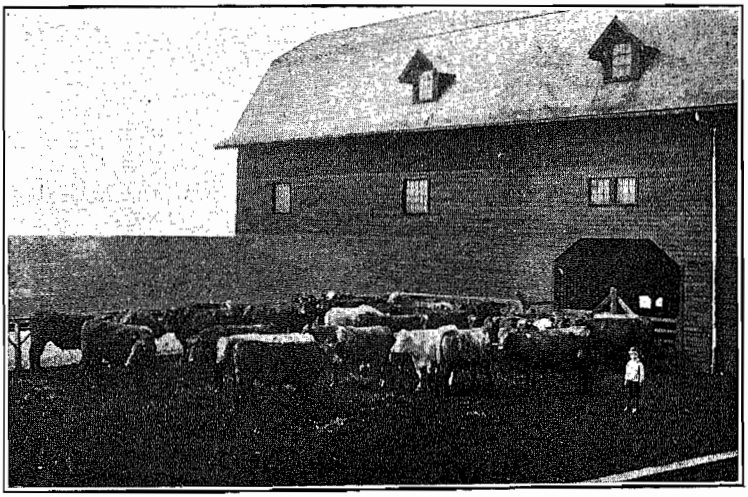
Agricultural Experiment Station
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University of Tennessee

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RELATION OF STEER FEEDING TO FARM RETURNS

BY
C. A. WILLSON



STEERS USED IN EXPERIMENT

KNOXVILLE, TENNESSEE

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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The Experiment Station building, containing the offices and laboratories, and the plant house, are located on the University campus, 15 minutes' walk from the Custom House in Knoxville. The experiment farm, the barns, stables, dairy building, etc., are located one mile west of the University on the Kingston Pike. The fruit farm is adjacent to the Industrial School and is easily reached by the Lonsdale car line. Farmers are cordially invited to visit the buildings and experimental grounds.

Bulletins of this Station will be sent, upon application, free of charge, to any farmer in the State

SUMMARY

1. Soy beans and barley ranked ahead of all other combinations used in these experiments in the amount of food material produced per acre. Page 103.

2. Soy beans ranked ahead of cowpeas in the production of grain each year. Page 103.

3. Better results can be secured from soy beans and barley as a rotation for the production of beef than from any other combination of crops used in these experiments. Page 105.

4. The rotation in which soy beans were used produced an average of 57 pounds more beef per acre than that in which cowpeas were used, and 74 pounds more than that in which corn was used. Page 105.

5. Larger beef gains were obtained per acre when the soy beans were allowed to reach maturity than when they were made into hay. Page 105.

6. Acre I, soy beans and barley, produced an average of 70 pounds more beef than Acre IV, soy beans, hay and barley. Page 105.

7. The soy-bean grain and barley acre ranked ahead of all the other rotations in the gross returns of beef per acre. This rotation produced an average of $61.23 per acre. Page 108.

8. The average gross returns per acre for each of the acres were as follows: Soy-bean grain and barley, $61.23; cowpea grain and barley, $58.94; corn and barley, $56.92; soy-bean hay and barley, $57.07; soy-bean grain and wheat, $55.99; soy-bean hay and oats, $59.23; alfalfa, $58.91. Page 108.

9. The average gross returns for beef sold from all the acres on experiment was $58.34, and the average beef yield for all the acres on experiment was 450 pounds. Page 108.

10. The returns in beef yield were 33 per cent larger when the crops grown were fed off in 90 days than when they were fed off in 60 days. Also the steers on 90-day feed, on account of their increased finish, would likely sell at ¼ to ½ cent more per pound than the steers on 60-day feed. Page 108.

11. The average prices received for the crops marketed through the steers were as follows: Soy beans, $1.40 per bushel; cowpeas, $1.60; wheat, $1.39; oats, $.57; barley, $1.02; corn, $1.00; soy-bean hay, $17.50 per ton; alfalfa hay, $14.20. Page 110.

12. If the crops produced on each acre were sold as grain or hay and the removal from the farm of the fertilizing elements were

reckoned as a factor, the price that each grain or hay would have to sell at in order to equal the returns obtained from the marketing of these through steers would be, for soy beans, $2.05 per bushel; for cowpeas, $2.03; for wheat, $1.60; for oats, $.69; for barley, $1.21; for corn, $1.17; for soy-bean hay, $27.99 per ton; for alfalfa hay, $24.03 per ton. Page 111.

13. The pounds of beef produced per acre were much larger when the winter-grown crop was fed instead of being plowed under. Pages 87 and 104.

14. The average beef yields per acre with the single-crop method were, for Acre I, where soy beans were grown and fed, 473 pounds; for Acre II, where cowpeas were grown, 294 pounds; for Acre III, where corn was grown, 165 pounds. The average beef yield with the double-crop method where both crops were fed, were, for the barley and soy-bean acre, 508 pounds; for the barley and cowpea acre, 451 pounds; for the barley and corn acre, 434 pounds. Page 109.

15. These experiments show that excellent returns per acre can be secured on Tennessee farms through the feeding of the crops to beef steers and the fertility be retained on the farm.

RELATION OF STEER FEEDING TO FARM RETURNS

INTRODUCTION

In Bulletin 79, published by this Station in 1903, the grains produced through the feeding to steers of crops grown on the farm were related to the acre basis. The present bulletin is a continuation of that work, with such changes and additions as the preliminary work showed should be made.

The author wishes to acknowledge his indebtedness to Director H. A. Morgan for many valuable suggestions, and for personal supervision of the experiments previous to the time that the author took up the work.

STEER FEEDING IN FARM ECONOMICS

Before beginning any type of farming, one should consider whether or not it will pay. That is usually the first question asked with regard to beef production in any particular section. The question is meant to be a relative one. The inquirer wishes to know whether beef production will pay more than some other kind of agriculture that he might engage in, and what profit he may expect to make if he engage in the raising of live stock instead of selling his crops from the farm. Most of all he wishes to know how much money he may expect to have on hand when tax time comes, or when he must meet the various other expenses that necessarily arise in the running of a farm.

In order to answer such questions with regard to beef-cattle raising it is necessary to relate the work to the acre basis. A feed that is shown to be the most profitable in a feeding trial when considered on the basis of market prices may prove to be the least successful when grown in actual practice for the production of beef. There are several reasons for this. The feed that gives the highest returns in the feeding trial may produce the smallest amount of food nutrients per acre, or it may be produced at much greater expense per acre, or it may remove more food nutrients per acre, and hence necessitate larger quantities of the fertilizing elements to replace the loss. These considerations are of more importance in determining the final returns from the farm than is the question which feed will make the most beef per given quantity. The data most needed by the farmer at the present time with regard to live stock production are those that will relate the work to the acre basis. The farmer needs to know which type of farming will return the most per farm. He is interested in

the question which type of farming will return the most over a series of years, and not which will return the most for one year without regard to weather conditions or the condition that the soil will be left in at the end of the year.

Live stock increases grain production

It may be shown in some instances that the selling of the crops off the farm for one year will bring in more money than the feeding of the crops to live stock on the farm, but the history of agriculture shows that the soil is maintained in a higher state of fertility in those counties and communities where live stock production prevails. Again, live stock production is not opposed necessarily to the sale of grains and other marketable crops from the farm. Live stock on the farm will increase the crop production per acre through the conservation of soil fertility. Records of the more progressive stock farms show that they actually sell more crops than the average farm.

Live stock provides a market for cheap feeds

The chief advantage that would result from the keeping of live stock on the majority of farms is that to a large extent the returns would be additional to those realized when live stock was not kept. These returns would be additional because live stock would turn the roughages of the farms, that are now going to waste, into money. More than one-half the fodder in this State goes to waste every year. For every head of cattle in the State there are produced three acres of corn, which will average one ton of stover per acre. One and one-half ton of stover is more than is needed to winter one head of cattle. There is going to waste, then, every year in this State, 5,700,000 tons of corn stover, which at a valuation of $5.00 per ton means a loss to the farmers of the State, through a lack of proper utilization of feeds by cattle, of over $28,000,000.

