Av. gain per steer, lbs.	360.8	364.08	375.56	355.88
Av. daily gain, lbs.	2.2	2.22	2.29	2.17
Av. daily ration, lbs:				
Ground shelled corn	9.62	8.66	7.66	8.67
Cottonseed meal	1.50	2.47	3.60	2.47
Prairie hay	5.23	5.13	5.14	5.09
Limestone (gr.)	.20	.17	.15	
Total concentrates per head, lbs.	11.12	11.13	11.26	11.14
Feed required to produce 100 lbs. gain, lbs.:				
Concentrates	505.	501.	493.	513.
Roughage	237.	231.	225.	234.

Note: There were no ill effects from the use of cottonseed meal in any of the lots during the 164-day feeding period.

Reference: Oklahoma Agricultural Experiment Station Report 1930-32, pages 81, 82 and 83, Table XXIV, "Solving Oklahoma Farm Problems," Stillwater, Oklahoma.

Suggestive: What amount of cottonseed meal gave the fastest gain? What amount gave the slowest gain? Which lot required the least amount of feed to make 100 lbs. of gain? How much meal was fed daily in this lot?

IX

Fifteen Pounds Silage and Two Pounds Cottonseed Meal Versus Thirty Pounds Silage and One Pound Cottonseed Meal for Fattening Two Year Old Cattle at Knoxville, Tennessee. 1914-16.

The purpose of this experiment was to compare silage and cottonseed meal when fed in varying proportions to two year old cattle.

The equipment used in this experiment was a barn 74x40 feet with stabling below and a loft for hay above. The silage was stored in a wood-hoop silo 12x28 feet.

The cattle used in this experiment were poor to medium market grade classes of Herefords and Shorthorns.

The feed used in this experiment was described as follows:

The silage was made from corn and sorghum with the sorghum predominating, and the corn well-eared but immature and was put into the silo generally before frost. **The cottonseed meal** was 36 per cent protein meal.

When the cattle were put on feed in the fall, the feeds were weighed for a few days until it was known what the measures held and thereafter they were fed like amounts by measure. The cattle were stabled in pens in the barn during the night and when stormy during the day. Manure was hauled from time to time during the winter when the weather permitted. When an animal was sick, it was isolated and given a pound of Epsom Salts. The cattle obtained water when let out of the pens each day. In the fall of each year, they were put on full feed immediately after weighing.

The cattle were divided into lots and **fed as follows**:

Lot 2. 15 pounds silage, 2 pounds cottonseed meal.

Lot 3. 30 pounds silage, 1 pound cottonseed meal.

In addition to the above winter ration, cattle from each group were allowed the run of the range during the day when the weather was fair.

Table 29—Fifteen Pounds Silage and Two Pounds Cottonseed Meal Versus Thirty Pounds Silage and One Pound Cottonseed Meal for Fattening Two Year Old Cattle at Knoxville, Tennessee. A Two Year Average 1914-15 and 1915-16.

Ration	Lot 2 15 lbs. silage 2 lbs. cottonseed meal	Lot 3 30 lbs. silage, 1 lb. C. S. meal
No. of head per lot	7	7
Av. initial wt. lbs.	579	598
Av. final wt., lbs.	903	899
Av. gain per head, lbs.	324	301
Av. daily gain per head, lbs.	1.2	1.1
Av. daily ration, lbs.:		
Silage	15	30
Cottonseed meal	2	1
Feed required per 100 lb. gain, lbs.:		
Silage	1250	2727
Cottonseed meal	166.6	90.9

Reference: Tennessee Agricultural Experiment Station Bulletin 125, pages 49, 50, 51 and 53, Tables 1 and 2, "Stocker Cattle Problems On The Cumberland Plateau," June, 1921, Knoxville, Tennessee.

Suggestive: Assuming that you could get the same results from feeding silage and cottonseed meal as indicated in the above experiment, could you afford to double the proportion of silage to cottonseed meal?

X

The Value of a Small Amount of Cottonseed Meal When Added to the Ration for Wintering Steers in Greenbrier County, West Virginia. 1914-18.

The objects of the experiments were to ascertain the effect of different rations upon subsequent pasture gains and to determine the most economical method of wintering beef steers.

The steers used in these experiments were of grade Shorthorn, Hereford and Aberdeen-Angus breeding. They were raised in Southern West Virginia and were a good uniform lot of cattle in age, weight, quality and condition.

The feeds used: Cottonseed meal was 41 per cent protein the first year and 36 per cent protein the last three years. The corn silage was made from a mixture of dent and silage corn. The mixed hay used was a mixture of timothy and clover.

The pasture used: About 160 acres of rather rough land, ¼ of which was in wood-land, was used for pasture. It was situated in a valley between two mountains and a small stream which flowed through it provided an abundance of water at all times throughout the summer.

Method of Feeding—In the fall before starting the steers on winter feed, they were divided into lots of 10 each. In this division care was taken to have the lots as nearly the same as possible in regard to quality, breeding, size and condition. The cattle were fed twice a day.

The lots were fed the following rations:

Lot 1. Corn silage, mixed hay and wheat straw.

Lot 2. Corn silage, wheat straw and cottonseed meal.

Lot 3. Mixed hay and wheat straw.

Details of the experiment are given in the following table.

Table 30—The Value of Cottonseed Meal When Used in the Ration for Wintering Beef Cattle in Greenbrier County, West Virginia. 1914-1918.—4 Year Average. Average Length of These Trials—129 Days.

Ration	Lot 1 Corn Silage Mixed Hay Wheat Straw	Lot 2 Corn Silage Wheat Straw C. S. Meal	Lot 3 Mixed Hay Wheat Straw
No. of steers per lot	10	10	10
Av. initial weight, lbs.	663	664	665
Av. final weight, lbs.	662	726	630
Av. gain or loss per steer, lbs.	-1	62	-35
Av. daily gain or loss, lbs.	-.01	.48	-.46
Av. daily ration, lbs.			
Corn silage	19.8	22.9	----------
Mixed hay	5.	----------	11.9
Wheat straw	2.5	4.9	4.1
Cottonseed meal	----------	1.	----------
Av. feed required per 100 lb. gain, lbs.:			
Cottonseed meal	----------	208.	----------
Corn silage	----------	4763	----------
Wheat Straw	----------	1019	----------
Av. summer gain per steer on pasture alone	317.	262	309.

Reference: U. S. D. A. Bulletin 870, pages 3, 4, 5, 6, 7, 8 and 9, Tables IV, V and VI, "The Effect of Winter Rations on Pasture Gains of Yearling Steers," November, 1921, Washington, D. C.

Suggestive: What was the average gain in each lot? What is the difference in the ration of Lot 1 and Lot 2? Was the increase in gain in Lot 2 per steer enough to justify the feeding of cottonseed meal?

7—COTTONSEED MEAL AND HULLS VERSUS THE ADDITION OF SOME OTHER CONCENTRATES

I

A Ration of Cottonseed Meal and Cottonseed Hulls Versus a Mixed Ration of Cottonseed Hulls, Hay, Corn Meal, Cottonseed Meal and Wheat Bran for Fattening Beef Cattle at State College, Mississippi. 1905.

The purpose of this test was to ascertain the value of cottonseed meal and cottonseed hulls as a beef cattle feed when compared with a well balanced ration of other feeds.

Cattle Used—The cattle used in this experiment were grade Shorthorns and Angus. They were all in good thrifty condition when purchased and would have been classed as medium feeders. Their ages ranged from two to four years. The four year old steers were fairly well finished when the experiment was begun and consequently made very poor gain.

Method of Feeding—All the cattle were fed twice a day at 6 A. M. and at 5 P. M. The troughs were cleaned out every time before feeding and the feeds

were weighed and the weights recorded. The roughage, hay and hulls were fed first, then the meal which was thoroughly mixed with it.

The lots receiving cottonseed meal and hulls had their ration divided equally between the two feeds, i. e., 13 to 15 pounds of hulls and 3 to 4 pounds meal at each feeding. Those receiving the mixed ration were given hulls in the morning and hay at night. During the first period, which was 32 days, 3 pounds of cottonseed meal was fed with the hulls and 2 pounds each of corn meal and bran with the hay.

In the second period, which was 28 days, 2 pounds each of cottonseed meal and bran were fed with the hulls and 5 pounds corn meal with the hay.

In the third period, which was 34 days, the corn meal fed at night was increased 1 pound daily up to 10 pounds and 2 pounds corn meal was fed in the morning along with 2 pounds cottonseed meal and bran, making a total of 12 pounds corn meal per day.

Feeds Used—The cottonseed meal and hulls used in this test were of good quality. The hay used during the first two feeding periods was about two-thirds alfalfa and one-half Johnson grass, but during the third feeding period, only second class Johnson grass hay could be obtained. The corn meal used was the best store meal and the wheat bran was a good quality.

Water was kept before the cattle at all times.

The steers were divided as nearly equal as possible in regard to age, quality and size, and fed the following rations:

Lot 4. Cottonseed hulls, mixed hay, corn meal, cottonseed meal and wheat bran.

Lot 5. Cottonseed hulls and cottonseed meal.

Details of the experiment are given in the following table.

Table 31—A Ration of Cottonseed Meal and Hulls Versus a Ration of Cottonseed Meal and Hulls, Corn Meal, Wheat Bran and Mixed Hay for Fattening Beef Cattle at State College, Mississippi. January 8 to April 11, 1905. Length of Test—94 Days.

Ration	Lot 4 Mixed Ration	Lot 5 C. S. Hulls C. S. Meal
No. of steers per lot	5	5
Av. initial weight, lbs.	871	974
Av. final weight, lbs.	1067	1119
Av. gain per steer, lbs.	196	146
Av. daily gain, lbs.	2.08	1.52
Av. daily ration, lbs.		
Cottonseed meal	2.3	6.7
Cottonseed hulls	13.72	28.1
Mixed hay	9.6	----
Corn meal	6.2	----
Wheat bran	2.1	----
Feed required per 100 lb. gain, lbs.		
Cottonseed meal	120	442
Cottonseed hulls	658	1854
Mixed hay	460	----
Corn meal	297	----
Wheat bran	100	----

Note: The steers in Lot 5 did not have shelter protection while those in Lot 4 had a shelter in one end of the lot. This was the only difference in feed lot conditions between the two lots.

Reference: Mississippi Agricultural Experiment Station Bulletin 92, pages 3, 4, 6, 8, 20 and 21, "Feeding Beef Cattle in Mississippi," August, 1905, State College, Mississippi.

Suggestive: How does the gain made per steer in the two lots compare? Was the cost per 100 lbs. gain in Lot 4 as economical as the gain in Lot 5? Calculate on basis of present feed prices. Is a complex ration more efficient than a simple ration?

8—COTTONSEED MEAL VERSUS MISCELLANEOUS PROTEIN CONCENTRATES

I

Cottonseed Meal Versus Old Process Linseed Meal Fed in Conjunction With Native Hay for Fattening Beef Steers, Laramie, Wyoming, 1920-1921.

Thirty-six high-grade range Hereford steers from the Gunnison district of Colorado were selected in the stockyards of Denver, January 19, 1920. These cattle were remarkably uniform in all particulars. They were classed as long yearlings and were graded as choice feeders. These were two-year-old steers at this time and had been run together on an upland pasture for 5 months during the summer.

The cattle were divided into 4 groups with due regard to uniformity in type, thrift, weight, breeding and quality. No attention was paid to any previous allotment. All groups were then placed on a preliminary feed for 21 days in order that they might become accustomed to dry lot feeding and to the feeds used.

Group I received a full feed of native hay and about 2.5 pounds cottonseed meal per steer.

Group II was fed the same amount of native hay as check Group I and the same amount of old process linseed meal as was fed of cottonseed meal to Group I.

Group III received one-half the amount of native hay consumed by the check group and the same allowance of cottonseed meal and a full feed of sunflower silage. Group IV was given identically the same ration as Group III due to the fact that oat and pea silage was not available during the preliminary feeding period.

The hay was fed to all groups in a large rack holding several days' allowance. The cottonseed meal was fed to Group I and the linseed meal to Group II in large feed bunks about 10:00 a. m. each day.

The hay used came from Robert Martin's ranch north of Laramie. It was a very high grade of hay but contained a large percentage of broadleaf grasses and less of the wheat grasses than the hay used in the former trial. There was a tendency for the cattle in Groups I and II to scour more or less throughout the test, probably due to the high ash content of the hay. The high ash content was probably due in part to external deposits of alkaline salts arising from evaporation of irrigation water from the grass plants. The hay was baled from the stack and hauled in as used in the experiment.

The cattle were confined to the lots throughout the entire trial, except when driven out to the scales, which were located at the end of a lane adjoining the shed.

Table 32—Cottonseed Meal Versus Linseed Meal for Fattening Steers When Fed With Native Hay, Laramie, Wyoming, 1920-1921.

	Group I Native Hay, Cottonseed Meal	Group III Native Hay, Linseed Meal
Steers per group	3*	3*
Average initial weight, lbs.	1002.33	1013.33
Average final weight, lbs.	1132.00	1129.00
Average gain per steer, lbs.	129.67	116.11
Average daily gain per steer, lbs.	1.63	1.08
Daily ration fed, lbs.:		
Native hay	15.00	15.00
Sunflower silage	———	———
Oat and pea silage	———	———
Cottonseed meal	3.44	———
Linseed meal	———	3.44
Total feed consumed daily, lbs.	18.44	18.44
Feed consumed per 100 lbs. gain, lbs.		
Native hay	1506.36	1769.33
Sunflower silage	———	———
Oat and pea silage	———	———
Cottonseed meal	207.12	———
Linseed meal	———	321.34

*One steer was added to each group Dec. 24, making a total of 9.

Note: Results obtained in Group III and IV have been omitted from the table because only silage comparisons are made.

Reference: Wyoming Agricultural Experiment Station Bulletin 128, pages 60, 68, 69, 70 and 72, Table IV, "Homegrown Feeds for Range Steers," June, 1921, Laramie, Wyoming.

Suggestive: How much more did each steer gain in Lot I than they did in Lot II? Based on the results of this test, how much more is a ton of cottonseed meal worth than a ton of linseed meal?

II

Cottonseed Meal Compared with Cold Pressed Cottonseed and Peanut Meal for Supplementing a Ration Composed of Ground Milo, Corn or Sorghum Silage, and Sudan Hay for Fattening Calves at College Station, Texas, 1915-1916.

The object of this test was to compare the value of cottonseed meal, cold pressed cottonseed and peanut meal as a protein supplement.

High grade Aberdeen-Angus steer calves were used in the experiment. They were quite uniform and, as a whole, a choice lot of feeders. Being, for the most part, March and April calves they were from six to eight months old when on November 2 they were weaned and shipped to College Station.

The experiment was not begun immediately, and the calves were fed together from the day they arrived until December 13, their ration consisting of cold-pressed cottonseed, ground milo, corn silage, and Sudan hay. There was no trouble whatever in getting them on feed. After the first few days they were fed all the roughage (silage and hay) they would eat but the amount of concentrates (cake and milo) was kept low until after the experiment started.

On December 12 and for several days previous, the ration per head daily was 2 pounds cold-pressed cottonseed, 2 pounds ground milo, 14 pounds silage, and 3 pounds Sudan hay.

On December 13 the calves were divided into three lots of twelve each, the effort being made to have the lots as similar to each other as possible with respect to weight, conformation, quality and condition. Each lot was then started on the ration it was to receive during the experiment. The feeds constituting the rations fed were as follows:

Lot 1. Cottonseed meal, ground milo, corn silage, and Sudan hay.

Lot 2. Peanut meal, ground milo, corn silage, and Sudan hay.

Lot 3. Cold-pressed cottonseed, ground milo, corn silage, and Sudan hay.

Each lot of calves was subjected to the same conditions throughout the experiment except in respect to the rations. Each lot occupied a pen 60x100 feet and had access to a shed open on the south side. Water from a deep well was supplied in galvanized iron troughs in the open pen, and granular salt in small wooden troughs under the shed, so that the calves had free access to both at all times. The hay racks were under the shed, but the troughs for the concentrates and silage were in the open. Except in the case of hay, all feeds were supplied regularly twice daily, early in the morning and late in the afternoon, the rations being divided between the two feeds. The concentrates and silage were thoroughly mixed together by hand in the troughs. The hay was placed in the racks in the morning, a sufficient quantity being allowed for the whole day.

