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A STUDY
OF THE EFFECT OF COTTONSEED MEAL VS. BEEF SCRAP
UPON THE EGG PRODUCTION, FERTILITY AND
VITALITY OF POULTRY

BY B. A. AHRENS

POULTRY HUSBANDRY

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A Study of the Effect of Cottonseed Meal vs. Beef Scrap Upon the Egg Production, Fertility and Vitality of Poultry

By B. A. AHRENS

INTRODUCTION

The value of cottonseed meal as a source of protein for poultry feeding has been a much discussed subject, and experiments have been conducted in an effort to determine its effect on the growth of chicks,* and also as to its value when used in a ration for egg production.** Many practical poultrymen believe that it pays to feed this material from an economic standpoint in reducing the cost of the daily ration, and for the further reason that it induces greater egg production. The object of the experiments herein described was to determine as fully as possible the value of cottonseed meal as a feed for egg production when compared with beef scrap, and to determine also the effect of cottonseed meal in moderate as well as in excessive quantities upon the fertility and hatchability of eggs.

Many articles have been published by champions of cottonseed meal, and their opinion of it is very high, but it is doubtful if the writers of these articles were in a position to make careful comparative tests with this feed.

The discussion of the data from these experiments is divided into two parts. Part I contains all data relating in any way to the breeding, and this includes the hatching season of 1914-15 for Pens Nos. 1, 2 and 3, as well as the hatching season of 1915-16 for the same pens. Besides the above, records are also included (Tables VII to X) for pens made up of the offspring of Pens Nos. 1, 2 and 3, and which were carried along as Pens Nos. 4, 5 and 6, the change in makeup being noted in later pages of this publication.

Part II contains data which will show the value of the protein from the two sources as a factor in egg production.

*Rhode Island Bulletin No. 156. Rhode Island Report for 1912.

**Mississippi Bulletin No. 162. North Carolina Bulletin No. 211. North Carolina Circular No. 27.

PART I
Season of 1914-15

Plan of Experiment

The birds selected for this experiment were purebred Single-Comb White Leghorns, hatched in 1914. They were bred and reared by the College, and it was definitely known that the sire and dams of these birds were of strong constitutional vigor. It was also known that no bird in the flocks chosen had ever suffered from any disease or shown any apparent weakness or other abnormal characteristic.

The birds were divided into three lots of ten pullets and two cockerels each. Great care was exercised in making the division to secure, as nearly as possible, uniformity of size, age, vigor, shape, and all other apparent characteristics.

The birds were started in large semi-monitor houses, but later three 8x10 colony houses were substituted, and these houses have proven very satisfactory in the work. Each house was equipped with five modern trap nests, a mash hopper, a grit, shell and charcoal hopper, as well as a water pan, and all raised off the floor so the birds could have full use of the 80 square feet of floor space for scratching.

Yarding and housing were practically uniform throughout. Feeding methods were also uniform throughout, being whole grain morning and evening, and mash in open hoppers, left open long enough so that the birds ate practically two-thirds as much whole grain as ground food in form of mash. Green food during the winter months was supplied in the form of sprouted oats. Feed was bought for the entire year in an effort to get more accurate results from the analysis which was made by the Chemistry Department, under the direction of Dr. C. K. Francis.

TABLE I
Chemical analysis of feeds used during the first year.

	Water	Ash	Protein	Fiber	Carbohy- drates	Fat
Kafir	16.51	1.33	12.56	1.98	64.93	2.69
Wheat	11.09	1.74	13.37	2.96	69.25	1.59
Bone meal			29.37			5.32
Meat scrap	9.73	15.77	59.37	4.19	0.04	10.90
Cottonseed meal			44.31	11.57	22.35	7.98
Corn chops			10.06	2.86	67.76	3.59
Bran			17.00	10.14	49.96	4.62

The experiment was started November 18, 1914, on the following feeding formulas:

TABLE II

Pen No. 1—Nutritive ratio 1:4.5.

	Protein	Carbohydrates	Fat
Grain Food			
Kafir 20 pounds	2.5120	12.9860	.5380
Whole wheat, 20 pounds	2.6740	13.8500	.3180
Ground Food			
Millrun 7 pounds	1.1900	3.4972	.3234
Corn chop 6 pounds .....	.6036	4.0656	.2154
Beef scrap 2 pounds	1.1874	.0008	.2180
Bone meal 1 pound .....	.2937	.0000	.0532
	8.4607	34.3996	1.6660

TABLE III

Pen No. 2—Nutritive ratio 1:4.5.