Live stock conserves fertility

Beef cattle would conserve the fertility of our farms and increase our average crop production. Writers often point out to us the wonders that have been accomplished in increased crop production in the Old World countries through the utilization of crops and feeds by cattle and the return of manure to the farms, and have held up to us Denmark, Germany and other countries as marked examples of what such methods would do for our crop yields.

Example in U. S. of live stock increasing crop production

If we could find similar illustrations of what has been accomplished in our country the lesson might be more forceful. With that thought in mind, we might compare the agriculture of Tennessee with that of Wisconsin. In the year 1880 the average cereal production of Tennessee was 16.3 bushels; of Wisconsin 23.0 bushels. We should expect that it would be a little higher

in Wisconsin at that time, for Wisconsin was a new state, and Tennessee was even then becoming an old state. The average acreage of cereals was practicaly the same for the two states. The number of horses, cattle, sheep, and hogs was also practically the same. In 1910 the average cereal production of each state was as follows: Tennessee, 19.1 bushels per acre; Wisconsin, 30.4 bushels. Through better methods of agriculture the farmers of Wisconsin have increased their cereal production more than 7 bushels, while the farmers of Tennessee have increased theirs less than 3 bushels.

Certainly these differences in crop yields can be accounted for. Judging by the history of other countries, it would seem that live stock had something to do with it. A review of statistics for the year 1910 shows that the number of horses, sheep, and hogs is still practically the same for the two states, but Wisconsin farmers had 1,683,545 more cattle than Tennessee farmers. There is not much wonder, then, that Wisconsin farmers during the past thirty years have increased the production per acre of their farms by 7.4 bushels while Tennessee farmers increased theirs by only 2.8 bushels; for Wisconsin farmers are putting back on their farms $50,000,000 worth more of manure each year than are Tennessee farmers. We have been selling cottonseed meal and corn, and Wisconsin has been adding the fertility from them to her soil through the use of live stock. Wisconsin farmers keep live stock. Tennessee farmers keep practically none. The average number of cattle per farm in Wisconsin is 8.3 head. The average number of cattle per farm in Tennessee is 1.7 head. Wisconsin has five times as many cattle per farm as Tennessee, and is producing 58 per cent larger crops per acre. The increased production per acre on Wisconsin farms during the past thirty years has been 2.6 times as great as on Tennessee farms. If we are to increase the average production per acre of cereals we must follow the method of other countries and communities that have increased their crop production; that is, keep live stock.

Live stock farmers have larger incomes than grain farmers

Farmers who keep beef cattle make more money than those who depend entirely upon grain crops. In a recent investigation by the Office of Farm Management of the U. S. Department of Agriculture on live stock and grain farms in Iowa, Illinois, and Indiana, it was found that the average annual labor income of farmers who conducted live stock farms was $755, while the average annual labor income of farmers who conducted grain farms was $28. Tenants who made live stock their principal source of income had a labor income of $717, while tenants who made grain crops their principal source of income had a labor income of $327. The reason why the live stock farmers had larger labor incomes was that they utilized all the rough feeds on their farms and thus obtained a return from feeds that otherwise would have been wasted, and that they were able through the use of live stock to utilize their labor to better advantage.

The live stock farmers were also, through the use of live stock, able to sell their crops at higher prices.

There is no question that the feeding of steers by farmers of this State would result in an increase of the soil fertility and production of larger crops per acre. This means that the income of each farmer would be greater and the farmer become more prosperous.

Farm values versus market values

"Nothing else has mitigated so much against the rational relation of live stock to average farm operations as the utter disregard of the fertiltiy sold from the farm when corn and other crops are sold direct and not fed. In other words, for the sake of the soils of the State and their future production it has been altogether too common a practice for the producer to calculate the value of his crop on the market price. The market price less the fertility sold in each pound, bushel, ton, or other commercial unit is a more logical basis of estimate, and yet under any system of direct marketing of crops we lose sight of the possibility of a better price if fed to live stock on the farm, the value of the utilization of roughage, the accumulation of elements of plant food and vegetable matter in the manure, a more judicious and profitable rotation and diversity of crops, and an increasing crop yield at much less cost per acre.

"Realizing the rather unconscious effect which market values, as ordinarily interpreted, are having, and may have, upon the live stock interests, and hence upon the general agriculture of the State, the Station has undertaken a series of experiments with the view of comparing market and farm values of various Tennessee crops."

REVIEW OF PREVIOUS WORK, PUBLISHED IN BULLETIN 79

This experiment with acres of various Tennessee-grown crops was started in 1906. Three acres were planted, respectively, to soy beans, cowpeas, and corn, side by side on the Station farm. The product of each acre was fed to four steers each winter. The results for the years 1906 and 1907 were published in Bulletin 79. In those years the crops were followed by crimson clover, which was plowed under each year for green manure. Only the crop grown on the land during the summer was fed. Inasmuch as the supply of Bulletin 79 is completely exhausted, we wish to repeat in this bulletin some of the important findings of that publication, as we believe that the work done and the results obtained should be considered by the reader before the succeeding work is reviewed. Pages 86 to 95, inclusive, are extracts from that bulletin, the table numbers being adapted to the present bulletin.

The results show that in the experiment of 1906-07 the corn acre lasted the four steers 54 days, producing a gain of 129 pounds; the soy-

bean acre fed 80 days, with a gain of 406 pounds; and the cowpea acre fed 54 days, with a gain of 289 pounds. These results were so suggestive that in 1907-08 the experiment was duplicated and the results were very similar.

The yields per acre for the two years were approximately the same, viz: 34 bushels of corn and 3,544 pounds of stover; 20 bushels of soy beans and 2905 pounds of straw; 13 bushels of cowpeas and 1365 pounds of straw. The gains in this experiment were decidedly heavier than in the privious year, the gains being as follows: Corn lot, 203 pounds; soy-bean lot, 540 pounds; cowpea lot, 327 pounds. The increase in gain in this experiment over that of the previous year is accounted for by the fact that the steers were of a little better quality than those of 1906-07.

Table I shows the exact amounts eaten during the two years that the experiment was run and the average per steer per day, the total gain on the lots and the average per steer per day, the total waste, the average waste per steer per day, and the amount of gain per pound of concentrates fed. The totals in this table are used in the business statement, which covers two years.

BUSINESS STATEMENT

As has been indicated, it is one of the objects of this bulletin to call attention to the relationship between farm and market values; to show if possible the value of a farm crop when marketed in the animal or when sold on the open market, as is the too common practice. With this object in view, the following business statement is presented for the three acres planted to the respective crops:

In this statement the results of the two years' experiments are combined (see Table I); that is, the statement is made out as though eight steers were fed on the products from two acres of each of the respective crops, corn, soy beans, and cowpeas. The steers used in this experiment were in each case continued on feed after the acre experiments were concluded, and sold to the East Tennessee Packing Co., after being on full feed a total of 100 days. The steers in both experiments were purchased in East Tennessee, off grass, for 4¼ cents, were fed for 30 days on preliminary feed before going on experiment, and sold, after being on full feed 100 days, for 5 cents.