Table 33—Cottonseed Meal Compared with Cold-Pressed Cottonseed and Peanut Meal for Fattening Calves at College Station, Texas. Length of Test—201 Days. December 20, 1915 to July 8, 1916.

	Lot 1 C. S. Meal	Lot 2 Peanut Meal	Lot 3 Cold Pressed Cottonseed
No. of calves	12	12	12
Av. initial weight, (lbs.)	475	465	476
Av. final weight at College Station (lbs.)	801	772	792
Av. gain per head (lbs.)	326	307	316
Av. daily gain per head (lbs.)	1.62	1.52	1.57
Net shrinkage, per cent	6.1	3.88	4.41
Av. daily ration (lbs.) :			
Meal or cake	1.89	3.77	3.77
Ground milo	8.23	8.21	8.21
Silage (corn or sorghum)	13.72	10.60	12.35
Sudan hay or cotton seed hulls	2.27	1.11	1.14
Feed required for 100 lb. gain (lbs.) :			
Meal or cake	116.54	247.18	240.14
Ground milo	507.59	538.11	522.78
Silage (corn or sorghum)	846.16	694.38	785.54
Sudan hay or cotton seed hulls	140.03	73.16	72.84
Blackstrap molasses	1.99	2.11	2.05

Note: The following report was given by Armour & Company: "In judging these lots from a beef standpoint, Lot 3 was first choice. The cattle in this lot were thicker and filled out better, had a very good cover, a good color, and a larger percentage of fat. Lot 2, second choice, were very good cattle, with a possible exception of two off cattle in the lot, which had not done as well as the

balance. They had a very good color, white fat, and showed a smoother finish than any of the other lots. However, they were not as thick, nor did they make the percentage of beef as Lot 3. Lot 1 was a third choice, had a higher color, and the fat was not as white as other lots. In summing up the total, however, taking all lots together, they were a very desirable kind of beef for this territory, and were about as even a bunch as we ever get."

Reference: Texas Agricultural Experiment Station Bulletin 198, pages 5, 8, 9, 15, and 17, Table VI, "Feeding Baby Beeves," November, 1916, College Station, Texas.

Suggestive: Which lot required the least amount of supplement to make 100 pounds of gain? What is the relative cost per 100 pound gain in each lot?

9—COTTONSEED MEAL VERSUS COTTONSEED

I

Silage Compared With Cottonseed Hulls, and Cottonseed Meal Compared With Cottonseed for Fattening Cattle at College Station, Texas, 1912-13.

The purpose of this experiment was to make a comparison of silage and cottonseed hulls in conjunction with cottonseed meal for fattening cattle, and to ascertain the relative values of cottonseed meal and cottonseed as supplements to silage.

The plan of the experiment is as follows: The morning of October 16, 1912, the steers were divided into four lots of 7 head each, (only Lots 1, 2 and 4 will be used in this report), the lots being designated as Lots 1, 2, 3 and 4. The division was made as equally as possible with regard to breed, conformation, quality, condition and weight.

The cattle used were well graded Shorthorn and Hereford steers, 19 head of Shorthorn and 9 of the Hereford, and were two years past in age. Most of them were of average quality and of very good feeder conformation. Eight of them were rather narrow, shallow bodied and leggy, and hence, noticeably inferior to the others. All were rather thin in flesh but in good thrift when the experiment began.

The greater portion of the cottonseed meal used was below prime grade. The other feeds were of very good quality. The silage fed during the first 107 days of the test was composed of sorghum and cowpeas and that fed during the remaining days (32) of Indian corn. It was estimated that the former contained about 90 per cent sorghum and 10 per cent cowpeas.

The pens in which the steers were confined were 60x100 feet in area, had neither sheds nor wind breaks, and hence, were entirely unprotected from the weather. Water from a deep well was kept before the cattle at all times. The cattle had free access to granular salt throughout the test.

The day's rations for each lot was carefully weighed and divided into two equal parts, one part being fed early in the morning and the other late in the afternoon. The feeds composing each ration were thoroughly mixed in the feed troughs.

Weights of the cattle were taken at intervals of every 30 days throughout the test.

The experiment covered a period of 139 days, from the evening feed of October 16, 1912, to the morning feed of March 4, 1913.

The day's ration per steer for each lot at the beginning was as follows:

Lot 1. Two pounds cottonseed meal, 20 pounds cottonseed hulls.

Lot 2. Two pounds cottonseed meal, 24 pounds silage.

Lot 4. Three pounds cottonseed, 24 pounds silage.

After only a few days taken to get the cattle accustomed to their feed, the hulls and silage were rapidly increased, as much being given them as was readily consumed. It was noticeable that from the beginning, and in fact, throughout the experiment that Lot 2, receiving meal and silage, ate their feed with much more relish than did Lot 1 receiving meal and hulls.

In getting the cattle to full feed, the cottonseed meal and the cottonseed were increased at much slower rate than was the roughage portion of the rations.

The feeds were gradually increased in each lot by periods—the first four periods were of 30 days each, the last period was only 19 days. The average daily ration per steer for the first 30 days was as follows:

	Lot 1	Lot 2	Lot 4
Cottonseed meal	2.6	2.6	----
Cottonseed hulls	22.6	----	----
Silage	----	42.3	37.4
Cottonseed	----	----	4.1

and the average daily ration received per steer for the last 19 day period was as follows:

	Lot 1	Lot 2	Lot 4
Cottonseed meal	6.	6.	5.6
Cottonseed hulls	30.	----	----
Silage	----	52.	49.2
Cottonseed	----	----	.56

Table 34—Cottonseed Hulls Versus Silage as a Roughage for Steers at College Station, Texas, October 12, 1912 to March 4, 1913

	Lot 1 Cottonseed meal Cottonseed hulls	Lot 2 Cottonseed meal Silage	Lot 4 Cottonseed Silage (Cottonseed meal)
No. steers per lot	7	7	7
Av. initial wt. at feed lot, lbs.	864.2	837.8	825.7
Av. final wt. at feed lot, lbs.	1227.	1156.	1140.
Av. gain per head feed lot ,wt., lbs.	362.8	318.5	314.2
Av. daily gain feed lot wt., lbs.	2.61	2.29	2.26
Shrinkage per head during shipment, lbs.	177.	105.	107.
Av. daily ration fed, lbs.:			
Cottonseed meal	4.2	4.2	----
Cottonseed hulls	28.4	----	----
Silage	----	50.9	44.42
Cottonseed	----	----	6.3
Feed consumed per 100 lb. gain, feed lot wt., lbs.			
Cottonseed meal	157.1	178.9	34.2
Cottonseed hulls	1081.3	----	----
Silage	----	2217.9	1948.4
Cottonseed	----	----	244.7
Total feed consumed per head, lbs.:			
Cottonseed meal	569.9	569.9	107.5
Cottonseed hulls	3923.6	----	----
Silage	----	7065.6	6123.6
Cottonseed	----	----	769.1

Note: During the last 19 day period of the test, the steers in Lot 4 were fed only .56 lbs. of cottonseed, but 5.6 lbs. of cottonseed meal was substituted for the cottonseed. A very noticeable condition existed, especially in Lot 1 and to a lesser degree in the other. Throughout the experiment the cattle consumed lots of salt and drank a great deal of water, more than in Lot 2. Though this is attributed, of course, to the drier character of the rations on which they were fed, it is nevertheless, a point of much importance from the fact that it very likely had much to do with the somewhat greater gains they made as well as the greater shrinkage they sustained in shipment to market. Weather conditions were quite severe during much of the experiment. It rained a great deal during December and January and the wind and cold were quite severe during much of that period. The pens became very muddy and the cattle were therefore kept from lying down much of the time.

Reference: Texas Agricultural Experiment Station Bulletin 159, pages 5, 8, 9, 10, 11, 12, 16, 17, Tables VII and IX, "Steer Feeding," July, 1913, College Station, Texas.

Suggestive: What was the average daily gain in Lot 1? In Lot 2? How much cottonseed meal was required per 100 lbs. in Lot 1? In Lot 2? Which lot made the most economical gains? Did cottonseed economically replace some of the cottonseed meal in Lot IV? If you had a group of steers to feed, and had studied this experiment, what roughage would you use?

SECTION B—COTTONSEED CAKE AS A CONCENTRATE

1—COTTONSEED CAKE AS A SUPPLEMENT TO PASTURE

I

The Value of Cottonseed Cake When Used as a Supplement to Pasture for Fattening Steers in Clay and Madison Counties, Miss., 1915 and 1916.

(1915)—Clay County

The purpose of this test was to obtain additional data concerning the fattening of steers on summer pasture in the South. The steers were placed on pasture in the spring and fattened for early fall market. Owing to the high price of corn at Abbott in the spring of 1915 only two lots were used.

Forty steers were divided into 2 lots of 20 each and fed as follows: Lot 1, 20 steers, pasture alone; Lot 2, 20 steers, pasture and cottonseed cake.

Cattle used: The 40 steers in this experiment were ordinary natives of mixed and inferior breeding. Jersey blood predominated in all but a few, which showed evidences of Angus and Shorthorn blood. They had been wintered on cottonseed meal, cottonseed hulls, and corn silage, and were in good condition when the experiment began, averaging 678 pounds.

The cottonseed cake which was fed to the steers of Lot 2 was of high quality, analyzing 43 per cent crude protein.

Owing to a dry period early in the spring of 1915 the pastures were not ready for use until late in May, and in midsummer a drought of two months' duration almost ruined the pastures for the season. Rains during the latter part of August also injured them somewhat. Owing to these unsatisfactory conditions good gains on the cattle could hardly be expected.

The cottonseed cake was fed each evening about sundown in troughs placed in the pasture. Pools in the open pastures furnished the only source of water supply for the steers, and became very low and foul during the extended dry period. Salt was provided each week.

The average daily ration of cottonseed cake for the steers of Lot 2 was 3.65 pounds each. They were given 2 pounds per head daily at the beginning, which was gradually increased during the first months to 4 pounds. This allowance was continued until the end of the experiment.

(1916)—Madison County

The series of experiments in fattening steers on summer pasture was continued in the summer of 1916 in cooperation with the Mississippi Experiment Station on the Canton Stock Farm, near Canton, Madison County, Mississippi.

The experiment had for its **chief object** a further study of the fattening of steers on summer pasture, emphasizing especially the comparison of pasture alone and pasture supplemented with cottonseed cake. The test was planned along the same lines as the previous ones.

The stock used in this test were inferior mature steers of nondescript breeding, weighing from 550 pounds to 1,000 pounds each when the experiment began. Evidences of Jersey breeding were most prominent, while a few showed marks of Shorthorn, Hereford, Aberdeen-Angus, Red Polled and Devon breeding. As a whole they were typical scrub steers of the South and very few were good feeders. All but 15, which were raised on the farm, had been bought in Madison County early in May. They were divided into 2 lots of 30 each, as equally as possible in regard to size, condition, and quality. Madison County is in tick-free territory, and as no ticks were on the animals dipping was unnecessary.

This region is in what is called the "brown-loam" classification, and the soil is very fertile, producing a great variety of grasses and clovers. The principal plants which furnished grazing were lespedeza, Paspalum, Bermuda grass, white clover, and some crab grass. No stock had been on the pastures before the experiment began, so that an abundance of grass and clover was available for the cattle throughout the experiment.

Heavy rains sometimes caused water to stand on parts of both pastures and the grass was considered too "washy" to produce the best gains on the cattle. Parts of the pastures were interchanged from one pasture to the other, so that discrepancies due to a difference in pastures might be avoided.

The steers in Lot 2 were fed their cake in troughs in the pasture about sundown each day. They came up well for their feed, and relished it. Water was obtained from ditches and pools in the pastures.

Lot 1 had only pasture. Cottonseed cake was fed to Lot 2 at the rate of 2 pounds a head daily for the first few days. This was increased gradually during the first 3 periods, until on August 1 the average daily allowance per head was 5 pounds, which quantity was fed until the steers were marketed.

Table 35—The Value of Cottonseed Cake When Used as a Supplement to Pasture for Fattening Steers in Clay and Madison Counties, Mississippi. Average of 2 Trials 1915 and 1916.

	Lot 1 Pasture alone	Lot 2 Pasture and cottonseed cake
Number of steers	25	25
Av. length of feeding period	120	120
Av. initial weight per steer	670	671
Av. final weight per steer	867	906
Av. total gain per steer	197	235
Av. daily gain per steer	1.64	2.96
Av. daily ration per steer:		
Cottonseed cake	----------	2.48

Note: The steers were taken off the experiment on September 28, driven to Canton on September 29, shipped to the St. Louis market, and slaughtered. After the steers had taken their "fill" at the market and were weighed, it was found that those of Lot 1 had lost an average of 57 pounds, while those of Lot 2 had lost 79 pounds. This wide variation in shrinkage between the 2 lots can not be accounted for. The conclusion that cake-fed steers shrink more in transit than grass-fed cattle is not supported by the results of many other shipments of steers.

Reference: United States Department of Agriculture Bulletin No. 777, pages 12, 13, 14, 16, 17, 18, "Fattening Steers on Summer Pasture in the South," July 10, 1919, Washington, D. C.

Suggestive: Did the addition of cottonseed cake increase the net profit per steer? (Calculate using present prices).

II

The Efficiency of Varying Amounts of Cottonseed Cake When Fed as a Supplement to a Full Corn and Silage Ration in Fattening Baby Beef at Manhattan, Kansas.

Cattle used—The calves used in this experiment were high-grade Herefords. They were raised at the Fort Hays branch of the Kansas Agricultural Experiment Station and were shipped to Manhattan, October 22, 1922. During the time which elapsed between this and November 3, when the experiment was started, the calves were fed on cane silage and alfalfa hay. The 50 steers were divided as carefully as possible with regard to size, type and quality into five lots. Ten heifers similar to the steers in size, type and quality were placed in the sixth lot.

Each group was kept in a lot approximately 30 by 40 feet, including a shed 15 feet deep and open on the south, located across the north end of the lot. They had access to salt and water at all times.

Method of Feeding—Each lot was fed exactly the same basal ration of shelled corn and cane silage, both full fed, and two pounds of alfalfa hay per head per day. In addition to this the different lots were fed cottonseed cake in the following amounts per head per day:

Lot 1. None.

Lot 2. One-half pound.

Lot 3. One pound.

Lot 4. One and one-half pounds.

Lot 5. Two pounds.

The heifers in Lot 6 were fed exactly the same as the steers in Lot 5.

Detailed results are given in Table 36.

Table 36—The Efficiency of Varying Amounts of Cottonseed Cake When Fed as a Supplement to a Full Corn and Silage Ration in Fattening Baby Beef at Manhattan, Kansas. 1922. (Length of test 231 days).

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Av. initial wt., lbs.	355.42	344.80	342.67	339.48	349.00	357.37
Av. final wt., lbs.	780.00	803.00	819.00	816.67	837.78	828.00
Av. total gain, lbs.	424.58	458.20	476.33	477.19	488.78	470.63
Av. daily gain, lbs.	1.84	1.98	2.06	2.07	2.12	2.04
Av. daily ration, lbs.:						
Cottonseed cake		.50	.98	1.45	1.92	1.91
Shelled corn	9.71	9.71	9.71	9.69	9.71	9.66
Alfalfa hay	2.00	2.00	2.00	2.00	2.00	2.00
Cane silage	9.10	9.16	9.12	9.04	9.13	9.12
Feed required per 100 lb. gain, lbs.:						
Cottonseed cake		24.99	47.55	70.41	90.63	93.59
Shelled Corn	528.46	489.69	471.05	469.00	459.01	474.39
Alfalfa hay	108.81	100.83	96.99	96.82	94.48	98.00
Cane silage	494.90	461.92	442.06	437.83	431.62	447.44

Reference: Kansas Agricultural Experiment Station Contribution 71, page 23, Table I, "Silage Feeding Investigation," 1922-23, Manhattan, Kansas.

Suggestive: What was the average daily gain in Lot 5? In Lot 1? Which lot made the most economical gains?

III

The Value of Cottonseed Cake When Used as a Supplement to Pasture for Fattening Steers at Auburn, Alabama. 1910.