In connection with this business statement attention should be called to the fact that the selling price of the steers is not what they would have brought at the end of the acre experiments, but what they were sold for at the end of 100 days. It is manifest that it would have been impracticable to sell the steers from the corn or cowpea acre at the end of the 54-day periods for 5 cents, when it is remembered that they cost 4¼ cents as feeders in the beginning of the experiment. The soy-bean lot, however, which fed 80 days, and in the two years made an average of 118 pounds gain per steer, could have been sold at the end of the 80 days for 5 cents. When it is remembered that it

TABLE I—*Statement of feed and gains*

Four steers fed 54 days

Lot I Corn acre	Corn eaten	Av. per steer per day	Stover eaten	Av. per steer per day	Silage eaten	Av. per steer per day	Total gain	Av. gain per steer per day	Corn per lb. gain	Total waste	Av. waste per steer per day
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dec. 8, 1906-Jan. 30, 1907	2450	11.34	1912	8.85	4320	20.00	128	0.59	19.10	1531	7.08
Dec. 2, 1907-Jan. 24, 1908	2455	11.34	1632	7.55	4400	20.37	203	0.94	12.06	1015	4.72
Total for 2 years	4905		3544		8720		331				

Four steers fed 80 days

Lot II Soy-bean acre	Soy beans eaten	Av. per steer per day	Soy-bean straw eaten	Av. per steer per day	Silage eaten	Av. per steer per day	Total gain	Av. gain per steer per day	Soy-bean meal per lb. gain	Total waste	Av. waste per steer per day
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dec. 8, 1906-Feb. 25, 1907	1133	3.54	3585	11.2	6814	21.29	406	1.27	2.78	415	1.92
Dec. 2, 1907-Feb. 19, 1908	1184	3.70	3280	10.25	6640	20.12	540	1.68	2.19	287	1.32
Total for 2 years	2317		6865		13454		946				

Four steers fed 54 days

Lot III Cowpea acre	Cowpea meal eaten	Av. per steer per day	Cowpea straw eaten	Av. per steer per day	Silage eaten	Av. per steer per day	Total gain	Av. gain per steer per day	Cowpea meal per lb. gain	Total waste	Av. waste per steer per day
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dec 8, 1906-Jan. 30, 1907	751	3.49	2404	11.12	4240	19.62	261	1.21	2.87	303	1.40
Dec. 2, 1907-Jan. 24, 1908	751	3.49	2200	10.18	4400	20.37	327	1.51	2.29	66	0.30
Total for 2 years	1502		4604		8640		588				

TABLE II—*Cost of production of corn acres*

	One acre	Two acres
Seed value	$ 0.21	$ 0.42
Shelling seed	0.02	0.04
Plowing	2.00	4.00
Disking	0.34	0.68
Dragging	0.48	0.96
Planting (horse planter)	0.25	0.50
Cultivating	1.62	3.24
Cutting (corn binder)	0.52	1.04
Shocking and tying	0.40	0.80
Twine	0.21	0.42
Cutting stover and grinding	3.31	6.62
Hauling to barn	1.00	2.00
Land rent	4.50	9.00
Total	$14.86	$29.72

was impossible to sell the steers on the corn and cowpea acres at the end of 54 days for the price of 5 cents used in this statement, and that at the end of 80 days the steers on the soy beans were in condition to demand 5 cents, it is clear that in expressing these calculations undue advantage has been given to both corn and cowpeas.

In table II (corn acre) is a statement of the cost of producing an acre of corn. Each item of this statement is carefully calculated from the most reliable data available, a large portion of which was gained from a cooperative experiment between the U. S. Department of Agriculture and the Minnesota Station. Minnesota Bulletin No. 97, which gives the results of the experiment, contains very reliable data on farm values, the cost of producing various crops, farm labor, worth of farm machines and cost of running same, etc. The data for this bulletin were three years in collecting and represent large averages upon all items of farm expense. The cost of production as outlined in Table II has been corrected for Tennessee conditions by comparison with the farm records of our own Station and upon the advice of practical Tennessee farmers to whom it was submitted for criticism.

In Table IV and following tables are outlined the values of the fertilizing constituents in the feeds from the respective acres which were consumed by the steers in this experiment. These values are computed from Table III, Appendix of Henry's "Feeds and Feeding." The available fertilizing compounds are placed at their standard commercial

TABLE III—*Statement of farm values—corn acres*

Dr.	Two acres of corn fed to eight steers		Cr.
Initial cost of 8 steers 7,827 lbs. at 4¼c	$332.65	8 steers, fed 54 days, sold 8,159 lbs. at 5c	$407.95
Cost of production of corn, farm value	29.72		
Labor, feeding 54 days	5.28		
15% fertilizing constituents lost in steers	5.03		
Silage, 4.36 tons at $1.82	7.93		
Bal. profit	27.34		
	$407.95		$407.95
Two acres of corn sold on the market			
Cost of production	$ 29.72	70 bu. corn at 50c	$ 35.00
Loss in fertility	26.51	1.77 ton stover at $3.00	5.31
		Bal. loss	15.92
	$ 56.23		$ 56.23
Price at which corn must be sold to balance profit and loss			
Cost of production	$ 29.72	70 bu. corn at 72.98c	$ 50.92
Loss in fertility	26.51	1.77 ton stover at $3.00	5.31
	$ 56.23		$ 56.23

TABLE IV—*Amounts and values of fertilizing constituents in feeds consumed during two years in experiment with corn acres*

Fertilizing constituent	Value per pound	4905 lbs. corn and cob meal	Fertilizing value	3544 lbs. corn stover	Fertilizing value	Total val. for corn acres	8720 pounds corn silage	Fertilizing value	Fertilizing value of all feeds
	Cts.	Lbs.		Lbs.			Lbs.		
Nitrogen	19.0	69.16	$13.14	36.85	$ 7.00	-----	24.41	$4.63	-----
Phos. acid	5.3	27.96	1.48	10.27	.54	-----	9.59	.50	-----
Potash	6.0	23.05	1.38	49.61	2.97	-----	32.26	1.93	-----
Total	---	----	$16.00	----	$10.51	$26.51	----	$7.06	$33.57

TABLE V—*Cost of production of soy-bean acres*

	One acre	Two acres
Seed value	$ 0.25	$ 0.50
Plowing	2.00	4.00
Disking	0.33	0.66
Dragging	0.48	0.96
Planting (horse planter)	0.22	0.44
Cultivating	1.61	3.22
Cutting (mowing machine)	0.60	1.20
Raking and shocking	1.50	3.00
Threshing at 6c per bushel	1.20	2.40
Grinding	0.40	0.80
Land rent	4.50	9.00
Total	$13.09	$26.18

values for Tennessee, 19 cents per pound for nitrogen, 5.3 cents for phosphoric acid, and 6 cents for potash. It is estimated that when the crop is sold on the open market all of the soil fertility contained in it is lost, and when the crop is fed to live stock and the manure returned to the land only 15 per cent is removed.

In Table III in the statement of corn fed to 8 steers the credit side shows, from the combined results of two years, that the 8 steers weighed 8,159 pounds at the end of the 54-day period, selling for 5 cents per pound, or $407.95. On the debit side is shown the initial cost of the steers at 4¼ cents when put on feed. The cost of producing an acre of corn is taken from the statement in Table II. The silage eaten is credited at farm value, or the actual cost of production. Labor in feeding and caring for the steers is placed at 66 cents each. This is the amount determined by the Illinois Station, from considerable experimental datum. Fifteen per cent of the value of the fertilizing constituents is estimated from Table IV. In Table III is a statement showing the result of selling the products from the corn acre on the market at 50 cents per bushel for the corn and $3.00 per ton for the stover. After the cost of production and the loss in fertility are deducted there is a loss of $15.92 in the transaction. The last part of the table shows that corn must sell for $0.7298 per bushel to balance profit and loss.

Tables V and VI are computed in the same way as Tables II and III. A comparison of these tables shows that the cost of the production of an acre of soy beans is slightly less than that of the corn acre.

TABLE VI—*Statement of farm values—soy-bean acres*

Dr.	Two acres of soy beans fed to eight steers		Cr.
Initial cost of 8 steers 7,595 lbs. at 4¼c	$322.78	Sold 8 steers, 8,542 lbs. at 5c	$427.10
Cost of 2 acres soy beans, farm values	26.18		
6.72 tons silage at $1.82	12.23		
Labor, feeding 80 days	7.68		
15% loss in soil fertility	10.33		
Bal. profit	47.90		
	$427.10		$427.10
Two acres of soy beans sold on the market			
Cost of production	$ 26.18	39 bu. soy beans at $2	$ 78.00
Loss in fertility	57.96	3.43 tons soy-bean straw at $3.00	10.29
Bal. profit	4.15		
	$ 88.29		$ 88.29
Price at which soy beans must be sold to balance profit and loss			
Cost of production	$ 26.18	39 bu. soy beans at $1.893	$ 73.85
Loss in fertility	57.96	3.43 tons soy-bean straw at $3.00	10.29
	$ 84.14		$ 84.14

TABLE VII—*Amounts and values of fertilizing constituents in feeds consumed during two years in experiment with soy-bean acres*

Fertilizing constituent	Value per pound	2317 lbs. soy-bean meal	Fertilizing value	6865 lbs. soy-bean straw	Fertilizing value	Total val. for soy-bean acres	13454 pounds corn silage	Fertilizing value	Fertilizing value of all feeds
	Cts.	Lbs.		Lbs.			Lbs.		
Nitrogen	19.0	122.80	$23.33	120.13	$22.82	-----	37.67	$ 7.15	-----
Phos. acid	5.3	43.32	2.29	27.46	1.45	-----	14.79	.78	-----
Potash	6.0	44.02	2.64	90.61	5.43	-----	49.77	2.98	-----
Total	---	-----	$28.26	-----	$29.70	$57.96	----	$10.91	$68.87

Table VI shows a balance of $47.90 profit from the soy-bean acre, or $20.56 more than from the corn acre. When the soy beans are sold on the market at $2.00 per bushel and the straw at $3.00 per ton there is a profit of $4.15, or, as shown in the last part of the table, soy beans at $1.893 per bushel will balance the profit and loss.

Table VII shows the fertilizing constituents removed in the soy beans to be worth $57.96, or $31.45 more than those removed in the corn. It will be remembered, however, that no account is taken of the fact that a large part of the nitrogen contained in the beans and peas came from the air, and the soil upon which cowpeas or soy beans are grown must in a measure be improved by the growing of these leguminous crops. While we know that there is a certain amount of improvement over the corn acre, we have not enough reliable data on the subject to give it a value or state the rate of such improvement. It is known from general observation that soils are improved by the growing of a leguminous crop and it is believed that this improvement will offset the cost of the corn silage fed in this experiment which was not produced on the acres in question.

The figures given in Tables VIII and IX for the cowpea acres are estimated in the same way as those for the corn and soy-bean acres. Table IX shows that the profit made is $39.70, or $12.36 more than the profit of the corn acre. The cost of production is about the same as for the soy-bean acre.

TABLE VIII—*Cost of production of cowpea acres*

	One acre	Two acres
Seed value	$ 0.20	$ 0.40
Plowing	2.00	4.00
Disking	0.33	0.66
Dragging	0.48	0.96
Planting (horse planter)	0.22	0.44
Cultivating	1.61	3.22
Cutting (mowing machine)	0.60	1.20
Raking and shocking	1.50	3.00
Hauling to thresher	1.60	3.20
Threshing at 9c	1.12	2.24
Grinding	0.35	0.70
Land rent	4.50	9.00
Total	$14.51	$29.02

TABLE IX—*Statement of farm values—cowpea acres*

Dr.	Acres of cowpeas fed to steers		Cr.
Initial cost of 8 steers, 7,626 lbs. at 4¼c	$324.10	Sold 8 steers, 8,242 lbs., at 5c	$412.10
Cost 2 acres cowpeas, farm values	29.02		
4.32 tons silage eaten at $1.82	7.86		
Labor, feeding 54 days	5.28		
15% loss in soil fertility	6.14		
Bal. profit	39.70		
	$412.10		$412.10

Statement when cowpeas are sold on market

Cost of production	$ 29.02	25 bu. cowpeas at $2.00	$ 50.00
Loss in fertility	33.97	2.3 tons cowpea straw at $3.00	6.90
		Bal. loss	6.09
	$ 62.99		$ 62.99

Price at which cowpeas must be sold to balance profit and loss

Cost of production	$ 29.02	25 bu. cowpeas at $2.235	$ 56.09
Loss in fertility	33.97	2.3 tons cowpea straw at $3.00	6.90
	$ 62.99		$ 62.99

TABLE X—*Amounts and values of fertilizing constituents in feeds consumed during two years in experiment with cowpea acres*

Fertilizing constituent	Value per pound	1502 lbs. cowpea meal	Fertilizing value	4600 lbs. cowpea straw	Fertilizing value	Total val. for cowpea acres	8640 pounds corn silage	Fertilizing value	Fertilizing value of all feeds
	Cts.	Lbs.		Lbs.			Lbs.		
Nitrogen	19.0	50.01	$ 9.50	89.70	$17.04	-----	24.19	$4.59	-----
Phos. acid	5.3	18.02	.95	23.92	1.26	-----	9.50	.50	-----
Potash	6.0	19.52	1.17	67.62	4.05	-----	31.97	1.92	-----
Total	---	----	$11.62	----	$22.35	$33.97	----	$7.01	$40.98

Table X shows the range of prices at which the steers might have been sold and the profit or loss that would accrue from such sales. It also shows the price per bushel at which the grain must sell on the market to produce the same profit or loss. For instance, in Table XI, corn acre, the first line shows that the 8 steers were bought for 4¼ cents per pound and weighed at time of purchase 7,827 pounds. At the end of the 54-days feed they weighed 8,159. If they had been sold at

TABLE XI—*Profit or loss when steers are sold at different prices per pound, and the price per bushel at which the feeds must sell on the market to produce a corresponding profit or loss*

Corn acres						
Bought 7,827 pounds at 4¼c., sold 8,159 pounds at	4c.	4¼c.	4½c.	4¾c.	5c.	5¼c.
Profit or loss when fed to steers	—$54.13	—$33.86	—$13.46	$ 6.94	$27.34	$47.73
Price per bushel at which corn must sell to equal the same profit or loss as above	4.47c.	24.38c.	53.51c.	82.6c.	$ 1.12	$ 1.41
Soy-bean acres						
Bought 7,595 pounds at 4¼c., sold 8,542 pounds at	4c.	4¼c.	4½c.	4¾c.	5c.	5¼c.
Profit or loss when fed to steers	—$37.52	—$16.17	$5.19	$26.54	$47.90	$69.25
Price per bushel at which soy beans must sell to equal above	98.16c.	$1.48	$2.03	$2.57	$3.12	$3.67
Cowpea acres						
Bought 7,626 pounds at 4¼c., sold 8,242 pounds at	4c.	4¼c.	4½c.	4¾c.	5c.	5¼c.
Profit or loss when fed to steers	—$42.72	—$22.12	—$1.51	$19.09	$39.70	$60.30
Price per bushel at which cowpeas must sell to equal above	53c.	$1.36	$2.18	$3.02	$3.83	$4.65

—Indicates loss.

the range of prices (4¼ to 5½ cents) indicated to the right in the same line there would be a profit or loss indicated immediately below the prices at the top of the columns at the right of the table. This second line just mentioned shows the profit or loss when the products of the acre are fed to steers according to the estimates outlined in previous tables. It is thus shown in the second column from the left (corn acre) that when steers are sold for 4¼ cents there is a loss of $33.86; when sold for 5¼ cents there is a profit of $47.73. In the line below this, or the fourth line from the top of the table, is shown the price per bushel that corn must sell for, taking into consideration the cost of production, loss in fertility, etc., as indicated in previous tables, to equal the profit or loss indicated above, when the corn is fed to steers. For instance, if steers sold for 4¼ cents there would be a loss of $33.86. If corn sold at 24.38 cents per bushel there would be an equal loss of $33.86. Similarly if the steers sold for 5¼ cents (last column) there would be a profit of $47.73; if the corn sold for $1.41 per bushel there would be an equal profit of $47.73.