The object of this test was to determine the profits, if any, in supplementing sandy soil pasture with cottonseed cake during the summer fattening process.

The Cattle Used—The cattle used in this experiment represented no particular breeding. They were, in fact, scrubs or common cattle of the neighborhood. Their ages ranged from three to four years. They were all dehorned before the test began.

Pasture Used—Large areas of the pastures used were low so that in rainy weather they became exceedingly wet. There was some ridge land, however, in each pasture.

Carpet grass, lespedeza, broom sage and a small amount of Bermuda and paspalum constituted the grasses that formed the pastures. They afforded an abundance of grass throughout the grazing season but the growth was rank and very watery, as frequent rains kept the pasture exceedingly wet during the whole test.

The cottonseed cake used had been broken into nut-size by the oil mill and sacked.

Both lots of cattle had had the run of a large range of approximately 20,000 acres of land throughout the winter without any kind of feed, however, the steers had some grazing in frost killed grass the first part of the winter. During the latter part of the winter when grazing is unusually short, no little amount of Augusta vetch came up and furnished good grazing during the early spring months. This plant, more than anything else, kept the steers from losing weight. It gave good grazing until the steers were put on the summer pasture test April 23.

Two lots were used for this experiment. Lot X was on pasture, supplemented with cottonseed cake. Lot Y was on pasture alone.

Details of the experiment are given in the following table.

Table 37—The Value of Cottonseed Cake When Used as a Supplement to Pasture for Fattening Beef Steers at Auburn, Alabama. April 23 to September 2, 1910. Length of Test—133 Days.

Ration	Lot X Pasture and C. S. Cake	Lot Y Pasture Alone
No. of steers per lot	28	15
Av. initial weight, lbs.	572	580
Av. final weight, lbs.	761	757
Av. gain per steer, lbs.	189	177
Av. daily gain, lbs.	1.42	1.33
Av. daily ration, lbs.:		
Cottonseed cake	3.6	.....
Av. feed required per 100 lb. gain, lbs.:		
Cottonseed cake	274	.....

Reference: Alabama Agricultural Experiment Station Bulletin 163, pages 80, 81, 82 and 91, Tables XI and XII, "Steer Feeding in Alabama," December, 1911, Auburn, Alabama.

Suggestive: How much gain was made per steer in each lot? Did the feeding of cottonseed cake pay in this case?

IV

The Value of Cottonseed Cake When Used as a Supplement to Pasture for Fattening Steers in Sumter County, Alabama, 1912-13, Two Year Average. (The 1912 Test)

The object of the experiment was to determine whether it is profitable to feed cottonseed cake to cattle on pasture: The steers of the three lots were chiefly grade Herefords, Shorthorns and Aberdeen-Angus. A few were grade Red Polls. All were 2 and 3 year olds of fair quality. They were divided unequally in number purposely to conform to the size of pasture used.

The cottonseed cake used in this test was nut size and of good quality, containing about 38 per cent crude protein. The advantages of feeding cake instead of meal are these: Rains do not make the cake unpalatable and winds do not blow it out of the feed bunks; the cake requires chewing, and greedy steers can not eat more than their share at the expense of the timid ones. When cottonseed meal is fed in open pastures, rain and wind are liable to cause waste; greedy steers bolt it and often get scours, which causes the animal to feed out unevenly.

The summer pastures used in these experiments consisted of a mixture of sweet clover (melilotus), Japan clover (lespedeza), Johnson grass, crab grass, and some Bermuda grass. The sweet clover seed had been planted, but the other plants were purely voluntary. As a rule sweet clover becomes available for light grazing before May 15.

The steers were put on pasture May 28, 1912. The pastures had not been used for a month and were in fine condition.

Lot 1 was supplied with good artesian water, while Lot 3 had water only from pools in the pasture. All the cattle were salted once a week. The cattle of Lot 1 had little attention other than salting. Lot 3 was fed cottonseed cake in troughs placed in the pasture. The cattle went on feed well, and came up for their feed with little trouble. All steers were dipped four times during the progress of the experiment to insure freedom from ticks.

(The 1913 Test)

The experiment conducted during the summer pasture season of 1913 was essentially a duplicate of previous year's test. The steers used were mostly 3-year-olds, with a few 2-year-olds that had been wintered on the Cobb farm. All were in thrifty condition April 8, 1913, when initial weights were taken. Most of the cattle were grade Aberdeen-Angus, Herefords and Shorthorns, though a few showed Jersey blood. In general the steers were typical of those raised in Alabama at the time of the experiment.

The same pastures were used as in the 1912 experiment, but all of them furnished better grazing. The pasture of Lot 1 had more sweet clovers. The only water in the pasture of Lot 3 was that in ditches and pools; Lot 1 contained both well water and ditch water. Except for a short, dry period early in May, rains were quite frequent and the steers had an abundance of grass throughout the summer.

Each day, about sundown, the steers in Lot 3 were fed in troughs in the open pasture. All were dipped in arsenical dip five times during the experiment, to keep them free from ticks. Salt was provided once a week.

The steers had been fed cake lightly for about 5 weeks before the test. Lot 3 was given, therefore, 3 pounds of concentrates per head at the beginning, and the quantity was gradually increased until on May 10 the steers of Lot 3 were each eating 4 pounds of cottonseed cake daily. This quantity was fed daily until the end of the experiment, September 2.

Table 38—The Value of Cottonseed Meal When Used as a Supplement to Summer Pasture in Sumter County, Alabama. Average of Two Trials 1912 and 1913.

	Lot 1 Pasture Alone	Lot 3 Pasture and cottonseed cake
Number of steers	27	31
Average length of feeding period	129	124
Average initial weight per steer	628	602
*Average final weight per steer	806	821
Average total gain per steer	178	219
Average daily gain per steer	1.33	1.69
Average daily ration per steer:		
Cottonseed cake	----	3.63

*In 1912 the final weight was based on market weight. In 1913 the final weight was based on farm weight.

Note: The steers were sold to butchers at Meridian, Miss., about 50 miles from the farm. The dressing percentages show that the steers of Lot 3, which were fed cake dressed out approximately 3 per cent higher than those getting pasture only, which indicates the higher finish on the cake-fed steers.

Reference: United States Department of Agriculture Bulletin No. 777, pages 3, 4, 8, 9, 5, Tables 1, 4, "Fattening Steers on Summer Pasture in the South," July 10, 1919, Washington, D. C.

Suggestive: How much more did each steer gain in Lot 3 than in Lot 1? What was the difference in the cost of total gain per steer?

V

The Value of Cottonseed Cake When Used as Supplement to a Sudan Grass Pasture for Fattening Steers at Beeville, Texas.

The object of this test was to determine whether Sudan grass should be supplemented with cottonseed cake when grazed by yearling steers. Thirty-four good to choice Hereford steer calves were purchased in August, 1932, from Mr. Dick Scott, Beeville, Texas. These 416 pound calves were grazed on the Sudan fields from September 2, to November 28, 1932. Except for the first 28 days of this period, they were fed a small amount of supplementary feed. These calves were started in a winter fattening test but following a severe stomach worm infestation and the subsequent treatment, the test was abandoned February 3, 1933, and a maintenance ration fed until the beginning of the Sudan grazing test April 27. During the 237 days, September 2 to April 27, the calves were fed an average of 1.6 lbs. ground ear corn, and ground hegari heads mixed; 1.4 lbs. cottonseed meal and 8.2 lbs. roughage per head daily. They gained 186.4 lbs. per head and entered the grazing test averaging 652.4 lbs. Following the Sudan grazing period, they were finished in dry lot.

The steers which received cottonseed cake were fed nearly as much as they would eat. Beginning with 2 pounds per head daily, gradual increases were made to 6 pounds daily, the average daily consumption being 4.64 pounds for the 108 day period.

Details of the results obtained during this trial are given in the following table.

Table 39—The Value of Cottonseed Cake When Used as a Supplement to a Sudan Grass Pasture for Fattening Steers at Beeville, Texas. April 27 to August 13, 1933. (108 Days).

Ration	Sudan Alone Lot 1	Cake on Sudan Lot 2
No. of steers per lot	17	17
Av. initial wt., lbs.	654.2	650.6
Av. final wt., lbs.	801.9	843.7
Av. total gain per steer, lbs.	147.7	193.1
Av. daily gain, lbs.	1.37	1.79
Av. lbs. cake fed daily, lbs.	.....	4.64
Av. lbs. cake required per 100 lb. gain, lbs.	.....	260.0

Note: Scouring, loss in weight and other symptoms of parasitism were noted among these calves during the fall of 1932. The trouble was not definitely recognized until in February when post mortem examination of one calf revealed a heavy infestation of stomach worms. The calves, then averaging 550 pounds, were given 300 cc per head of 1.75% copper sulphate and .8% nicotine sulphate solu-

tion. This treatment was repeated two weeks later, but the calves were not treated again until they had completed the Sudan grazing period and were 800 to 850 pound yearlings. They were drenched three times at ten day intervals with 500 cc per head of the same solution. This treatment occurred during the preliminary feed lot period, August 14 to September 7. The parasite infestation handicapped these steers. The steers improved rapidly after the treatments in February. No stomach worms were found when the steers were slaughtered in December. In comparing the two groups when finished in dry lot, the steers which received cottonseed cake with Sudan grazing finished in 99 days as compared to 122 days for the steers on Sudan alone.

Reference: Texas Agricultural Experiment Station Cattle Feeding Report Series No. 15, pages 1, 2 and 3, Tables 2 and 3, July, 1934, Beeville, Texas.

Suggestive: Was the increase in total gain per steer sufficient to pay for the cottonseed cake? (Calculate additional feed cost and value of extra beef, use current prices).

VI

The Value of Cottonseed Cake When Used to Finish Steers on Grass in Haywood County, North Carolina. 1914-1916.

The object of this experiment was to determine which was the most profitable plan, viz, to finish steers on grass alone or to finish them on grass and cottonseed cake.

The steers used in the experiment were mostly two year old grade Shorthorns, Herefords and Angus with a small amount of Devon blood.

The steers had been wintered on various rations consisting of

Lot 1. Ear corn, corn stover and hay.

Lot 3. Corn stover and corn silage.

Most of the pasture used had been established for some time; they consisted of a mixture of blue grass, clover, orchard grass, Timothy and Herd's grass. The land was rolling and hilly, some of it being very rough and steep, having some of the old dead trees standing.

The steers were turned on pasture in the spring as soon as the grass would carry them without injury to its subsequent growth. They were given salt once a week.

Troughs were provided in the pasture for feeding the cottonseed cake which was given late in the afternoon.

The steers were given an average of about 3 acres of pasture per steer during the summer.

The different lots were divided as nearly uniform in weight and quality as possible, and fed as follows:

Lot 1. Pasture and cottonseed cake.

Lot 3. Pasture only.

Details of this test are reported in the following table.

Table 40—The Value of Cottonseed Cake When Used as a Supplement to Grass Pasture for Finishing Beef Cattle in Haywood County, North Carolina. 1914-1916. A Three Year Average.

Ration	Lot 1 Pasture and C. S. Cake	Lot 3 Pasture Alone
Av. number of days on feed	133	152
Av. number steers per lot	16	33
Av. initial weight, lbs.	757	691
Av. final weight, lbs.	1103	1044
Av. gain per steer, lbs.	346	353*
Av. daily gain, lbs.	2.65	2.44
Av. daily ration of cottonseed cake, lbs.	3.80	.....
Av. lbs. cottonseed cake required per 100 lb. gain, lbs.	143.3	.....

*These steers were grazed 19 days longer than those in Lot 1.

Reference: U. S. D. A. Bulletin 628, pages 20, 21, 22, Tables IX and X, "Wintering and Fattening Beef Cattle in North Carolina," January, 1918, Washington, D. C.

Suggestive: What was the average daily gain per steer in Lot 1? In Lot 3? How much cottonseed cake was consumed per 100 lb. gain in Lot 1? Was the feeding of cottonseed cake in Lot 1 justified?

2—COTTONSEED CAKE VERSUS OTHER CONCENTRATES

I

Cottonseed Cake Versus Mixed Grains for Growing Beef Cattle at Laramie, Wyoming. 1914-15.

The object of this test was to make a comparison in the feeding value of cottonseed cake and mixed grains for growing beef cattle during the winter months.

Cattle Used—The cattle used in this experiment were Herefords kept in the college herds. Each of the two lots consisted of two Aberdeen-Angus and two Poll-Herefords. Lot 1 averaged 10 months and 8 days, in age while Lot 2 averaged 10 months and 29 days.

Feed Used—The corn used was native ground. The bran used was what is known as mill fed or mill run bran. No attempt had been made to separate the bran and middlings. The cottonseed cake used was 40 per cent protein. The hay used was made from native grasses.

The lots were fed the following ration:

Lot 1. Corn meal, bran and native hay.

Lot 2. Cottonseed cake and native hay.

Details of the experiment are given in the following table.

Table 41—Cottonseed Cake Versus Mixed Grains for Growing Beef Cattle at Laramie, Wyoming, Winter of 1914-15. Length of Test, 141 Days.

Ration	Lot 1 Corn meal and Bran	Lot 2 Cottonseed cake
No. of steers per lot	4	4
Av. initial weight, lbs.	562.5	531.3
Av. final weight, lbs.	697.3	628.3
Av. gain per steer, lbs.	134.8	97.
Av. daily gain, lbs.	.95	.68
Av. daily ration, lbs.:		
Corn meal	2.	----
Bran	2.	----
Cottonseed cake	----	2.
Hay	9.1	9.2
Av. feed required per 100 lb. gain, lbs.:		
Corn meal	209.	----
Bran	209.	----
Cottonseed cake	----	260.
Hay	896.	1269.

Reference: Wyoming Agricultural Experiment Station Bulletin 106, pages 7, 8, 9 and 10, Tables A, B, C and D, "Mixed Grain Versus Cottonseed Cake for Growing Beef Cattle," July, 1915, Laramie, Wyoming.

Suggestive: Compare the average gain per steer in the two lots. Which lot made the more economical gain? (Use current prices).

II

Cottonseed Cake Versus Grain as Supplemental Feeds for Calves and Yearlings at Hays, Kansas, 1931-1933.

The purpose of this test was to determine the possibility and advisability of substituting grain for cottonseed cake as supplements to such feeds as silage, fodder and sorghum hay when these feeds are used as the basis of stock cattle rations.

Each of the five lots in this experiment received Atlas sorgo silage as the basal ration. In addition Lot 1, the check group, received 1 pound cottonseed cake per head per day. Each of the other lots received 2 pounds of grain per head per day; Lot 2, ground kafir; Lot 3, ground milo; Lot 4, ground barley; and Lot 5, ground wheat.

During the winter of 1931-32 the experiment extended over a period of 150 days; during the winter of 1932-33, a period of 155 days. During the summer of 1932 the cattle in this test were grazed together at the Hays Branch Experiment Station.

The results of these two experiments conducted during the winters of 1931-32 and 1932-33 are given in detail in Table 42.

Table 42—Cottonseed Cake Versus Grain as Supplement to Atlas Sorgo Silage.

Lot No.	1	2	3	4	5
No. animals per lot	10	10	10	10	10
Ration fed	At. Sor. Silage C. S. Cake	At. Sor. Silage Ground Kafir	At. Sor. Silage Ground Milo	At. Sor. Silage Ground Barley	At. Sor. Silage Ground Wheat
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Av. wt. per hd., Nov. 21, 1931	430.80	429.70	430.20	430.40	[illegible]
Av. weight per head, April 19, 1932	559.50	549.70	547.80	563.30	[illegible]
Average gain per head winter, 1931-32	128.70	120.00	117.60	132.90	138.20
Average weight per head, Nov. 18, 1932	691.70	700.33	699.70	698.8[illegible]	707.10
Average gain per head, summer 1932	132.20	150.63	152.00	13[illegible].50	139.10
Average weight per head, April 20, 1933	911.80	867.20	851.50	8[illegible]7. 0	926.70
Average gain per head winter, 1932-33	220.10	166.87	151.80	[illegible].8.90	219.60
Av. gain per head Nov. 21, 1931 to April 20, 1933	481.00	437.50	421.40	4[illegible].50	496.90
Av. daily ration fed:					
Atlas sorgo silage					
1931-32 as calves	31.00	31.00	31.00	31.00	31.00
1932-33 as yearlings	53.05	52.89	52.90	53.05	53.05
Supplement—same each year					
Cottonseed cake	1.00				
Ground kafir		2.00			
Ground milo			2.00		
Ground barley				2.00	
Ground wheat					2.00
Gain per ton of atlas sorgo sil. fed					
1931-32 as calves	55.18	51.45	50.42	56.98	59.25
1932-33 as yearlings	53.50	40.80	37.10	48.30	53.50

Reference: Kansas Agricultural Experiment Station Twenty-first Annual Cattlemen's Round-up, April 1933, pages 3, 4 and 5, Tables I and II.

Suggestive: What grain substituted gave a higher total gain than cottonseed cake? What were the relative profits according to present prices?

III

Cottonseed Cake Versus Cold Pressed Cottonseed Cake as a Protein Supplement for Stock Cattle at Hays, Kansas, 1925-1926.

The large number of inquiries relative to the value of cottonseed cake and cold pressed cottonseed cake, prompted no doubt by the fact that cold pressed cottonseed cake is cheaper than cottonseed cake, indicated the need of more information regarding the feeding value of these two feeds as protein supplements for stock cattle. **To secure information bearing upon the problem** two lots of calves—one heifers and one steers—were wintered on cane silage supplement with cottonseed cake and two lots—one heifers and one steers—were wintered on cane silage supplemented with cold pressed cottonseed cake. Details of the results secured are given in Table 43.

Table 43—Cottonseed Cake Versus Cold Pressed Cottonseed Cake as a Protein Supplement for Silage for Wintering Calves at Hays, Kansas. 1925-1926.

Ration	Lot 11* Cane silage C. S. cake	Lot 12* Cane silage Cold pressed C. S. cake	Lot 13** Cane silage C. S. cake	Lot 14** Cane silage Cold pressed C. S. cake
No. of days on test	130	130	130	130
Av. initial wt. per calf, lbs.	476.50	487.50	503.5	499.00
Av. final wt. per calf, lbs.	588.5	574.5	632.5	591.00
Av. gain per calf, lbs.	112.0	96.0	129.	92.00
Av. daily gain per calf, lbs.	.86	.74	.99	.71
Av. daily ration per calf, lbs.				
Cane silage	31.00	31.00	31.0	31.0
Cottonseed cake	1.50	.....	1.5	.....
Cold pressed cottonseed cake	.....	1.5	.....	1.5
Feed required per 100 lb. gain, lbs.				
Cane silage	3604.68	4188.	3131.	4371.
Cottonseed cake	174.39	.....	151.5	.....
Cold pressed cottonseed cake	.....	206.6	.....	211.5

*The calves in Lots 11 and 12 were heifers. **The calves in Lots 13 and 14 were steers.

It might be well to mention that the chief difference in the manufacture of these two protein concentrates lies in the fact that the hulls are removed and only the kernels pass through the press in making cottonseed cake, whereas, the whole seed is passed through the press in making cold pressed cottonseed cake. The cold pressed cottonseed cake contains a much higher percentage of hulls and less protein than the ordinary cottonseed cake.

Reference: Kansas Experiment Station Fourteenth Annual Cattlemens' Round Up, page 8, Table IV, May 1, 1926, Hays, Kansas.

Suggestive: How much gain did the heifers in Lot 11 make? How much in Lot 12? To what can this difference be attributed? Does the test with steers in Lot 13 and 14 prove the same point as the test with the heifers in Lot 11 and 12? What is the difference between cottonseed cake and cold pressed cottonseed cake?

IV

Cottonseed Cake Versus Linseed Oil Cake for Fattening Calves at Fort Collins, Colorado, 1931-32.

One of the objects of this experiment was to determine the relative feeding value of cottonseed cake and linseed oil cake in a beet by-product ration.

The Cattle Used: Eighty choice-quality grade Hereford steer calves were bought in the vicinity of the station and used in the test. They averaged about 420 pounds at the start. These calves were divided into eight as nearly uniform lots as possible by balancing the factors of weight, origin, type, breeding, condition and color. Only the first four lots are considered here.

The following rations were fed the steers:

Lot 1. Ground corn, ground barley, .5 pound cottonseed cake, wet beet pulp, alfalfa hay.

Lot 2. Ground corn, ground barley, 1 pound cottonseed cake, wet beet pulp, alfalfa hay.

Lot 3. Ground corn, ground barley, 1.5 pounds cottonseed cake, wet beet pulp, alfalfa hay.

Lot 4. Ground corn, ground barley, 1 pound linseed oil cake, wet beet pulp, alfalfa hay.

The grain-and-cake ration was fed twice daily, morning and evening. Pulp was hauled into the cattle pens shortly after the morning grain feed. Alfalfa, mineral mixture and salt were self-fed. The cattle were started on 1 pound of grain concentrate per head daily and gradually increased to 8 pounds daily. Cake was fed at the rate of .1 pound per head at first but increased quite rapidly to the specified amount in the ration. Wet pulp was fed as heavily as the calves would consume it and until 35 pounds per head per day was reached.

Table 44—Cottonseed Cake in Various Amounts and in Comparison to Linseed Oil Cake at Fort Collins, Colorado, 1931-32. Fed 194 days. November 18, 1931 to May 30, 1932. Alfalfa, minerals and salt self-fed in all lots.

Lot No.	I .5 lb. C. S. Cake	II 1 lb. C. S. Cake	III 1.5 lb. C. S. Cake	IV 1 lb. L. O. Cake
Animals per lot	10	10	10	10
Weight at start, lbs.	423.0	422.5	427.3	420.7
Market weight at Denver, lbs.	806.5	813.0	816.0	803.9
Gain at market, wt. lbs.	383.5	390.5	388.7	383.2
Daily gain at market, wt. lbs.	1.98	2.01	2.00	1.97
Shipping shrinkage (percentage)	4.56	3.90	4.39	4.17
Average daily feed (lbs.)				
Ground corn	2.46	2.46	2.46	2.46
Ground barley	2.46	2.46	2.46	2.46
Cottonseed cake	.49	.98	1.45	
Linseed oil cake				.98
Wet beet pulp	25.65	25.49	25.50	25.31
Alfalfa hay	6.97	6.67	6.50	6.09
Mineral mixture	.02	.02	.02	.02
Salt	.03	.03	.03	.03
Feed required per cwt. market gain (lbs.)				
Ground corn	124.5	122.4	123.0	124.7
Ground barley	124.5	122.4	123.0	124.7
Cottonseed cake	25.0	48.8	72.6	
Linseed oil cake				49.7
Wet beet pulp	1297.8	1266.4	1272.8	1281.8
Alfalfa hay	352.8	331.4	324.4	308.6
Mineral mixture	1.2	.8	.8	1.0
Salt	1.6	1.6	1.7	1.4

Note: The selling price was the same for both cottonseed and linseed oil cake lots and a carcass study in the packing house coolers showed six good and four medium carcasses where cottonseed cake was fed and only two good and seven medium carcasses in the lot fed linseed oil cake as the protein supplement.

Reference: Colorado Agricultural Experiment Station Press Bulletin 78, pages 2, 3 and 4, Table I, "Progress Report of Livestock Feeding Experiment 1932," September 1932, Fort Collins, Colorado.

Suggestive: What amount of Cottonseed Meal gave the greatest gain? How does this compare with Linseed Meal? Which ration required the least amount of feed per cwt gain? Does this ration give the most economical gain? (Use current prices).

3—THE ADDITION OF COTTONSEED CAKE TO RATIONS

I

The Value of Cottonseed Cake When Added to a Ration of Ground Barley, Sunflower Silage and Alfalfa for Fattening Beef Yearlings at Fort Collins, Colorado, 1922-24.

The experimental cattle feeding pens of the Colorado Experiment Station are located on the college farm. The pens are 114 by 24 feet in size, the long dimension running north and south. At the north end of the lots, 14 by 24 foot sheds provide shelter for the cattle. Water is piped into each lot. Small galvanized watering troughs were used. No cover was provided for the hay.

In 1922 the south end of the pens around the hay bunks, and also around the grain troughs, was cemented and the rest of the yard graveled to get away from the mud and mire present.

The quality of steers and heifers used in these experiments has perhaps been somewhat above the average grade of cattle fed in most commercial feed lots.

Experiment 1922-23.

Sixty-six good grade Hereford steers were purchased in May, 1922. They were put on the college foothill range May 19, weighing 435 pounds per head. On October 17 they were taken off the range, weighing 688 pounds. They were carried on beet tops and beet-top silage until November 25, when they were divided into six equal pens of 10 steers each and started on the fattening test.

All feeds were fed twice daily. Alfalfa hay was fed three times daily.

The feeds used in this test were as follows:

Barley was locally grown, good quality grain.

Cottonseed cake was guaranteed 43 per cent protein.

Sunflower silage was made from sunflowers yielding 17.2 tons per acre. The plants had developed branching heads when cut for silage. This silage was from plants too mature and very unpalatable to the cattle.

Alfalfa hay was of good quality.

Experiment 1923-24.

The grade Hereford steers used in this test were purchased as yearlings in May, 1923. They were put on the college foothill range weighing 447 pounds per head. On October 29 they were taken off the range weighing 687 pounds and were fed silage and alfalfa until December 12, when they were divided into six equal pens of 10 steers each and started on the fattening test. At that time they weighed an average of 759 pounds per head. They were graded good.

All feeds were fed twice daily, morning and evening. Alfalfa was fed so that the steers had access to it at all times. The feeds used in this test were:

Barley was locally grown California feed barley.

Cottonseed cake was guaranteed 43 per cent protein.

Sunflower silage was made from sunflowers yielding 19.2 tons per acre. They were cut at an immature stage when only about one third of the heads were in bloom. This was much more palatable and a brighter silage than that of the previous year.

Alfalfa hay was of good quality.

Table 45—The Value of Cottonseed Cake When Added to a Ration of Ground Barley, Sunflower Silage and Alfalfa for Fattening Yearling Steers at Fort Collins, Colorado. 2 Year Average (183 days) 1922-23, 1923-24.

Ration fed	Lot 1 Ground barley Sunflower silage Alfalfa	Lot 2 Cottonseed cake Ground barley Sunflower silage Alfalfa
No. of steers per lot	10	10
Average initial weight, lbs.	738.2	735.1
Average final feed lot weight, lbs.	1125.8	1139.2
Average gain steer, lbs.	387.6	404.1
Average daily gain per steer, lbs.	2.12	2.21
Average daily ration fed, lbs.:		
Ground barley	11.31	11.14
Cottonseed cake	.....	1.85
Sunflower silage	17.83	16.83
Alfalfa	9.69	7.84
Feed required per 100 lb. gain at feed lot, lbs.:		
Ground barley	533.4	504.7
Cottonseed cake	.....	83.6
Sunflower silage	842.7	762.9
Alfalfa	456.7	355.1

Note: The carcass grade was the same in each lot.

Reference: Colorado Experiment Station Bulletin 422, pages 67, 79, 80, 81 and 85, Table 42, "Colorado Fattening Rations for Cattle," February, 1936, Fort Collins, Colorado.

Suggestive: What was the average gain per steer in each lot? To what do you attribute the difference? Based on total gain, was the feeding of cottonseed cake justified?

II

Feeding Cottonseed Cake in Varying Amounts When Silage is Used as the Basal Winter Ration for Stock Cattle, Hays, Kansas, 1933-34.

Object—Six lots of calves were fed 150 days during the winter of 1933-34 in an effort to secure information as to the amount of cottonseed cake that should be fed to stock cattle with silage as the basal ration. To secure such information six lots of cattle were fed as follows:

Lot 4 All the silage the calves would eat. No protein supplement during the entire period of the experiment—150 days.

Lot 6 All the silage the calves would eat plus 1 pound of cottonseed per head daily during the entire period of the experiment—150 days.

Lot 7 All the silage the calves would eat. No protein supplement the first 60 days; one-half pound of cottonseed cake per head daily during the remaining 90 days.

Lot 8 All the silage the calves would eat. No protein supplement the first 60 days; one pound of cottonseed cake per head daily during the remaining 90 days.

Lot 10 All the silage the calves would eat plus one-half pound of cottonseed cake per head daily during the entire period of the experiment—150 days.

Lot 11 All the silage the calves would eat plus one-half pound of cottonseed cake per head daily the first 60 days; one pound per head daily the remaining 90 days.

The results of this experiment are given in Table 46.

III

Table 46—How Much Cottonseed Cake Should be Fed When Silage is Used as the Basal Winter Ration for Stock Cattle.

Lot No.	4	6	7	8	10	11
No. animals per lot	10	9	10	10	10	10
No. days on test	150	150	150	150	150	150
Daily Rations Fed	No cotton-seed cake	One pound cotton-seed cake	No cotton-seed cake first 60 days then ½ lb.	No cotton-seed cake first 60 days then 1 lb.	½ lb. cotton-seed cake	½ lb. cotton-seed cake first 60 days then 1 lb.
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Average weight per head into test Nov. 18, 1933	526.60	522.44	526.80	527.50	526.80	527.00
Average weight per head out of test April 17, 1934	632.80	712.55	675.30	705.80	698.00	717.70
Average total gain per head during test	106.20	190.11	148.50	178.30	171.20	190.70
Average daily gain per head during test	.71	1.27	.99	1.19	1.14	1.27
Average daily ration per head:						
Atlas sorgo silage	32.97	34.60	34.22	34.22	34.60	34.22
Cottonseed cake						
Entire period		1.00			.50	
First 60 days						.50
Last 90 days			.50	1.00		1.00
Total feed consumed per head:						
Atlas sorgo silage	4945.00	5190.00	5132.50	5132.50	5190.00	5132.50
Cottonseed cake		150.00	45.00	90.00	75.00	120.00

Reference: Kansas Agricultural Experiment Station Twenty-second Annual Cattlemen's Round-up, pages 6 and 7, Table III, April 28, 1934, Hays, Kansas.

Suggestive: Which lot made the greatest total gain? How much cottonseed cake was saved in Lot 11 over Lot 6? Which ration would you feed to obtain the greatest per cent return from money invested in feed?

4—COTTONSEED CAKE VERSUS ROUGHAGE

I

Cottonseed Cake Compared With Alfalfa and Corn Fodder for Wintering Beef Cows for Calf Production at Bozeman, Montana. 1926-1927.

The objects of this test were to compare cottonseed cake with alfalfa hay when fed with straw with a brush arbor as the only means of shelter, and to compare cottonseed cake with corn fodder when fed with straw when the cows are given good shelter.

The cattle used in this test were grade Herefords. The shed used was 19x150 feet and was divided into three equal size pens. A creek bottom with brush shelter was divided into equal size lots, ranging from 13 to 19 acres in area. There was a small amount of browse in these lots but as they had been overgrazed throughout the summer and fall the amount of feed available after the cattle were put in winter quarters was negligible. No sheds were provided for these lots.

The cows were kept on native grass during most of the grazing season. The lots were fed twice daily. The lots receiving silage or fodder, were fed the silage or fodder in the morning. Straw was given in the afternoon. The amounts of feeds were varied somewhat at the beginning of the trial and with changes of weather conditions. Salt was provided for all lots.

The feeds used: First cutting alfalfa hay, Northwestern Dent corn fodder containing very little corn, wheat straw of good quality and cottonseed cake, nut size, containing 43% protein.

The weather during this trial was unusually severe. The winter was considered hard on all classes of live stock in northern Montana. The snow covered the ground during the time of this test.

At the beginning of the trial the cows were carefully separated into lots as uniform as possible, with respect to weight, type, quality and condition and fed the following ration:

Lot 1. Cottonseed cake and straw.

Lot 2. Alfalfa hay and straw.

Lot 3. Corn fodder and straw under shelter.

Lot 5. Cottonseed cake and straw under shelter.

Table 47—Cottonseed Cake Versus Alfalfa Hay With Brush Arbor as Shelter and Cottonseed Cake Versus Corn Fodder With Shed as Shelter for Wintering Beef Cows for Calf Production at Bozeman, Montana. December 9, 1926 to March 21, 1927. (102 days).