The estimates were made in the same way for the soy-bean and cowpea acres.

RESULTS OF STEER ACRE WORK 1908-1914

General outline of experiments

It was found that in the experiments published in Bulletin 79 advantage was not taken of the climate of this State, which makes it possible to grow two mature crops on the same piece of land each year. After the removal of the crops in the year 1907, the double-crop system was inaugurated. Barley was sown on the land after the removal of the crops grown during the summer, and was allowed to mature the following spring, and then harvested as grain. The barley grain was fed each year along with the other crop grown on the acre, and thus the total food-nutrient production of the acre was greatly increased, and greater gains per acre were secured. The winter crop of barley was harvested in time to replant this land to soy beans, cowpeas, and corn.

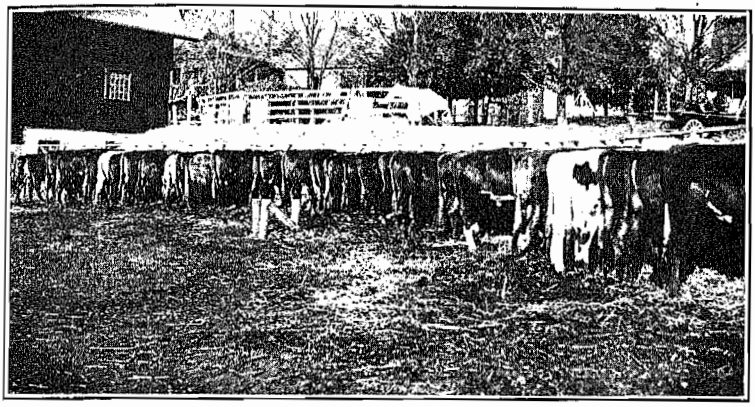
Object of experiments

The object of these experiments has been to encourage the feeding of live stock in this State. Naturally, farmers who plan to engage in this type of farming wish to know (1) which kinds of crops will produce the largest yields, (2) which kinds of crops will produce the largest amount of beef when fed to finishing steers, (3) which kinds of rotations are best adapted for the feeding of beef steers, (4) which are the best means of harvesting the various crops when they are intended for cattle-feeding, (5) whether or not the crop should be fed off through heavy feeding in a short time or should be fed in lighter feeds extending over a longer period of time, and (6) which crops will deplete the soil most rapidly.

Crop rotations used

In these experiments not all of the crops that may be grown in this State have been experimented with, but only the principal crops. Those that have been tried thus far are soy beans, corn, soy-bean hay, wheat, oats, alfalfa, and barley. These crops were incorporated into rotations, and the experiments have been with those rotations. The rotations were as follows:

Acre I—Barley and soy beans
Acre II—Barley and cowpeas
Acre III—Barley and corn



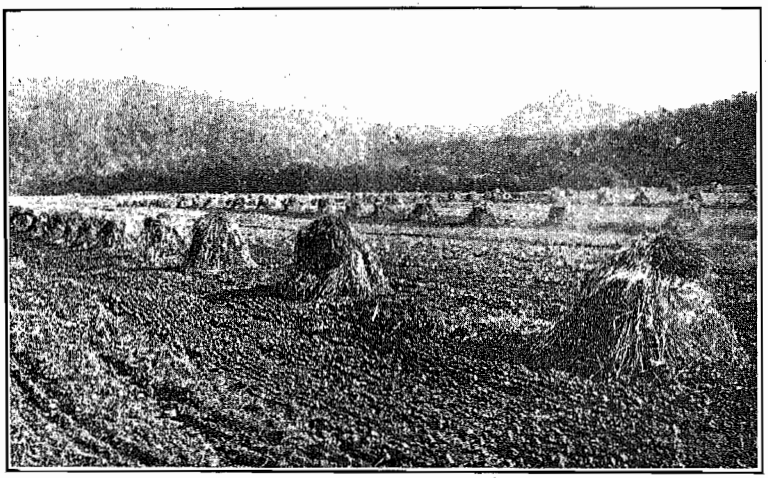
STEERS ON PRELIMINARY FEED

Acre IV—Barley and soy beans, with the soy beans harvested as hay
Acre V—Wheat and soy beans
Acre VI—Oats and soy beans, with the soy beans taken off as hay
Acre VII—Alfalfa hay

After the experiments had been conducted for three years, visiting farmers often said they believed that if the soy beans on Acre I were taken off as hay the crop from this acre would produce as good results as if it were taken off as grain and would have the added advantage of being out of the way early in the season so that the barley could be put in earlier. Some suggested that wheat might give better results than winter barley. Still another suggestion was that oats as a winter crop might give better returns. An alfalfa-hay acre was added to the series beginning with the year 1910.

Plan of experiments

The plan of the experiments for the first two years was that the crop grown in the summer should be taken off and fed to a group of steers, and that the crop grown in the winter should be turned under in the spring. After the experiments had been conducted according to this plan for two years it was observed that it might be better to harvest the winter-grown crop for grain and then put the acre into a summer crop, to be harvested as grain or hay as seemed best. There appeared to be no reason why the winter crop could not be grown to maturity in this climate and still leave time enough for the growth of the summer crop. The feeding of the winter crop would of course destroy some



STEER ACRES WITH WINTER GRAIN IN SHOCK

of the organic matter, but it was thought that the manure, which was returned to the acre that produced it, would more than supply the organic matter actually needed for the building up of the soil. There would also be the advantage of securing an added return from the winter-grown crop before it should be returned to the acre that produced it. The first two years' work with the single-crop method was published in Bulletin 79. In 1908 it was decided to revise the methods as noted above. The original crops experimented with were soy beans, cowpeas, and corn. In the new outline, barley was to be added to the rotation and to be fed along with the summer-grown crop. Other rotations were added, as follows: In 1909 barley and soy beans, the latter crop to be taken off as hay, were added as Acre IV; in 1911 winter wheat and soy beans were added as Acre V; in 1911 winter oats and soy beans as hay were added as Acre VI; and in 1910 an acre of alfalfa was added.

Basal ration

In all of the experiments a basal ration of 20 pounds of silage per day was added to the ration of each steer. In the calculation of the financial returns for each acre the silage was estimated at $3.00 per ton. Corn and sorghum silage was used in all experiments. At $3.00 per ton each acre of silage used for feeding gave a return of from $33.00 to $48.00 per acre.

Dates of seeding

Up to the year 1911 the barley was sown on the same date on all the acres. Since then the practice has been followed of sowing the barley as soon after the harvesting of the summer's crops as the ground could be got ready. Up to the year 1911 the average date of seeding in the fall was from October 17 to 24. Since the year 1911 the average date of seeding for Acres I, III, and IV has been from October 17 to 29, and for Acres II, IV, and V from September 26 to October 1. The reason for changing the methods of seeding so that the winter crops could be put in as soon as the summer crops were removed was that it seemed unfair not to allow the cowpea acre and the acres in which the soy beans were taken off as hay the natural advantage that they would have in practice of an earlier seeding of the winter crop of barley, which would insure a larger yield of that crop.

Date of harvesting

The average date of harvesting of the barley acre was in the first week of June; of the wheat acre from June 5 to 10; and of the oat acre from June 10 to 15.

Preparation of soil

As soon as the winter-grown crops were harvested, the ground, if hard, was broken up with the subsoil plow, and then fitted for the summer crops as soon as there was sufficient moisture. If the ground was in good condition at the time of harvest, with plenty of moisture, it was plowed and fitted. In the fall, in preparation for the winter crop, the ground was usually broken immediately after the removal of the summer crop, by the running of the subsoil plow every two feet. The subsoil plow, or the turning plow, was always followed immediately with a culto-packer and then a harrow.

Varieties and methods of harvesting

The varieties and rates of seeding of the various crops grown were as follows:

Soy beans (Mammoth Yellow) sown at the rate of 70 to 80 pounds per acre, in rows 24 inches apart, where the crop was to be taken off as grain. Where the soy beans were intended to be taken off as hay they were sown at the rate of 90 to 100 pounds per acre, in rows 24 inches apart.

Cowpeas (Whippoorwill) sown at the rate of 60 to 75 pounds in rows 24 inches apart.

Corn (Hickory King) drilled with the corn planter, in rows 38 inches apart, at the rate of 25 to 30 pounds per acre, and then thinned

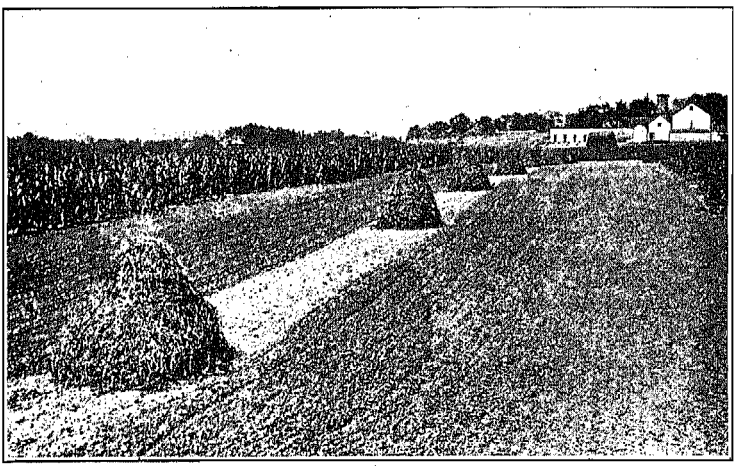
to a stand of 18 to 20 inches in the row. This, perhaps, would not be the best field practice, but for experimental purposes it insured a stand.

Wheat (Poole) sown at the rate of 1½ bushels per acre.

Oats (Culberson) sown at the rate of 2 bushels per acre.

Barley (a mixture of Union and Tennessee) sown at the rate of 75 to 80 pounds per acre.

All the grains were harvested when the grain was ripe. The rule for harvesting the soy beans as hay was to cut them at 15 to 20 days after they were in bloom. At this state the beans are just beginning to form the pod so that they are not noticeable. The hay



COWPEA ACRE, SHOWING METHOD OF HARVESTING AND PREPARING GROUND FOR SUCCEEDING CROP. HAY CURED ON RACKS

crops were well cured on racks, and then weighed when taken into the barn. The grains were weighed just after they were threshed, as were also the stovers resulting from the threshing. The corn in the fall, when it was desired to begin the feeding, was too wet to grind and feed, and it was therefore measured with the bushel basket, and then an equal measure of old corn was weighed and ground and fed.

Preparation of crops for feeding

The grains were ground before feeding, and the corn was ground with the cob. All stovers were run through the cutting box, as were also the hays. The hays and stovers from each acre were kept separate,

Calculating rations As soon as the amounts of grain, hay and stover were known for each acre, rations for each 30 days were made out for the 90-day periods, or the 60-day periods, according to whether or not it was the intention to run the feeding for 90 or 60 days. Increases in the grain rations were made at the beginning of the second and third 30-day periods when the experiment was to run for 90 days, and at the beginning of the second and third 20-day periods when the experiment was to run for 60 days.

Handling manure The manure produced from each acre was returned to that acre. Manure was left in the stall until mornings when the ground was frozen hard enough to hold up a team and a manure spreader. Thus all the fertility passing through the steers, that was produced from a particular acre, was returned to that acre. Thus far there seems to be no diminution in the fertility of those acres where a leguminous crop is grown at some time during the year. From the appearance of the corn grown on Acre III, there seems to be a diminution in the fertility of that acre. The other acres are gathering nitrogen from the air, which appears to keep up that element in those acres sufficiently to insure good crops.

Method of selecting steers, and preliminary feeding The steers selected each year would grade as medium-to-good feeders on the Chicago market, and were from cattle produced in Tennessee. They were mostly of Shorthorn breeding; some of them, however, were of Angus breeding, and a few were Hereford grades. The steers were usually selected in August or the fore part of September, and were got into the feed-lot about the latter part of October. For a period of three weeks the steers were put on a preliminary feed of corn stover, green corn, and green sorghum, and some hay. From 50- to 100-pounds fill was secured in this manner during the three weeks. The steers were then numbered with wooden blocks suspended from the neck, and were weighed individually for three days, the average weight being taken. They were then divided into groups of four, according to weight, and quality, and the experiment proper was begun.

Weighing of steers The steers were weighed individually for two days at the end of every 10 days, and for three days at the end of every 30- or 20-day period, according to whether the experiment was to run 90 or 60 days.

Feeding and care During the actual time that the steers were on experiment they were fed twice daily, the day's ration being divided equally between the two feeds. They were fed between five and six o'clock in the morning and between five and six o'clock in the afternoon. In the afternoon, when the weather was favorable, they were turned into one common lot,

where they had access to water. The stalls were then bedded with straw produced from the acres. Each ration was carefully weighed and the roughage and the concentrates were thoroughly mixed.

Numbering of steers At the beginning of the experiment numbers were cut in the hair on the hips by means of curved shears, which were better than the blocks because the steers were more easily distinguishable and the numbers could not be lost.

TABLE XII—*Crop yields of acre experiments*

No. of acre	Crops grown	1908	1909	1910	1911	1912	1913	1914	Average	
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bu.
I	Soy-bean grain	984	1020	1560	1174	1300	667	1616	1189	19.8
	Soy-bean stover	2800	3190	3670	2740	2270	2235	3335	2877	
	Barley grain	1920	1104	1412	1276	1440	1512	1211	1411	29.4
II	Cowpea grain	690	360	510	684	765	315	543	550	9.2
	Cowpea stover	2180	2110	2070	2280	1800	1615	2675	2104	
	Barley grain	1920	1512	1515	1307	1390	2106	1837	1656	34.5
III	Corn grain	1572	1680	2835	2450	1260	1395	1680	1839	26.3
	Corn stover	3583	2560	3524	3855	2645	2150	3000	3045	
	Barley grain	1920	1240	1486	1226	1240	1030	1181	1332	27.8
IV	Soy-bean hay		4000	3865	3555	3370	3455	4120	3727	
	Barley grain		1104	1472	1418	1350	1716	1598	1443	30.0
V	Soy-bean grain				1067	1166	746	1828	1202	20.0
	Soy-bean stover				2595	2540	2040	3085	2552	
	Wheat grain				1200	1200	1390	1072	1216	20.3
VI	Soy-bean grain				1067	1324				
	Soy-bean hay						2165	3615	3376	
	Soy-bean stover				2595	2745				
	Oat grain				2080	1472	1998	892	1610	50.3
VII	Alfalfa hay			9860	7000	8205	7500	8577	8228	

Crop yields

In the original outline of these experiments provision was made that they should cover for each acre a period of ten years in order that the agencies affecting yields, such as weather conditions, and individual variations of steers, would be distributed over a long enough period of time so that the error from those sources would be reduced to the minimum. This bulletin is, then, only preliminary to the final report that will be published when all the data are complete. Results from the acres that have been on experiment for seven years may be considered conclusive, but those from the acres that have been on ex-



SOY-BEAN ACRE ON RIGHT; COWPEA ACRE ON LEFT

periment for less time than that should not be taken as conclusive. It was also desired to carry on the experiment for a period of ten years so that any increase or decrease in yield per acre could be observed.