	Brush Arbor For Shelter		Shed For Shelter	
Ration	Lot 1 C. S. cake and straw	Lot 2 Alfalfa hay and straw	Lot 3 Corn fodder and straw	Lot 5 C. S. cake and straw
No. of cows per lot	8*	10	9*	9*
Av. initial wt. lbs.	1021.9	1028.3	1028.7	1044.4
Av. final wt., lbs.	1016.5	1025.1	1023.7	1028.4
Av. gain or loss per head, lbs.	-5.4	-3.2	-5.0	-16.0
Av. daily ration, lbs.:				
Cottonseed cake	.95	----	----	.95
Straw	13.99	11.28	14.36	15.27
Alfalfa	----	4.43	----	----
Corn fodder	----	----	5.68	----
No. calves dropped during spring of 1927	8	10	6	9

*Original No. 10 head. Removed from lots and feed deducted.

Reference: Montana Agricultural Experiment Station Bulletin 275, pages 23, 24, 27 and 28, Table XX, " Maintenance of Beef Cows for Calf Production," April, 1933, Bozeman, Montana.

Suggestive: Which of the rations maintained the weight of the cows through the winter best? Which lot dropped the most calves? Can all of these feeds be grown in your locality? Is the experiment of long enough duration to draw definite conclusions in regard to calf production?

SECTION C—WHOLE COTTONSEED AS A FEED
1—COTTONSEED VERSUS COTTONSEED MEAL

I

Cottonseed Versus Cottonseed Meal as a Supplement of a Kafir Corn Ration for Fattening Beef Steers at Clarendon, Texas. 1907.

The purpose of this test was to obtain data on a relative feeding value of cottonseed and cottonseed meal when used as a supplement for fattening beef steers.

Cattle Used—Most of the steers used in this test were well graded Shorthorns though there were a number of Herefords and a few cross breeds; they were considered above the average in conformation and quality.

Feeds Used and Method of Feeding—Throughout the test the roughage consisted of threshed Kafir corn stalks and bundled fodder which was fed in grain bunks.

On January 5, the day the experiment begun, Lot 1 was receiving 21 pounds Kafir corn meal per head daily and 4 pounds of cottonseed, while the ration for Lot 2 was 21 pounds Kafir corn and 4 pounds cottonseed meal per head. Between January 8 and 12, Lot 1 was carrying up to 5 pounds cottonseed. The corn remained the same. At the same time Lot 2 was raised to 22 pounds Kafir corn meal and the cottonseed meal reduced to 3 pounds per head. These amounts remained unchanged through March 7. On this date, the feed of both lots was increased as it was expected they would be marketed at the end of the month. All changes were made very gradually.

The steers were divided into uniform lots with special regard to weight, conformation, quality and age, and fed the following ration:

Lot 1. Ground Kafir corn, cottonseed and Kafir corn stover.

Lot 2. Ground Kafir corn, cottonseed meal and Kafir corn stover.

Details of the experiment are given in the following table.

Table 48—Cottonseed Versus Cottonseed Meal as a Supplement of a Kafir Corn Ration for Fattening Beef Steers at Clarendon, Texas. 1912. January 5 to March 30, 1912. Length of Test—84 Days.

Ration	Lot 1 Cottonseed	Lot 2 Cottonseed meal
No. of steers per lot	50	50
Av. initial weight, lbs.	1114.5	1114.5
Av. final weight, lbs.	1376.1	1317.6
Av. gain per steer, lbs.	261.6	203.1
Av. daily gain, lbs.	3.1	2.4
Av. daily ration, lbs.		
Kafir corn	21.5	22.6
Cottonseed	5.19	----
Cottonseed meal	----	3.3
Av. feed required per 100 lb. gain, lbs.		
Kafir corn	694.3	942.3
Cottonseed	167.12	----
Cottonseed meal	----	137.3

Note: The steers in Lot 1 fed cottonseed dressed 60 per cent, while those in Lot 2 fed cottonseed meal dressed 62 per cent.

Reference: Texas Agricultural Experiment Station Bulletin 97, pages 10, 11, 12 and 13, Table IV, "Kafir Corn and Milo Maize for Fattening Cattle," June, 1907, College Station, Texas.

Suggestive: How much gain was made per steer in Lot 1? In Lot 2? Which proved the more efficient as a supplement to Kafir corn, cottonseed or cottonseed meal?

II

Whole Cottonseed Versus Cottonseed Meal When Fed With Ground Milo Heads, Chopped Sumac Fodder and Pulverized Oyster Shells at Spur, Texas, 1932-1933.

This experiment was conducted at Substation 7, Spur, Texas, by the Texas Agricultural Experiment Station in cooperation with the Bureau of Animal Industry, U. S. Department of Agriculture.

Cattle Used: The steers available for this test were selected as an average of Herefords produced on ranches in Northwest Texas. The steers were divided as nearly equal as possible with respect to type, breeding and condition into lots of ten head each, and placed on feed November 16, 1932.

Table 49—Whole Cottonseed Versus Cottonseed Meal for Fattening Steers, Spur, Texas, (168 day test). Nov. 16, 1932 to May 3, 1933.

	Lot 1 Ground Milo hds. Cottonseed meal gr red top fodder	Lot 4 Ground Milo hds. Cottonseed meal gr red top fodder
Av. steers per lot	10	9
Av. initial wt. at feed lot, lbs.	689.43	699.20
Av. final wt. at feed lot, lbs.	1011.43	1007.78
Av. daily ration (amt. fed), lbs.:		
Grain	14.03	13.88
Cottonseed meal	2.67	----
Cottonseed	----	3.91
Roughage	8.34	6.98
Oyster shell, pulv.	.12	.12
Salt	.024	.025
Feed per 100 lb. gain (feed lot basis):		
Grain	731.83	755.73
Cottonseed meal	139.05	----
Cottonseed	----	212.91
Roughage	435.25	380.29
Total feed per steer (amt. fed) lbs.:		
Grain	2356.5	2332.02
Cottonseed meal	447.75	----
Cottonseed	----	657.0
Roughage	1401.5	1173.5
Oyster shell, pulv.	20.4	20.4
Salt	4.11	4.26
Carcass grades: Choice		
Good	1	1
Medium to good	8	4
Medium	----	4
Fair	1	----

Note: Comparing the two which received 2.67 lbs. cottonseed meal and 3.91 lbs. whole cotton seed respectively in the ration, it is observed that based on market weights, the average daily gains were practically the same. Based on final

feed lot weights, the dressed yield was 57.2% for the Lot 1 steers receiving cottonseed meal, as compared with 58.5% for the Lot 4 steers which received cottonseed in place of the meal. The Lot 4 ration containing the cottonseed seemed to be slightly less palatable than was the Lot 1 ration. In the previous year's test, there was little or no apparent difference in this respect.

Reference: Texas Agricultural Experiment Station, Substation 7, Spur, Texas. "Cattle Feeding Report," Series 8, June 23, 1933.

Suggestive: Does this experiment indicate that it is practical to feed whole cottonseed to steers?

III

Cottonseed Versus Cottonseed Meal for Fattening Yearling Steers on a Ground Threshed Milo and Alfalfa Hay Ration at Balmorhea, Texas, 1933-34.

Object—This is the third of a series of cattle feeding tests begun at the Balmorhea Substation in the Madera Valley three years ago, to determine the best methods of utilizing the locally grown feeds in cattle fattening rations. The object of the test was to determine the most economical ration for fattening yearling steers in that area.

The basal ration was composed of ground threshed milo, ground pegari fodder, alfalfa hay and salt. Lot 1 received cottonseed meal while Lot 5 received cottonseed.

Cattle Used—Good to choice Hereford yearling steers produced by the Reynolds Cattle Company near Kent were used in this test.

Table 50—Cottonseed Fed Whole Versus Cottonseed Meal for Fattening Yearling Steers on a Ground Milo and Alfalfa Hay Ration at Balmorhea, Texas. Dec. 20, 1933 to May 23, 1934.

	Lot 1 C. S. Meal	Lot 5 Cottonseed
No. of steers per lot	10	10
Av. initial wt. at feed lot, lbs.	677.75	675.27
Av. final wt. at feed lot, lbs.	999.00	1051.57
Av. gain per head, feed lot wts., lbs.	321.25	376.30
Av. daily gain, feed lot wts. lbs.	2.09	2.44
Shrinkage per head during shipment, %	4.96	5.76
Feed consumed per 100 lb. gain, feed lot wts., lbs.:		
Ground threshed milo	410.	295.
Cottonseed	----------	136
Cottonseed meal	79	----------
Ground hegari fodder	374	334
Alfalfa hay	164	145
Total feed consumed per steer, lbs.:		
Ground threshed milo	1318	1110
Cottonseed	----------	510
Cottonseed meal	254	----------
Ground hegari fodder	1203	1255
Alfalfa hay	526	545
Salt	5.26	4.15
Carcass grades:		
Choice (Armour's 302 grade)	----------	1
Choice (Armour's 303 grade)	4	5
Good (Armour's 304 grade)	3	4
Medium (Armour's 34 grade)	3	----------

Note: Lot 1 made gains quite comparable with those of Lot 5 during the first 140 days, however, their appetites slackened and they had a small loss in weight in the final 14-day period.

Reference: Texas Agricultural Experiment Station Cattle Feeding Report, Series No. 19, pages 1, 2 and 3, Table 1 and 2, July 1934, Balmorhea, Texas.

Suggestive: Compare average gains in each lot and calculate the cost per pound of gain in each case. Which made the more economical gain, cottonseed or cottonseed meal?

2—THE VALUE OF COTTONSEED IN VARIOUS RATIONS.

I

Cottonseed as a Protein Supplement to Grain Sorghum and Carbonaceous Hay for Fattening Yearling Steers, College Station, Texas, 1932-33.

This experiment was conducted by the Animal Husbandry Department, Texas A & M College, in cooperation with the Texas Agricultural Experiment Station; the Extension Service, Texas A & M College; and the Bureau of Animal Industry U. S. Department of Agriculture. The purpose of the test was to determine the value of cottonseed as a protein supplement in cattle feeding when used in varying amounts and to compare cottonseed meal and cottonseed when combined as a protein supplement with each feed when fed alone.

Cattle Used: Fifty short yearling Brazos County Steers, bred and raised on one ranch were used. They were light weight, thin cattle of fair to medium grade. They were dehorned.

The following rations were fed:

Lot 1. Ground threshed milo; cottonseed meal; Johnson grass hay.

Lot 2. Ground threshed milo; cottonseed in such amount as to make the protein content of the ration the same as Lot 1; Johnson grass hay.

Lot 3. Ground threshed milo; cottonseed (smaller amount than Lot 2); Johnson grass hay.

Lot 4. Ground threshed milo; same amount of cottonseed at Lot 3, with enough cottonseed meal added to bring the protein content up to that of Lot 1; Johnson grass hay.

Table 51—Cottonseed Fed in Varying Amounts and Compared With Cottonseed Meal, College Station, Texas, 1932-33. (158-Day Test).

	Lot 1 Ground threshed milo C. S. Meal J. G. Hay	Lot 2 Ground threshed milo Cottonseed J. G. Hay	Lot 3 Ground threshed milo Cottonseed J.G. Hay	Lot 4 Ground threshed milo C. S. Meal Cottonseed J. G. Hay
No. steers per lot	10	10	10	10
Average initial wt. at feed lot, lbs.	490	486	487	486
Average final wt. at feed lot, lbs.	791	771	792	800
Average gain per head, feed lot wt., lbs.	301	285	305	323
Average daily gain per head feed lot wt., lbs.	1.90	1.80	1.93	2.04
Shrinkage per head during shipment, (Percentage)	5.44	4.93	5.43	5.44
Average daily ration (consumed) lbs.:				
Ground threshed milo	11.27	9.10	10.21	9.79
Cottonseed meal	1.72	----	----	.53
Cottonseed	----	3.63	2.89	2.88
Johnson grass hay	6.24	4.71	6.05	5.08
Limestone flour	.1	.1	.1	.1
Feed consumed per 100 lb. gain, feed lot wts., lbs.:				
Ground threshed milo	592	504	529	479
Cottonseed meal	90	----	----	26
Cottonseed	----	201	150	141
Johnson grass hay	328	261	313	248
Limestone flour	5.25	5.54	5.18	4.89
Total feed fed per steer, lbs.:				
Ground threshed milo	1781	1437.5	1612.6	1546.5
Cottonseed meal	271.6	----	----	83.2
Cottonseed	----	573.1	456.2	455.1
Johnson grass hay	1054.5	918.5	1024.	851.5
Limestone flour	15.8	15.8	15.8	15.8
Carcass grades: Good minus	----	2	1	----
Medium plus	1	2	3	3
Medium	4	2	3	4
Medium minus	1	4	2	3
Common plus	3	----	----	----
Common	1	----	1	----

Note: There was little significant difference between the lots as regards dressing per cent and grade of carcass. The average grade of carcass in Lot 1 was a little lower than in the other three lots.

Reference: Texas Agricultural Experiment Station Cattle Feeding Report, Series No. 11, pages 1, 2 and 3, Table I and II, College Station, Texas.

Suggestive: What was the gain in Lot 1? In Lot 3? What difference is there in the ration of Lots 1 and 2? Is there any advantage in feeding whole cottonseed?

II

The Value of Cottonseed in a Ration of Limited Allowance of Concentrates for Finishing Yearling Steers, Balmorhea, Texas, 1932.

The object of the test was to determine economy of gains and finish of yearling steers as follows:

1. When full fed on a ration high in grain content.

2. When fed a limited allowance of grain.

3. When fed a limited allowance of concentrates in a ration in which whole cottonseed has replaced a portion of the grain.

Cattle Used—Thirty head of medium to good grade Hereford yearling steers raised by Mrs. J. L. Moore & Sons, Balmorhea, Texas, were used in this test. The lots were fed as follows:

Lot 1. Ground threshed milo (full fed); cottonseed meal; and ground hegari fodder 2 parts, and low grade alfalfa hay 1 part.

Lot 2. Ground threshed milo (grain limited); cottonseed meal; and ground hegari fodder 2 parts, and low grade alfalfa hay 1 part.

Lot 3. Whole cottonseed 1 part, ground threshed milo 2 parts (these concentrates limited to amounts fed Lot 2); cottonseed meal; and ground hegari fodder 2 parts, low grade alfalfa hay 1 part.

Lots 2 and 3 were supplied with as much roughage as they would consume.

Table 52—The Value of Cottonseed in a Ration of Limited Allowance of Concentrates for Finishing Yearling Steers, Balmorhea, Texas, (a 140 Day Test).

Lot	Lot 1 Gr. Thr'd milo C. S. Meal Gr. hegari fodder Alfalfa hay Salt	Lot 2 Gr. Thr'd milo C. S. Meal Gr. hegari fodder Alfalfa hay Salt	Lot 3 Gr. Thr'd milo C. seed C. S. Meal Gr. hegari fodder Alfalfa hay Salt
No. of steers	8	8	10
Av. initial wt. at feed lot, lbs.	619.06	583.31	589.41
Av. final wt. at feed lot, lbs.	956.72	884.31	923.08
Av. gain per head, feed lot wts., lbs.	337.66	301.00	333.67
Av. daily gain per head feed lot wts., lbs.	2.41	2.15	2.38
Shrinkage per head during shipment to mkt.	5.80	5.15	5.59
Average daily ration, lbs.			
Ground threshed milo	10.08	6.67	4.45
Cottonseed	----	----	2.22
Cottonseed meal	1.87	1.87	1.87
Ground hegari fodder	5.42	7.46	7.84
Alfalfa hay	2.72	3.73	3.92
Salt	0.015	0.022	0.021
Feed required per 100 lb. gain, feed lot basis, lbs.:			
Ground threshed milo	418.02	310.22	186.61
Cottonseed	----	----	93.30
Cottonseed meal	77.59	87.04	78.52
Ground hegari fodder	224.68	347.15	328.97
Alfalfa hay	112.64	173.57	164.48
Salt	.62	1.05	.89
Total feed consumed per steer, lbs.:			
Ground threshed milo	1411.50	933.75	622.67
Cottonseed	----	----	311.33
Cottonseed meal	262.00	262.00	262.00
Ground hegari fodder	758.67	1044.92	1097.67
Ground alfalfa hay	380.33	522.46	548.83
Salt	2.08	3.15	2.98
Dressing percentage	61.27	60.33	61.11

Note: The addition of cottonseed to the ration in Lot 3 produced daily gains practically equal to Lot 1. There was no difference in finish as indicated by carcass grades although the Lot 1 steers on foot showed slightly more finish and sold at $5.69 per 100 pounds as compared to $5.46 for Lot 3. The cattle in the cottonseed lot showed more bloom than in either of the other two lots.