Table XII shows the yields for each year, and the average yields per acre for each acre.

Crop yield per acre

Acre I produced an average of 2,600 pounds of grain; Acre II, 2,206 pounds; Acre III, 3,171 pounds; and Acre V, 2,418 pounds. The yield for the corn acre is given as the weight of corn and cob, and therefore does not quite compare with the other acres. Acre I ranks ahead of all other acres in the amount of food material produced. Soy beans rank ahead of cowpeas in the production of grain each year. Cowpeas were ready for harvest earlier in the season each year, and therefore allowed for the collection of more moisture in the ground

previous to the barley seeding, or made it possible to sow the barley earlier in the season, as has been done since 1911, and thus insured a better crop of barley than was produced on the other acres. The increase in barley, however, did not compensate for the decrease in summer grain produced. Where soy beans are taken off as hay, thus permitting the winter grain crop of barley to be sown at an earlier time, the barley will yield practically as well as when sown after cowpeas. This fact is shown by the yields on Acre IV as compared with Acre II, since the year 1911, when the practice was adopted of sowing the winter crop on each acre as soon as the summer crop was removed. Cowpeas do not remove as much moisture from the ground upon which they are growing as do soy beans, owing to the fact that they do not produce as large a crop of grain and stover.

Effect of leguminous crops in the rotations

In every one of the rotations planned for the experiment, with the exception of Acre III, there is included in the rotation a leguminous crop, and a careful study of the table will show that in every one of the acres there seems to be a tendency for the crop yields to remain on a par with those of the first two or three years of the experiment, with the exception of Acre III, where the crops grown are barley and corn. The barley yields on that acre have been constantly on the decrease, and there seems to be a tendency for the corn yields to decrease. There is no nitrogen-gathering crop in the form of a legume, and manifestly the nitrogen content is on the decrease, and thus the yields are on the decrease.

Beef yields per acre

The primary object of these experiments was to determine the amounts of beef that an acre of land would produce if the crops grown upon it were fed to live stock. Table XIII shows the amounts that have been

TABLE XIII—*Gains produced per acre*

No. of acre	Crops grown	1908	1909	1910	1911	1912	1913	1914	Average gain per acre
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
I	Soy beans and barley	673	632	609	420	364	367	494	508
II	Cowpeas and barley	529	561	441	305	366	528	370	451
III	Corn and barley	602	476	708	350	169	355	378	434
IV	Soy-bean hay and barley		617	461	393	241	518	372	435
V	Soy beans and wheat				354	347	493	412	402
VI	Soy-bean hay and oats				570	400	485	367	456
VII	Alfalfa			758	302	431	581	502	515

produced up to the present time with the various rotations of crops grown.

These experiments show that better results in beef production can be secured from a rotation of soy beans and barley than from any other combination of crops used in these experiments. The rotation

TABLE XIV—*Ranking of acres according to beef yield*

No. of acre	Crops grown	No. of years on experiment	No. of times that acre ranked							Average rank
			1st	2nd	3rd	4th	5th	6th	7th	
I	Barley and soy beans	7	2	2	1	1	---	1	---	2
II	Barley and cowpeas	7	---	1	3	2	---	1	---	4
III	Barley and corn	7	1	1	---	2	---	1	2	6
IV	Barley and soy-bean hay	6	---	1	3	---	1	1	---	5
V	Wheat and soy beans	4	---	---	1	1	2	---	---	7
VI	Oats and soy-bean hay	4	1	1	---	---	1	---	1	3
VII	Alfalfa	5	3	---	1	---	---	---	1	1

in which soy beans were used produced an average of 57 pounds more beef than that in which cowpeas were used, and 74 pounds more than that in which corn was used. Larger gains were obtained when the crop was harvested at maturity than when it was made into hay. This is clearly brought out by a comparison of Acres I and IV. On the latter acre the soy beans were harvested as hay and on the former acre they were harvested as grain. Acre I produced an average of 70 pounds more than Acre IV. While this amount for one acre may not seem large, for ten acres there would be produced 700 pounds more beef when the crop was taken off as grain than when it was taken off as hay. This means that, with beef selling at 6 cents per pound, the method used on Acre I would return $42.50 more per ten acres than the method used on Acre IV.

It is especially worthy of note that corn and barley, the rotation used on Acre III, gave the lowest average returns in beef yield of all the rotations on experiment, with the exception of Acre V, soy beans and wheat. Acre V, however, has been on experiment for only four years, and shows a tendency to produce larger yields than the corn and barley rotation for the last three years. The corn and barley rotation is not to be recommended on account of its low beef yield, the difficulty of operation, and the constantly decreasing crop and beef yields, due to the constantly decreasing nitrogen content of the soil. Table XIV shows the number of years that each of the acres ranked first.

It is evident that no conclusions can be drawn from the results of any single year. To determine the yield of beef that may be made per acre, the average results of several years must be taken.

Ranking of acres

The alfalfa acre has ranked first in yield of beef for three years and last for one year. In beef yield this is the ranking acre. It has not, however, been on experiment so long as some of the other acres. The soy-bean and barley acre ranked ahead of it in gross returns per acre.



CORN ACRE ON RIGHT; COWPEA ACRE ON LEFT

The soy-bean and barley acre has ranked first for two years and second for two years. It has never ranked lowest. Five of the seven years it has ranked among the upper half of the acres in beef production.

Oats and soy-bean hay have been on experiment for only four years. They have made a good showing for that time, but not enough results have been obtained from them to warrant the drawing of conclusions.

The cowpea and barley acre has not averaged so well as the soy-bean and barly acre. It has never ranked first in production. It has, however, for three years produced more than 500 pounds of beef per acre.

The corn and barley acre thus far has proved to be nearly the poorest of the acres for the production of beef. This acre has ranked, five years out of the seven, in the lower division. The use of corn

and barley as a rotation for the growing and finishing of beef cattle is not to be recommended as compared with soy beans and barley.

Gross returns per acre

In order to determine the gross returns per acre, the following method of calculation was employed: The beef produced was valued at 6 cents per pound, the silage fed at $3.00 per ton, and it was assumed that there would be a margin of $1.00 on 1,000-pound steers for the feeding period. Table XV is calculated on this basis, and shows under these conditions the returns per acre when the crops were fed to finishing steers.

TABLE XV—*Gross returns per acre with beef produced at 6 cents per pound, silage fed at $3.00 per ton and $1.00 margin on 1000-pound steers for 60 to 90 days*

No. of acre	Crops grown	1908	1909	1910	1911	1912	1913	1914	Av.
I	Soy beans and barley	$69.58	$67.12	$65.74	$54.40	$54.64	$54.82	$62.32	$61.28
II	Cowpeas and barley	61.54	66.46	59.26	51.10	54.76	64.48	55.00	58.94
III	Corn and barley	65.32	57.76	71.68	51.20	42.94	54.10	55.48	56.92
IV	Soy-bean hay and barley		66.22	56.86	53.08	47.26	63.88	55.12	57.07
V	Soy beans and wheat				50.44	53.62	62.38	57.52	55.99
VI	Soy-bean hay and oats				63.40	56.80	61.90	54.82	59.23
VII	Alfalfa hay			71.08	47.32	53.74	64.06	58.36	58.91
	General average								$58.34

Comparison of gross returns per acre

The soy-bean and barley acre ranked first in the gross returns per acre, with the alfalfa acre a close second. The alfalfa acre, however, has been on experiment for a shorter period of time, and therefore the data cannot be so nearly conclusive. The striking thing to be noted is that the returns for each of the acres are good even though the margin between the purchase price and the selling price of the cattle be but $1.00. If the margin between the purchase price and the selling price were $1.50 then the returns per acre would be from $5.00 to $6.00 greater than those given in the table.