Reference: Texas Agricultural Experiment Station Cattle Feeding Series No. 6, pages 1, 2 and 3, Table I and II, 1932, Balmorhea, Texas.

Suggestive: From the results of this test, is it possible for cottonseed to be marketed profitably through steers?

SECTION D—COTTONSEED HULLS AS A ROUGHAGE

1—COTTONSEED HULLS VERSUS SILAGE

I

Cottonseed Hulls Versus Various Kinds of Silage for Feeding Beef Cattle at State College, Mississippi, 1914-1915.

The cattle used were a fairly uniform bunch of native Southern steers slightly above the average in quality; they were bought locally. All steers were dehorned just before going on feed. The steers were fed all winter in a shed open on three sides and shielded by a five foot wall on the north side.

Table 53—Cottonseed Hulls Versus Various Kinds of Silage for Feeding Beef Cattle at State College, Mississippi, 1914-15.

	Lot I Goliad Corn Silage	Lot II Early Amber Sorghum Silage	Lot III Equal Parts Mixture Cowpea & Johnson Grass Silage	Lot IV Goliad Corn Stover Silage	Lot V Cotton-seed Hulls
Av. initial weight (lbs.)	887.8	902.8	809.06	941.25	809.06
Av. total gain per steer (lbs.)	243.8	216.8	179.8	71.4	216.8
Av. daily gain per steer (lbs.)	1.78	1.58	1.31	.65	1.58
Av. daily ration:					
Cottonseed meal (lbs.)	6.5	6.5	6.5	6.5	6.5
Silage or Hulls (lbs.)	45.32	45.32	45.32	45.32	27.15
Feed consumed per 100 lbs. gain:					
Cottonseed meal	365	410	495	997	410
Silage	2588	2910	3509	7070	1716

Reference: Mississippi Agricultural Experiment Station Bulletin 182, pages 5, 6 and 7, Tables II and III, "Silage for Fattening Steers," June 1917. State College, Mississippi.

Suggestive: Which of the silages gave a higher average daily gain than cottonseed hulls? Using current prices, which produces more economical gains, sorghum silage or cottonseed hulls?

II

Cottonseed Hulls Compared With Corn Silage, Sorghum Silage and Sagrain Silage for Finishing Beef Steers at State College, Mississippi. 1927-28.

The object of this test was to secure data on the feeding value of locally grown roughages for finishing beef steers.

The cattle used in this test were 2 and 3 year old native "Yellow Hammer" steers of fairly uniform type and quality. The roughages compared in this test were corn, Texas Seeded Ribbon Cane, sagrain silage and cottonseed hulls. The silages were produced on the Station farm. All the lots were fed the same amounts of cottonseed meal and Johnson grass hay, the steers were fed all the silage and cottonseed hulls that they would clean up twice daily. Fresh water and block salt were available at all times.

The rations fed:

Lot 1. Cottonseed meal, Johnson grass hay, corn silage.

Lot 2. Cottonseed meal, Johnson grass hay, cottonseed hulls.

Lot 4. Cottonseed meal, Johnson grass hay, sorghum silage.

Lot 5. Cottonseed meal, Johnson grass hay, sagrain silage.

Details of the experiment are reported in the following table.

Table 54—Cottonseed Hulls Compared With Corn Silage, Sorghum Silage and Sagrain Silage for Finishing Beef Steers at State College, Mississippi. December 8, 1927 to April 6, 1928. (120 Days).

Ration	Lot 1 Corn Silage	Lot 2 C. S. Hulls	Lot 4 Sorghum Silage	Lot 5 Sagrain Silage
No. of steers per lot	8	8	8	8
Av. initial wt., lbs.	728.7	727.7	727.6	726.8
Av. final wt., lbs.	962.7	965.6	952.0	936.2
Av. gain per steer, lbs.	234.0	237.9	224.4	209.4
Av. daily gain per steer, lbs.	1.95	1.98	1.87	1.74
Av. daily ration consumed, lbs.				
Cottonseed meal	6.55	6.55	6.55	6.55
Johnson grass hay	3.0	3.0	3.0	3.0
Corn silage	43.35	.....	.....	.....
Cottonseed hulls	.....	21.88	.....	.....
Sorghum silage	.....	.....	50.96	.....
Sagrain silage	.....	.....	.....	42.53
Feed required per 100 lb. gain, lbs.:				
Cottonseed meal	335.88	330.84	350.29	376.43
Johnson grass hay	153.84	151.53	160.44	172.41
Corn silage	2223.0	.....	.....	.....
Cottonseed hulls	.....	1105.0	.....	.....
Sorghum silage	.....	.....	2725.0	.....
Sagrain silage	.....	.....	.....	2444.0

Note: The selling price for the steers in Lots 1 and 2 were slightly more than those in Lots 4 and 5 due to a better finish.

Reference: Mississippi Agricultural Experiment Station Press Circular 359, pages 1 and 2, Table I, "Comparison of Roughages for Finishing Steers," May, 1928, State College, Mississippi.

Suggestive: Which lot showed the highest total gain per steer? Do the results of this test indicate that cottonseed hulls are worth more as a roughage for finishing beef steers when fed with cottonseed meal and Johnson grass hay? With corn silage? Sorghum silage? Sagrain silage? Under conditions prevailing in your locality, which roughage could be produced most economically on your farm?

III

Varying Amounts of Cottonseed Hulls and Sorghum Silage Compared for Finishing Mature Steers at State College, Mississippi, 1930-1932.

The plan of the experiment was to divide 32 common mature steers into 4 lots of 8 steers each and feed them the following rations:

Lot 1: Cottonseed meal, 5 to 7 pounds; sorghum silage, ad libitum; Johnson grass hay, 3 pounds.

Lot 2: Cottonseed meal, 5 to 7 pounds; ¾ sorghum silage, ¼ cottonseed hulls, ad libitum; Johnson grass hay, 3 pounds.

Lot 3: Cottonseed meal, 5 to 7 pounds; ½ sorghum silage, ½ cottonseed hulls, ad libitum; Johnson grass hay, 3 pounds.

Lot 4: Cottonseed meal, 5 to 7 pounds; Cottonseed hulls, ad libitum; Johnson grass hay, 3 pounds.

The first test was for a period of 106 days, the second 99 days, and the third 120 days. In order to check the gains made, individual weights were taken every 14 days during the progress of the experiment. On the second weighing day, at the beginning of each test the steers were divided as nearly as possible with reference to quality, weight and condition into 4 equal lots and started on the experimental rations. They were fed daily, at 7 A. M. and 5 P. M., on all feeds except hay, which was all fed at the evening feed. The silage, hulls and combinations of silage and hulls were fed ad libitum and the hay was limited to 3 pounds per steer. Two pounds of cottonseed meal per steer were fed for the first 4 days. The meal was increased 1 pound each 4 days until 6 pounds were being fed. This amount was fed during the first 60 days of the test. Seven pounds were fed during the next 30 days and 8 pounds were fed during the remainder of the test. The cottonseed meal was thoroughly mixed with the silage and hulls and silage and hulls mixture. Adjustments were made on a dry weight basis in mixing the cottonseed hulls and sorghum silage, 3 pounds of silage being allowed for each pound of cottonseed hulls fed. In Lot 2 the ratio was 1 pound of cottonseed hulls to 9 pounds silage and in Lot 3 the ratio was 1 pound of cottonseed hulls to 3 pounds silage.

Fresh water was supplied to each lot in concrete troughs and block salt was available at all times.

The steers used in the three trials were of Jersey breeding, commonly termed Yellow Hammers, and were 2 years old or older. All cattle used were dehorned.

All the steers went on feed with good appetites and in neither test were there any indications of scouring. During the 1932-33 test one steer in Lot 3 went off feed and failed to gain in weight about 60 days after the test had begun and was removed from the experiment. All steers in the 1932-33 trial, for some unknown reason, made small daily gains.

The four lots of cattle recived as nearly the same treatment as was possible during the experimental feeding period. Each lot was fed under a shed 30 feet long and 16 feet wide. These sheds opened into lots approximately 1/7 acre in size. The lots became very muddy during the rainy weather, but the stalls

were bedded with oat straw as often as it was necessary to keep them dry. All the feeding was done by student labor under the supervision of the Animal Husbandry Department of the Experiment Station.

Table 55—Cottonseed Hulls Versus Sorghum Silage Versus Varying Amounts of Cottonseed Hulls and Sorghum Silage for Finishing Mature Steers at State College, Miss., 1930-32. Summary of 3 trials—Average Length of Test—108 days.

	Lot 1 C. S. Meal Sorghum Silage J. G. Hay	Lot 2 C. S. Meal ¼ C. S. Hulls ¾ Sorghum Silage J. G. Hay	Lot 3 C. S. Meal ½ C. S. Hulls ½ Sorghum Silage J. G. Hay	Lot 4 C. S. Meal C. S. Hulls J. G. Hay
No. steers per lot	24	24*	24	24
Av. initial wt., lbs.	874.4	879.0	872.7	875.3
Av. final wt., lbs.	1036.7	1058.3	1051.3	1041.0
Av. gain per steer, lbs.	162.3	179.3	178.6	165.7
Av. daily gain, lbs.	1.50	1.65	1.65	1.53
Feed consumed per daily ration, lbs.:				
Cottonseed meal	5.94	5.94	5.94	5.94
Cottonseed hulls	.....	6.45	14.28	31.10
Sorghum silage	67.08	58.05	42.46	.....
J. G. Hay	3.00	3.00	3.00	3.00
Feed required per 100 lb. gain, lbs.:				
Cottonseed meal	414.0	365.0	364.5	392.3
Cottonseed hulls	.....	392.1	859.0	2061.0
Sorghum silage	4493.2	3528.8	2577.2	.....
J. G. Hay	207.1	183.3	183.1	197.7
Shrinkage per cent	7.34	6.70	6.93	6.99
Dressing per cent (Market wt.)	56.78	56.21	57.24	57.39

*In the 1932-33 trial, one steer was removed from Lot 2.

Reference: Mississippi Agricultural Experiment Station Bulletin 301, pages 1, 2 and 7, Table VI, "Varying Amounts of Cottonseed Hulls and Sorghum for Finishing Mature Steers," November 1933, State College, Mississippi.

Suggestive: Under your conditions, could you better afford to feed sorghum silage or cottonseed hulls?

IV

A Ration of Cottonseed Meal and Hulls Versus a Ration of Cottonseed Meal, Silage and Hay for Fattening Beef Cattle at College Station, Texas, 1911-12.

The purpose of this experiment was to ascertain whether or not cottonseed meal and silage may be used more profitably for fattening cattle than cottonseed meal and cottonseed hulls.

The Cattle Used—The cattle used in this experiment were range bred three and four year old grade Shorthorn and Hereford steers, all of which were dehorned. They were the "tops" of the bunch of about 200 head and were fairly uniform as to conformation, quality and condition.

Method of Feeding—The ration per steer for the first day, December 8, was as follows:

Lot 1. Three pounds cottonseed meal, 19½ pounds cottonseed hulls.

Lot 2. Three pounds cottonseed meal, 24-1/5 pounds silage.

Hay was added to the ration of Lot 2 on January 8. This addition was made because the steers on this lot were not eating a sufficient quantity of the silage, possibly because of its succulent character, to afford them as much dry matter as was being consumed by those in Lot 1. They were supplied with hay until the end of the experiment. After the first few days, as much hulls for Lot 1 and as much silage for Lot 2 were supplied as the steers would clean up, the daily amount for each steer being about 20-2/3 pounds of hulls and about 50 pounds silage.

The cottonseed meal for both lots was gradually increased. On January 6, the amount reached 6 pounds per head daily for each lot. This amount remained unchanged until February 11, when 7 pounds cottonseed meal was fed per steer in each lot. This amount remained unchanged for the remainder of the experiment.

The cattle were fed twice daily, early in the morning and late in the afternoon. The meal and hulls were thoroughly mixed in the feed troughs. The silage was placed in the trough and the meal sprinkled over it and the two feeds thoroughly mixed with an ordinary hull-fork. The hay was supplied in a separate trough.

Feeds Used—The feeds used, namely, cottonseed meal, cottonseed hulls and hay, were of various qualities.

The silage was composed chiefly of Milo maize which had been harvested when the heads were about mature and the stalks and leaves were still green. The other components of the silage were sorghum and Indian corn. It was estimated that the larger portion of the silage fed consisted of about 75 per cent milo maize, 15 per cent Indian corn, and 10 per cent sorghum.

The hay was composed of sorghum and Johnson grass, about half and half.

The cottonseed meal used analyzed about 45 per cent protein.

The steers were divided into uniform lots and fed the following ration:

Lot 1. Cottonseed meal and cottonseed hulls.

Lot 2. Cottonseed meal, silage, and during a part of the experiment, mixed sorghum and Johnson grass hay.

Details of the experiment are given in the following table.

Table 56—Cottonseed Hulls Versus Silage for Fattening Beef Cattle at College Station, Texas. December 8, 1911 to April 4, 1912. Length of Test—119 Days.

Ration	Lot 1 C. S. Hulls	Lot 2 Silage
No. of steers per lot	15	25
Av. initial weight, lbs.	895	909
Av. final weight, lbs.	1131	1151
Av. gain per steer, lbs.	236	242
Av. daily gain, lbs.	1.98	2.03
Av. daily ration, lbs.:		
Cottonseed meal	5.98	5.98
Cottonseed hulls	27.87	———
Silage	———	47.57
Hay	———	3.
Av. feed required per 100 lb. gain, lbs.:		
Cottonseed meal	301.9	295.9
Cottonseed hulls	1405.4	———
Silage	———	2339.0
Hay	———	115.

Note: There was practically no difference in the shrinkage of the 2 lots in shipping, and there was no difference in the dressing per cent of the 2 lots.

Reference: Texas Agricultural Experiment Station Bulletin 152, pages 3, 6, 7, 8 and 9, Table II, "A Test of the Relative Values of Cottonseed Meal and Silage and Cottonseed Meal and Cottonseed Hulls for Fattening Cattle," August 1912, College Station, Texas.

Suggestive: Which lot of steers produced the more economical gain? (Use current prices).

V

Cottonseed Hulls Compared With Sorgo Silage and Sorgo Fodder as a Roughage for Fattening Calves at College Station, Texas, 1923-1926.

Object—This experiment was planned for the purpose of determining the relative feeding values of sorgo silage, sorgo fodder, and cottonseed hulls, respectfully, as sources of roughage in the rations of fattening calves.

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

Cattle Used—In each of the three tests representative groups of well-bred Hereford calves of weaning age were fed. The calves were divided as equally as possible with reference to size and type into three groups. The respective periods of feeding varied from 168 to 203 days in the three tests.

The rations fed:

Lot 1. Ground milo heads, cottonseed meal, sorgo silage and Sudan grass hay.

Lot 2. Ground milo heads, cottonseed meal and cottonseed hulls.

Lot 3. Ground milo heads, cottonseed meal and sorgo fodder.

An open shed 20 feet deep by 78 feet in length (south exposure) provided shelter to protect the calves during inclement weather. Each lot had an area of 60 feet by 26 feet. A fresh supply of water was available at all times. A liberal supply of granulated stock salt was available in boxes under the shed throughout the feeding period. The feed lots were situated on a sandy loam soil and mud was not a serious factor even during wet weather.

The calves were fed twice each day, the morning feed being given about 8 A. M. and the evening feed about 6 P. M. The concentrates, consisting of ground milo heads and cottonseed meal, were weighed and then thoroughly mixed before being spread over and carefully mixed with the respective roughages in the feed bunks.

The sorgo fodder which was supplied to Lot 3 was run through the silage cutter before being fed. Sudan grass hay was fed once daily to Lot 1, this roughage being placed in the feed bunk after the calves had consumed the bulk

of the silage-concentrate mixture. In the first test, all lots received the same amount of cottonseed meal. However, during the second and third tests Lot 2, receiving cottonseed hulls, was fed a slightly increased amount of meal as compared with the other two lots for the purpose of determining whether this would tend to offset the lower feeding value of the cottonseed hulls fed to Lot 2. The calves used in all three tests were high-grade Herefords.