While these results seem high, it must be observed that they are gross returns per acre, and no account has been taken of the cost of production. On the other hand, the labor has been evenly distributed throughout the year by the utilization of the crops for the feeding of steers during slack seasons. After all, the farmer is most interested in the gross returns per acre if the work can be done with the labor which he has already at hand.

The average gross returns are as follows:

Acre	Years	Average gross returns
Soy beans and barley	7	$61.23
Cowpeas and barley	7	$58.94
Corn and barley	7	$56.92
Soy-bean hay and barley	6	$57.07
Soy beans and wheat	4	$55.99
Soy-bean hay and oats	4	$59.23
Alfalfa hay	5	$58.91

These returns would indicate that the finishing of beef steers could be profitably practiced on $100-$150 acre land, where the land was fertile and the cultivation intensive. The returns from these acres will illustrate the possibilities of the South for beef production in a system by which more than a single crop is grown each year.

Time in which crop should be fed off

A question that is often asked is, whether or not it is better to finish steers with a heavy or with a medium ration of grain. It is of course well known that heavy grain rations will make the larger gain for the same length of time, but the gains thus far have not been related to the acre basis. The farmer feeds crops to beef cattle in order to utilize the roughage grown on the farm, to secure a larger price for his products than he would on the market, and to conserve his soil fertility. These experiments have been conducted so as to determine whether it would be better to feed up the crops grown in a short feeding period with a heavy ration, or to feed a lighter grain ration and thus extend the time for finishing. During the last three years of the experiments the crops grown have been

TABLE XVI—*Comparison of lengths of time of feeding the crops produced*

No. of acre	Crops grown	When fed in 90 days			When fed in 60 days		
		No. of years	Average gain	Average gross returns	No. of years	Average gain	Average gross returns
I	Soy beans and barley	4	584	$64.21	3	375	$57.26
II	Cowpeas and barley	2	447	56.32	5	453	59.99
III	Corn and barley	4	527	61.49	3	301	50.84
IV	Soy-bean hay and barley	3	492	58.38	3	277	55.42
V	Soy beans and wheat	1	354	50.44	3	417	57.84
VI	Soy-bean hay and oats	1	570	63.40	3	417	57.84
VII	Alfalfa hay	5	515	58.91	---	-----	-----
	Averages*		496	$59.04		373	$56.53

*Not including alfalfa acre.

fed up in a feeding period covering 60 days. In Table XVI the experiments have been grouped according to the length of time in which the crops grown have been fed.

Results from 60- and 90-day feeding periods

The averages of the results given in Table XVI do not include the data for the alfalfa acre, since it appears on but one side of the table. The average beef yield for all the acres on experiment, excepting the alfalfa acre, when they have been fed off in 90 days, was 496 pounds, while the average for the same acres when they were fed off in 60 days was 373 pounds. The returns in beef yield per acre were 33 per cent larger when the crops grown were fed off in 90 days than when fed off in 60 days. The average gross returns for the 90-day feeding period were $59.04, and for the 60-day feeding period $56.53. The increased finish which the steers on 90-days feed put on would likely make them bring from one-fourth to one-half cent more per pound than the steers on 60-days feed. The steers on the 90-days feed made more gains than the steers on the 60-days feed, owing to a greater utilization of the roughages grown on each acre.

Farm values of feed fed

In the following discussion we have tried to determine the gross returns for each pound of hay or grain when sold through the steers. The data have been derived from Tables XII and XV. In the calculation, on the weight basis, the grains have been considered of equal value for feeding purposes. The hays were calculated at two-thirds the value of the grain. Table XVII gives the prices obtained for grains and hays grown on the acres on experiment when sold through the steers fed from those acres. The table also gives the price that each bushel of grain would have to bring when sold off the farm to equal the price obtained when sold through steers and in addition pay for the fertilizer that would have to be purchased in order to equal the fertility returned by the steers. The fertilizer content of the feeds was calculated from Henry and Morrison's "Feeds and Feeding," Appendix, Table III, and it was assumed that 80 per cent of the fertilizing elements was returned through the manure.

Prices received for crops fed

From Table XVII it will be seen that the average prices received for the crops fed the steers were as follows: Soy beans, $1.40 per bushel; cowpeas, $1.60; wheat, $1.39; oats, $.57; barley, $1.02; corn, $1.00; soy-bean hay, $17.50 per ton; alfalfa hay, $14.20 per ton. These prices were obtained for the feeds fed from the acre, and it is estimated that 80 per cent of the fertilizing elements contained in the feeds was returned to the acre that grew the crop. If the crops had been sold on the market as grain and hay these elements would have been lost to the acre that produced the crop unless replaced through commercial fertilizer. In the righthand column is shown the price that each would have to sell at in order to equal the price received for each when sold through the steers, and also to pay for 80

TABLE XVII—*Prices obtained for grains and hay by marketing through steers. Also prices they must sell at when not fed to make up for fertility returned by steers when fed*

No. of acre	Feed grown	Average No. pounds grown	Gross returns obtained when sold through steers		Price each must sell at when not fed to make up for fertility* returned by steers
			Per pound	Per bu. or ton	
			Cents		
I	Soy beans	1189	2.35	$ 1.41 per bu.	$ 2.06 per bu.
	Barley	1411	2.35	1.13 per bu.	1.31 per bu.
II	Cowpeas	550	2.67	1.60 per bu.	2.03 per bu.
	Barley	1656	2.67	1.28 per bu.	1.45 per bu.
III	Corn	1839	1.80	1.00 per bu.	1.17 per bu.
	Barley	1322	1.80	.86 per bu.	1.04 per bu.
IV	Soy-bean hay	3727	.86	17.20 per ton	27.59 per ton
	Barley	1443	1.72	.83 per bu.	1.06 per bu.
V	Soy beans	1202	2.32	1.39 per bu.	2.04 per bu.
	Wheat	1216	2.32	1.39 per bu.	1.60 per bu.
VI	Soy-bean hay	3376	.89	17.80 per ton	28.39 per ton
	Oats	1610	1.79	.57 per bu.	.69 per bu.
VII	Alfalfa hay	8228	.71	14.20 per ton	24.03 per ton

*Fertilizing elements were valued at 20 cents for nitrogen and 5 cents each for phosphoric acid and potash, and it was assumed that 80 per cent of the fertilizing elements of feeds fed to steers was returned to the acre that produced the crop.

per cent of the fertilizing elements contained in each feed produced on the acre; for that amount of fertilizing elements must necessarily be returned in order to equal the gross returns when the crops are fed to steers. If sold as grain or hay and the fertilizing elements reckoned as a factor, then in order to equal the returns when sold through feeding to steers the crops would have to sell at the following prices: Soy beans, $2.05 per bushel; cowpeas, $2.03; wheat, $1.60; oats, $.69; barley, $1.21; corn, $1.17; soy-bean hay, $27.99 per ton; alfalfa hay, $24.03 per ton. The question of the fertilizing elements contained in a bushel of grain or a ton of hay is too large a factor to be ignored in considering the profits of any crop produced on the farm today. If the fertilizing elements are sold from the farm in this generation they must be replaced in the succeeding generation. The farmer cannot eat his cake and have it too. He cannot sell his farm fertiltiy and have it too. Fertility is an asset, and if sold from the farm it must be replaced at some future date just as destroyed buildings or fences must be replaced.