The feeds used in all of the tests were of good quality. The cottonseed meal used sold under a guarantee of 43 per cent protein. The milo heads were finely ground and there was practically no waste either of grain or ground head roughage. The sorgo silage was made from the first cutting of the sumac variety of sweet sorghums, and was of good quality. The sorgo fodder was also of the first cutting and was of good quality. The cottonseed hulls were of a fair to good quality. The Sudan grass hay fed to Lot 1 was of good quality.

Table 57—Cottonseed Hulls Compared With Sorgo Silage and Sorgo Fodder as a Roughage for Fattening Calves at College Station, Texas. 1923-26. A Three Year Average. (Average Length of Trials 162 Days).

Rations	Lot 1 Silage	Lot 2 C. S. Hulls	Lot 3 Fodder
No. steers per lot	15	15	15
Av. initial feed lot wts., lbs.	415	363	413
Av. final feed lot wts., lbs.	776	707	756
Av. gain per head, feed lot wt., lbs.	361	344	343
Av. daily gain per head, feed lot wt., lbs.	2.	1.6	1.9
Av. daily ration, lbs.:			
Ground milo heads	9.59	9.61	9.61
Cottonseed meal	1.72	1.86	1.73
Sorgo silage (sumac)	16.49	.....	.....
Cottonseed hulls	.....	8.95	.....
Sorgo fodder (sumac)	.....	.....	9.15
Sudan grass	1.45	.....	.....
Feed required per 100 lbs. gain, lbs.:			
Ground milo heads	483	604	509
Cottonseed meal	87	116	92
Sorgo silage (sumac)	827	.....	.....
Cottonseed hulls	.....	569	.....
Sorgo fodder (sumac)	.....	.....	483
Sudan grass	87	.....	.....

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

Reference: Texas Agricultural Experiment Station Bulletin 363, pages 7, 8, 9, 15, 21, 27 and 35.

Suggestive: Was there enough difference in the total gain per steer in each lot to justify changing from one feed to the other if the prices were approximately the same? In your locality, are the roughages in this experiment obtainable? Which roughage could be produced on your farm most economically?

VI

Cottonseed Hulls Versus Corn Silage as a Roughage for Fattening Beef Cattle at Clemson College, South Carolina. 1912.

The object of this test was to determine the relative value of cottonseed hulls and corn silage as a roughage for beef cattle when fed with cottonseed meal.

Cattle Used—The cattle used were all dehorned and were chiefly grade Shorthorns of fair quality.

Method of Feeding—The cattle were fed in an open shed 25x100 feet with a feed trough extending length-wise through the middle. The steers were started on ½ pound cottonseed meal per 100 lb. live weight per day and at the end of the second week, they were increased to 5 pounds per day. This was gradually increased to 7 pounds per day for 2nd month and 8 pounds per day for the last 40 days. Both lots were fed in exactly the same manner, the only difference being the roughage fed. The cattle were fed twice a day and had access to water and salt at all times.

Feeds Used—The cottonseed meal used in this test was 36 per cent protein. The silage and hulls fed were of good quality.

Each lot was fed the following ration:

Lot 1. Cottonseed meal and corn silage.

Lot 3. Cottonseed meal and cottonseed hulls.
Details of the experiment are given in the following table.

Table 58—Cottonseed Hulls Versus Corn Silage for Fattening Beef Steers at Clemson College, South Carolina, 1912. Length of Test—102 Days.

Ration	Lot 1 Corn Silage	Lot 3 Cottonseed hulls
No. of steers per lot	20	20
Av. initial weight, lbs.	890	890
Av. final weight, lbs.	1112.36	1043.
Av. gain per steer, lbs.	222.36	153.
Av. daily gain, lbs.	2.18	1.5
Av. daily ration, lbs.		
Corn silage	40.	
Cottonseed hulls		25
Cottonseed meal	6.3	6.3
Av. feed required per 100 lb. gain, lbs.:		
Corn silage	1684.	
Cottonseed hulls		1786.
Cottonseed meal	322	469

Reference: South Carolina Agricultural Experiment Station Bulletin 169, pages 4, 5, 6, 8 and 10, Tables I and III, "Feeding Beef Cattle in South Carolina," September, 1912, Clemson, South Carolina.

Suggestive: Which lot made the most gain per steer? What was the difference in the ration of the two lots? Which roughage produced the most economical gain, hulls or silage? Which lot required the most meal per 100 lb. gain?

VII

Cottonseed Hulls Versus Corn Silage for Fattening Beef Cattle at Raleigh, North Carolina, 1909-11.

The purpose of this test was to determine the difference in the feeding value of corn silage and cottonseed hulls when fed with cottonseed meal for fattening beef cattle.

Cattle Used—The steers used in this test were fairly uniform in size and type, averaging about 900 pounds in weight both years. They were principally Shorthorn grades, although some showed traces of other blood. On the whole they would class as average feeders in the Southern States.

Method of Feeding—The steers were fed regularly twice each day, at 7:00 in the morning, and at 5:00 in the afternoon. The corn silage was fed in troughs and distributed uniformly, after which the cottonseed meal was spread over and thoroughly mixed with the silage. These rations were consumed readily when prepared in this manner. The cottonseed hulls were put in the through, the meal sprinkled over it uniformly, and thoroughly mixed.

Feeds Used—The cottonseed meal used in this test was the ordinary commercial product. During the first year of the test, the corn silage was inferior, principally because of the small number of ears on it. In the second year, the corn silage was superior, principally because of the large number of ears it contained.

The steers were fed in a barn. The stalls were located on the south side and were 15x20 feet. They were connected with lots 20 feet wide by 80 feet long. The steers were kept in the stalls during the night and a large part of the day.

Water was kept before the steers at all times.

The steers were divided into two lots equal in uniformity, size and weight, and fed the following ration:

Lot 2. Cottonseed meal and corn silage.

Lot 3. Cottonseed meal and cottonseed hulls.

Details of the experiment are given in the following table.

Table 59—Cottonseed Hulls Versus Corn Silage for Fattening Beef Cattle at Raleigh, North Carolina. 1909-1911. Average Length of Experiment—112 Days.

The 1909 to 1910 test ran from November 6, to February 26.

The 1910 to 1911 test ran from October 12, to January 31.

Ration	Lot 2 C. S. Meal Corn Silage	Lot 3 C. S. Meal C. S. Hulls
No. of steers per lot	6	6
Av. initial weight, lbs.	918	923
Av. final weight, lbs.	1063	1084
Av. gain per steer, lbs.	144	161
Av. daily gain, lbs.	1.29	1.44
Av. daily ration, lbs.		
Cottonseed meal	7.45	7.45
Cottonseed hulls	.....	19.74
Corn silage	33.95	.....
Av. feed required per 100 lb. gain, lbs.		
Cottonseed meal	577	517
Cottonseed hulls	.....	1371
Corn silage	2634	.....

Reference: North Carolina Agricultural Experiment Station Bulletin, 218, pages 30, 31, 34 and 36, Table IV, "Feeding Experiments With Beef Cattle," July 1911, Raleigh, North Carolina.

Suggestive: Which lot required the most cottonseed meal per 100 lb. gain? Which lot made the most economical gain? Which roughage would you feed?

VIII

Immature Corn Silage Versus Cottonseed Hulls as a Basal Winter Ration for 2 Year Old Heifers, Manhattan, Kansas, 1934-35.

Immature corn silage and cottonseed hulls were full fed to Lots 1 and 2 respectively. The heifers in Lot 3 received one-half the amount of cottonseed hulls fed to Lot 2 plus all the immature corn silage they would clean up. In addition to roughage, each lot was fed cottonseed meal at the rate of two pounds per head daily and Bomin, a mixture of bone meal and ground limestone, at the rate of 1/10 pound per head daily. The immature, drouth-stricken corn had reached the tasseling stage when it was put into the silo August 15, 1934.

Table 60—Immature Corn Silage Versus Cottonseed Hulls as a Basal Winter Ration for 2 Year Old Heifers at Manhattan, Kansas. December 18, 1934 to February 12, 1935—A 56 Day Test.

Ration	Lot 1 Immature Corn Silage C. S. Meal Bomin	Lot 2 C. S. Hulls C. S. Meal Bomin	Lot 3 Immature Corn Silage C. S. Hulls C. S. Meal Bomin
No. of heifers per lot	8	8	8
Av. initial weight per heifer, lbs.	1117.50	1111.04	1115.42
Av. final wt. per heifer, lbs.	1257.29	1159.58	1229.38
Av. total gain per heifer, lbs.	139.79	48.54	113.96
Daily gain per heifer (av.), lbs.	2.50	.87	2.04
Av. daily ration per heifer, lbs.:			
Immature corn silage	71.13	----	42.12
Cottonseed hulls	----	22.22	11.11
Cottonseed meal	2.00	2.00	2.00
Bomin	.10	.10	.10
Av. feed required per 100 lb. gain, lbs.:			
Immature corn silage	2845.2	----	2063.08
Cottonseed hulls	----	2555.3	544.9
Cottonseed meal	80.0	230.0	98.0
Bomin	4.0	11.5	4.9

Reference: Kansas Agricultural Experiment Station Circular 35, pages 2 and 3, Table II, "Cattle Feeding Experiments," May 1935, Manhattan, Kansas.

Suggestive: How much gain was made per heifer in Lot 1? In Lot 2? In Lot 3? To what can this difference in gain be attributed? Calculate the number of tons of cottonseed hulls required to equal one ton immature corn silage in feeding value.

2—COTTONSEED HULLS VERSUS DRIED ROUGHAGES.

I

Cottonseed Hulls Versus Chopped Sagrain Fodder for Fattening Baby Beef Cattle at Stoneville, Mississippi. 1932-33, 1934-35.

Object—In order to learn something of the comparative value of cottonseed hulls and other roughages, the Stoneville Experiment Station conducted an experiment with grade calves with some marking of Hereford blood.

The calves were permitted to run on stalk and soybean field before putting them on the finishing feed. On December 20, the calves were divided as nearly equal as possible according to quality, sex and size. Good water and large well drained feed lots were made available for the experiment.

The ration fed each lot per 1000 pounds live weight daily, during the years 1932-33, were as follows:

Lot 1. Alfalfa hay 2.31 lbs.; chopped sagrain fodder 25.31 lbs.; cottonseed meal 7.23 lbs.; crushed sagrain (grain) 16.22 lbs.

Lot 2. Alfalfa hay 2.31 lbs.; cottonseed hulls 24.72 lbs.; cottonseed meal 7.24; crushed sagrain (grain) 16.24 lbs.

The following rations were fed in 1934-35:

Lot 1. Alfalfa hay 2.52 lbs.; cottonseed hulls 14.19 lbs.; cottonseed meal 22.22 lbs.; crushed corn 2.52 lbs.

Lot 2. Alfalfa hay 2.47 lbs.; chopped sagrain fodder 7.73 lbs.; cottonseed meal 23.30 lbs.; crushed corn 2.47 lbs.

Details of the experiment are given in the following table.

Table 61—Cottonseed Hulls Versus Chopped Sagrain Fodder as a Roughage for Fattening Baby Beef Cattle at Stoneville, Miss., 1932-33, 1934-35. A Two Year Average—120 Days Each Year.

Ration	Lot 1 C. S. Hulls	Lot 2 Chopped Sagrain Fodder
Av. No. of calves	16	16
Av. initial wt. per calf, lbs.	426.1	425.6
Av. final wt., lbs.	642.3	641.3
Av. gain per calf, lbs.	216.2	215.7
Av. daily gain per calf, lbs.	1.78	1.78
Feed required per 100 lb. gain, lbs.:		
Alfalfa hay	57.78	57.41
Cottonseed hulls	455.1	...
Ground sagrain	373.4	367.61
Crushed corn	62.4	62.3
Sagrain fodder	...	439.4

Reference: Mississippi Agricultural Branch Experiment Station Service Sheet 154 and Service Sheet 109, 1933-1935, Stoneville, Mississippi.

Suggestive: Did the cottonseed hulls make more total gain per calf than the sagrain fodder? Which of the roughages could be most conveniently fed on your farm?

II

Sumac (Cane) Fodder, Sumac Fodder and Alfalfa, and Cottonseed Hulls and Alfalfa Hay Compared as Roughages in Rations of Fattening Yearling Steers, Big Spring, Texas, 1930-1931.

This experiment was conducted at the U. S. Experiment Station at Big Spring by the Bureau of Animal and Plant Industries, in cooperation with the Agricultural Experiment Station, Texas A. & M. College.

The object of this test was to determine the comparative feeding values of (1) Sumac Fodder (heads included); (2) Sumac fodder and approximately 4 pounds of alfalfa hay, as roughages.

The cattle used in this experiment were thirty head of good representative Hereford yearling feeder steers, averaging approximately 611.2 pounds, were purchased from Tom Good, Big Spring, Texas, at a price of 8 cents per pound, with a 3 per cent shrinkage and were delivered to the Experiment Station at Big Spring, December 12, 1930. The steers were divided into 3 uniform groups of 10 each.

In this experiment, three different rations were fed on a basis of equal amounts of digestible protein for each of the respective lots. Calculation of rations were based largely on analyses and productive feeding values of Texas feeds by Fraps, and in view of the fact that the Sumac fodder (due to the unfavorable 1930 growing season) was for the most part inclined to be immature, there is the possibility that the total digestible nutrients in the rations received by Lots 1 and 2 might have been slightly lower than the amount shown in the calculated ration.

Table 62—Sumac Fodder Versus Sumac Fodder and Alfalfa Hay Versus Cottonseed Hulls and Alfalfa Hay, Big Spring, Texas, 1930-31. (A 140 day test).

	Lot 1 Gr. milo hds., C. S. meal, Sumac Fodder	Lot 2 Gr. milo hds., C. S. meal, Sumac Fodder Alfalfa Hay	Lot 3 Gr. milo hds., C. S. meal, C. S. Hulls Alfalfa Hay
No. of steers	10	10	10
Av. initial wt. at feed lot, lbs.	611.2	611.5	611.2
Av. final wt. at feed lot, lbs.	975.23	956.95	995.97
Av. gain per head, feed lot, wts., lbs.	364.03	345.45	384.77
Av. daily gain per head, feed lot, wts., lbs.	2.6	2.47	2.75
Shrinkage per head during shipment to market, %	5.82	4.54	5.72
*Average daily ration, lbs:			
Ground milo heads	12.24	12.76	13.03
Cottonseed meal	2.49	1.65	1.98
Sumac fodder (red top)	13.98	8.86	.....
Alfalfa hay	.....	4.20	4.18
Cottonseed hulls	.....	.....	9.01
*Feed required per 100 lbs. gain, lbs.:			
Ground milo heads	470.7	516.9	474.2
Cottonseed meal	95.6	66.8	71.9
Sumac fodder (red top)	537.8	358.9	.....
Alfalfa hay	.....	170.4	152.1
Cottonseed hulls	.....	.....	327.8
*Total feed consumed per head, lbs.:			
Ground milo heads	1713.6	1785.8	1824.7
Cottonseed meal	348.2	230.9	276.6
Sumac fodder (red top)	1957.8	1239.9	.....
Alfalfa hay	.....	588.5	585.1
Cottonseed hulls	.....	.....	1261.4
Salt consumed per head, lbs.	6.4	5.3	5.4

*Waste or rejected feeds were not deducted in summarizing data.

Note: The dressed yield of the respective lots was as follows: Lot 1, fed Sumac fodder, 58.9 per cent; Lot 2, fed Sumac fodder and alfalfa, 59.5 per cent; Lot 3, fed cottonseed hulls and alfalfa, 59.8 per cent.

The weight of internal fat, consisting of the caul and ruffle fat, was obtained from the individual carcasses, this being considered a partial index of the fatness of each group. The average weight of internal fat per head for each of the lots was: Lot 1—19.98 pounds; Lot 2—22.48 pounds; and Lot 3—22.65 pounds.

The Lot 3 steers, which received cottonseed hulls and alfalfa hay as roughage, showed a slight advantage in dressed yield and weight of internal fat over the other two groups. The Lot 1 carcasses, however, graded highest of the 3 lots, while those constituting Lot 2 ranked second, and those in Lot 3 ranked third.

All unconsumed, or rejected roughage was weighed back, the percentage of rejected feed being as follows: Lot 1—one per cent; Lot 2—one and three tenths per cent; Lot 3—one and two tenths per cent.

Reference: U. S. Experiment Station, Big Spring, Texas, Cattle Feeding, Series No. 2.

Suggestive: Which lot made the highest average gain per head? What were the constituents of the ration fed Lot 3? What is the cost per pound of gain in Lot 2? In Lot 3? In which lot did the carcasses grade lowest? Which ration would you feed to yearling steers?

III

Cottonseed Hulls Versus Sorghum Hay for Fattening Cattle at College Station, Texas, 1912-1913.

The basal ration used in this test consisted of cottonseed meal, either ground Kafir corn or milo maize, and silage. **The purpose**, therefore, was to compare sorghum hay and cottonseed hulls as supplements to this ration.

The cattle used were 32 head of range-bred, high grade Hereford steers two years past in age. They were a fairly uniform lot, most of them of very good feeder conformation and above the average in quality. All were rather thin in condition, but thrifty when the experiment began.

On the morning of October 16, 1912, the steers were divided into two lots, designated as Lot V and Lot VI, each containing 16 head. The division was made equally with regard to type, quality, condition and weight.

The two pens in which the lots were fed were each 60x100 feet in area and equal in all respects. Water and salt were amply provided. From the beginning of the experiment until January 6, the two lots had no shelter, whatever. Thereafter, each was protected by a shed, 14x36 feet, open on the south side. The cattle were, of course, subjected to the same weather conditions.

The two lots were fed the same ration with the exception of the kind of roughage. Lot V was fed cottonseed meal, ground milo maize or Kafir corn, cottonseed hulls and silage. Lot VI was fed identically the same ration except the cottonseed hulls were replaced by sorghum hay.

The ration per steer in each lot at the beginning of the experiment was 2 pounds of cottonseed meal, 4 pounds milo maize chops, 12 pounds silage. Lot V received 10 pounds cottonseed hulls and Lot VI 10 pounds Sorghum hay in addition to the above ration. This ration was gradually increased by periods until at the end of the experiment the ration per steer in each lot was 4 pounds cotton-

seed meal, 18 pounds Kafir chops, 17 pounds silage. Steers in Lot V were receiving 24 pounds cottonseed hulls and steers in Lot VI were receiving 24 pounds sorghum hay per head daily.

The rations were carefully weighed and supplied to the cattle in two parts, one early in the morning and the other late in the afternoon. All of the feeds were thoroughly mixed in the feed troughs, with the exception of the sorghum hay for Lot VI, which was placed in a rack.

Table 63—Cottonseed Hulls Versus Sorghum Hay for Fattening Beef Cattle, College Station, Texas, Oct. 16, 1912 to March 4, 1913—140 Days.

	Lot V Cottonseed hulls	Lot VI Sorghum hay
No. of steers	16	16
Av. initial wt., lbs.	777.5	775.6
Total gain per head, lbs.	413.1	431.6
Av. daily gain per head, lbs.	2.97	3.1
Total feed consumed per head, lbs.:		
Cottonseed meal	477.	477.
Milo maize chops	318.1	318.1
Ground kafir heads	187.5	187.5
Kafir chops	1461.	1461.
Cottonseed hulls	906.	
Silage	2549.4	2549.4
Sorghum hay		906.
Feed per 100 lb. gain per head, lbs.:		
Cottonseed meal	115.5	110.5
Milo maize chops	77.	73.7
Ground kafir heads	45.4	43.4
Kafir chops	353.6	338.5
Cottonseed hulls	219.3	
Silage	617.1	590.7
Sorghum hay		209.9

Note: The cattle took to their rations readily, and at no time during the test was there a steer in either lot "off feed" or affected with scours. After only two or three days the cottonseed meal, grain and silage in both lots were gradually increased, but at no time during the experiment was the cottonseed hulls and sorghum hay more than 10 pounds a head daily. On December 16, it was found necessary to begin a gradual reduction in these two feeds, from the fact that the other portion of the rations, especially the meal and grain, had been increased to such an extent, that the cattle could no longer eat as much roughage as they had been eating. After February 15, the hulls and hay were left off altogether, silage being the only roughage fed for the rest of the period. Milo maize chops was fed from the beginning of the experiment until November 24, after which ground Kafir corn heads was substituted for it and used until December 4. After this, threshed ground Kafir corn or Kafir corn chops was fed, with the exception of two days, viz: December 17 and 19, on which ground heads was again fed. The change from sorghum-cowpea silage to corn silage took place on February 1, the same as in the other experiment.

Reference: Texas Agricultural Experiment Station Bulletin 159, pages 24, 25, 26 and 30, Table XVIII, "Steer Feeding," July 1913, College Station, Texas.

Suggestive: What was the average daily gain in Lot V? In Lot VI? What is the comparative cost of 100 pounds gain in each lot (use current prices). Which would it be more convenient for you to feed, hulls or sorghum hay?

SECTION E—OTHER STUDIES WITH COTTONSEED PRODUCTS AS A FEED FOR BEEF CATTLE.

I

Vitamin A Studies in Cottonseed Meal With Beef Cattle, Raleigh, N. C. 1930.

By the curative method five steers of seven to eight hundred pounds in weight were fed the basal ration of 50% cottonseed meal, 25% each of cottonseed hulls, and beet pulp with minerals supplied. The steers developed Vitamin A deficiency symptoms in five and one-half to seven months, and died unless Vitamin A was supplied from some other source.

In 1931-32 the curative and preventive methods were used by feeding eight younger heifer calves of three to four hundred pounds in weight. Two were on the above basal ration, while two were placed on the basal ration in which yellow corn replaced one-half of the cottonseed meal. Four were fed the basal ration to which cod liver oil was added daily or in which 9.1 per cent alfalfa leaf meal was used.

The heifers on the basal and yellow corn rations developed Vitamin A deficiency symptoms which were relieved by supplying Vitamin A in cod liver oil. Those fed cod liver oil and alfalfa leaf meal daily in the ration fared better and made consistent gains.

The necessity of supplying some source of Vitamin A to the ration when feeding relatively large amounts of cottonseed meal has been demonstrated by both the supplemental and preventative methods of feeding.

The work completed the past year has shown that cattle on heavy cottonseed meal rations do not develop Vitamin A deficiency symptoms when cod liver oil is supplied with the basal ration. After the symptoms have become pronounced, cod liver oil added to the ration has a marked curative effect.

Cottonseed meal can constitute as high as 50 per cent of the ration for growing beef cattle and fattening yearlings over a period much longer than is necessary when the ration is adequately supplemented with feeds rich in Vitamin A, such as alfalfa leaf meal and cod liver oil.

Another trial of this experiment was started in the fall of 1932. Eight high grade Shorthorn heifer calves of similar breeding, age, type, and former treatment were selected. These were March and April calves and had been running on pasture all summer. A few of them were still nursing, but most of them had been weaned a short time.

The calves were divided into groups of two each and started on feed November 7. Each group received 26% of cottonseed meal, 26% of corn, and 1% mineral mixture. Group 1 received yellow corn, but Groups 2, 3 and 4 received white corn. In addition, the Group 1 mixture contained 22% cottonseed hulls and 25% dried beet pulp.

Group 2, 27% cottonseed hulls and 20% alfalfa hay.

Group 3, 27% cottonseed hulls and 20% soybean hay.

Group 4, 17% cottonseed hulls and 30% soybean hay.

They were full fed the above rations until April 6, when they were destroyed by fire. During the 140 day feeding period (last weights taken March 28) the average daily gains for Groups 1, 2, 3 and 4 were 2.10 lbs., 1.98 lbs., 2.04 lbs., and 1.81 lbs., respectively. On April 6 all calves were looking all right and were apparently in good health.

The experimental period was too short for a deficiency in Vitamin A in the ration to show any definite effect. The data for 140 days show that the only source of Vitamin A, alfalfa or soybean hay or yellow corn, apparently supplied sufficient Vitamin A for the heifers to make uniform total gains and feed consumption with the exception of the last two, Nos. 7 and 8, receiving 30 per cent soybean hay in the ration.

Reference: North Carolina Agricultural Experiment Station Fifty-Fifth Annual Report, pages 50 and 51, December, 1932, and Fifty-Sixth Annual Report, pages 48 and 49, December, 1933, Raleigh, North Carolina.

II

The Palatability of Cottonseed and Linseed Meals Compared as a Protein Concentrate Feed for Cows and Calves, East Lansing, Michigan, 1935.

"Considerable variation in feed consumption has been noted when beef calves have been fed individually on heavy grain rations containing cottonseed meal as a chief source of protein. An opportunity appeared in a trial concerning economy of production and palatability of beef with calves fed individually, at the Michigan Agricultural Experiment Station, to study the palatability of cottonseed meal as compared with a feed like linseed meal, which is ordinarily considered quite palatable.

Twelve heifer and twelve steer calves were fed by the reversal method, using 43 per cent protein cottonseed meal in the mixture for one-half the calves in each group and 37 per cent protein linseed meal for the remaining calves. Six calves were fed 105 days, reversing the two feeds at the end of each 28-day period for each calf; six calves were fed 154 days, and 12 calves were continued on feed 203 days, following a similar procedure in regard to feeding in each case, except that the last two periods for the twelve calves were 42 and 49 days in length.

All calves were fed as much as they desired of a mixture consisting of shelled corn 6 parts, cottonseed or linseed meal 1 part, corn silage 3.5 parts and cut alfalfa hay 2 parts, by weight. These proportions of feed were consumed by calves fed together in lots in three previous experiments, receiving as much of each feed as they desired. They were fed twice daily in individual stalls and released in two large pens for the day and night. Granulated salt, steamed feeding bone meal and ground limestone were available to both groups.

No differences in feed consumption, indicating a preference for either feed, were noted when the calves were changed from one feed to the other. The ration contained a large proportion of grain, and feed consumption varied from time to time, but there was no apparent relation between changes in feed and feed consumption.

The 24 cattle received cottonseed meal a total of 2,044 days and made an average daily gain of 2.103 pounds, while the same cattle received linseed meal a total of 1,946 days and gained on the average of 2.140 pounds per day. The

average amount of feed required for each 100 pounds gain was exactly the same for each feed, a single weight was obtained on each animal at the time of changing feed, and no doubt variations in fill were responsible for some variations in weights and gains. It was noted that 12 cattle made a faster gain while receiving linseed meal, 10 gained more rapidly while receiving cottonseed meal and 2 cattle made exactly the same gain on each feed.

These data indicate that cottonseed meal, containing 43 per cent protein and linseed meal containing 37 per cent protein are approximately equal in palatability and efficiency when fed with corn, corn silage and alfalfa hay to fattening beef calves."

Reference: Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. 18, No. 4, May, 1936. Page 253.

RESUME

Cottonseed Products Versus Other Feeds for Fattening Beef Cattle

Feed Compared	Place	Amount fed daily	Average daily gain	Average total gain per steer	Concentrates required per 100 lb. gain
Cottonseed meal	Laramie,	3.44	1.63	159.81	207.12
Linseed meal	Wyoming	3.44	1.08	106.11	311.94
Cottonseed cake	Fort Collins,	.98	2.01	390.5	48.8
Linseed oil cake	Colorado	.98	1.97	383.2	49.7
Cottonseed meal	State College	5.8	1.9	265.5	305.84
Velvet bean & pod meal	Mississippi	11.6	1.59	222.21	730.85
Cottonseed meal	Lafayette,	2.60	2.16	323.4	124.0
Soybean oil meal	Indiana	2.58	2.17	325.7	119.0
Cottonseed meal	Lafayette,	2.60	2.16	323.0	124.0
Whole soybeans	Indiana	2.59	2.25	337.0	115.0
Cottonseed meal	Manhatten,	11.04	2.39	334.0	462.81
Ground corn	Kansas	10.04	2.43	340.0	413.47
Cottonseed meal	Lafayette,	1.23	2.10	499.6	59.00
Whole soybeans	Indiana	1.24	2.08	494.4	59.00
Cottonseed meal	Lafayette,	2.28	2.45	367.9	93.00
Whole oats	Indiana,	4.87	2.16	324.2	225.00
Cottonseed meal	Lafayette,	2.28	2.45	367.9	93.00
Ground oats	Indiana	4.87	2.33	350.1	209.00
Cottonseed cake	Hays,	1.00	1.01	481.00	99.00
Ground kafir	Kansas	2.00	.92	437.50	217.6
Cottonseed meal	Hays,	1.00	1.01	481.00	99.00
Ground milo	Kansas	2.00	.88	421.40	227.26
Cottonseed meal	Hays,	1.00	1.01	481.00	99.00
Ground Barley	Kansas	2.00	.98	467.30	204.08
Cottonseed meal	Hays,	1.00	1.01	481.00	99.00
Ground wheat	Kansas	2.00	1.04	496.90	192.30
Cottonseed hulls	Manhatten,	22.22	.87	48.54	2555.3
Immature corn silage	Kansas,	71.13	2.50	139.79	2845.20
Cottonseed hulls	State College,	27.15	1.58	216.8	171.60
Goliad corn silage	Mississippi	45.32	1.78	243.8	258.80
Cottonseed hulls	State College,	27.15	1.58	216.8	171.60
Early amber sorg. sil.	Mississippi	45.32	1.58	216.8	291.00
Cottonseed hulls	State College,	27.15	1.58	216.8	171.60
Cowpea & J. G. Silage	Mississippi	45.32	1.31	179.8	350.90
Cottonseed hulls	State College,	27.15	1.58	216.8	171.60
Goliad Corn Stover Silage	Mississippi	45.32	.65	71.4	707.70
Cottonseed hulls	State College,	31.10	1.53	165.7	2061.0
Sorghum Silage	Mississippi	67.08	1.50	162.3	4493.2
Cottonseed meal	McNeill,	5.1	2.1	178.0	242.8
Dry Velvet Beans	Mississippi	11.9	2.8	235.0	424.9
Cottonseed meal	McNeill,	5.1	2.1	178.0	242.8
Soaked Velvet Beans	Mississippi	11.9	1.04	88.0	540.8
Cottonseed meal	Lafayette,	2.95	2.41	404.9	121.39
Ground Soybeans	Indiana	2.92	2.32	390.0	125.85
Cottonseed hulls	College Station,	6.40	2.97	413.1	219.3
Sorghum Hay	Texas	6.40	3.1	431.6	209.9
Cottonseed hulls	Big Spring,	4.18	2.75	384.77	327.8
Alfalfa Hay	Texas	4.20	2.47	345.45	170.4
Cottonseed hulls	Stoneville,	.....	1.78	216.2	455.1
Chopped Sagrain Fodder	Mississippi	.....	1.78	215.7	439.4

RESUME—Continued.

Cottonseed Products Versus Other Feeds for Fattening Beef Cattle

Feed Compared	Place	Amount fed daily	Average daily gain	Average total gain per steer	Concentrates required per 100 lb. gain
Cottonseed hulls	Raleigh,	19.74	1.44	161	1371
Corn Silage	N. Carolina	33.95	1.29	144	2634
Cottonseed hulls	Clemson,	25	1.5	153	1786
Corn Silage	S. Carolina	40	2.18	222.36	1684
Cottonseed hulls	Manhatten,	22.22	.87	48.54	2555.3
Corn Silage	Kansas	71.13	2.50	139.79	2845.2
Cottonseed hulls	College Station,	27.87	1.98	236	1405.4
Silage	Texas	47.57	2.03	242	2339.0
Cottonseed hulls	College Station,	28.4	2.61	362.8	1081.3
Silage	Texas	50.9	2.29	318.5	2217.9
Cottonseed meal	Lafayette,	2.29	2.29	342.8	100
Soybeans	Indiana	2.28	2.51	376.7	91
Cottonseed meal	Auburn,	5.	1.55	185.5	327
Velvet Beans	Alabama	10.6	1.6	190.3	670
Cottonseed meal	State College,	3.69	1.74	271	213
Shelled Corn	Mississippi	8.78	1.8	280	489

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Index by Tables According to Use Made of Cottonseed Products.