	Protein	Carbohvdrates	Fat
Grain Food			
Kafir 20 pounds	2.5120	12.9860	.5380
Whole wheat 20 pounds	2.6740	13.8500	.3180
Ground Food			
Millrun 6 pounds	1.0200	2.9976	.2772
Corn meal 6 pounds .....	.6036	4.0656	.2154
Cottonseed meal 3 pounds	1.3293	.6705	.2394
Bone meal 1 pound .....	.2937	.0000	.0532
	8.4326	34.5697	1.6412

TABLE IV

Pen No. 3—Nutritive ratio 1:3.5.

	Protein	Carbohydrates	Fat
Grain Food			
Kafir 20 pounds	2.5120	12.9860	.5380
Whole wheat 20 pounds	2.6740	13.8500	.3180
Ground Food			
Millrun 3 pounds .....	.5100	1.4988	.3186
Corn chop 3 pounds .....	.3018	2.0328	.1077
Cottonseed meal 9 pounds	3.9879	2.0115	.7183
Bone meal 1 pound .....	.2937	.0000	.0532
	10.2794	32.3791	1.8737

The pens were known from the start as follows:

Pen No. 1—A Check Pen.—Beef scrap was used as the chief protein constituent of the mash, and had a nutritive ratio of 1:4.5.

Pen No. 2—A Comparison Pen.—Cottonseed meal was used in place of the beef scrap of Pen No. 1, in the proper quantities to have the nutritive ratio as in Pen No. 1, or 1:4.5.

Pen No. 3—An Indicator Pen.—Rations of the same type as for Pens Nos. 1 and 2, but carrying an excess amount of cottonseed meal, which gave a very narrow ratio of 1:3.5.

The chicks hatched from the different lots were kept separate from time of birth and fed on the same type of ration as their parents, due allowance being made for changing the exact composition of the ration to meet the requirements of the growing period.

Complete records were kept as follows:

1. Record of weights of birds at end of each month.
2. Amount and cost of feed consumed.
3. Weight and value of eggs produced for regular intervals.
4. Individual trapnest records.
5. Individual records of egg weights.
6. Percent of fertile eggs for each pen.
7. Percent of infertile eggs for each pen.
8. Dead germs early and late.
9. Weak and strong chicks hatched.

Of the above, totals for Nos. 1, 2, 3 and 5 will be shown in Part II.

MANAGEMENT AND RESULTS

The flocks were confined in their respective houses with the males for about one week to get them accustomed to their new quarters, and after that they were set free in their several yards and kept out in the open as much as possible.

The health of the birds was excellent. One bird, however, a pullet from Pen No. 3 died of roup, and one male from the same pen died from the effects of being crop-bound.

The males in all pens were removed after July 1.

INCUBATION

The plan of the experiment called for the hatching of enough chicks to give a wide opportunity for selecting birds for the year's work of 1915-16.

Records were kept as follows:

First a Preliminary Test.—Every egg which had been collected from each pen three weeks previous to February 2, 1915, was set, without any effort at selection, but merely for a fertility test. This resulted in the following record being made after the eggs had been incubated seven days:

TABLE V

	Set	No. Fertile	Sterile	Dead	Percent Fertile
Pen No. 1	78	59	19	2	75.7
Pen No. 2	39	38	1	2	97.4
Pen No. 3	45	45	0	18	100.0

After February 2, 1915, regular records were kept as follows:

INCUBATION RECORD

TABLE VI
First Hatch

Pen Number	Date Set	No. of Eggs Set	Date Tested	Percent of Fertile Eggs	Sterile Eggs	Percent Fertile Eggs Hatched	Percent All Eggs Hatched	Healthy Chicks
Pen No. 1	2-25-15	68	3- 3-15	91.1	6	14.5	13.2	9
Pen No. 2	2-25-15	64	3- 3-15	98.4	1	46.0	45.6	29
Pen No. 3	2-25-15	47	3- 3-15	85.1	7	50.0	42.5	20
Second Hatch								
Pen No. 1	3- 9-15	75	3-16-15	70.6	22	56.5	40.0	30
Pen No. 2	3- 9-15	60	3-16-15	100.0		45.0	45.0	27
Pen No. 3	3- 9-15	46	3-16-15	97.8	1	35.5	34.8	16
Third Hatch								
Pen No. 1	3-31-15	139	4- 6-15	97.1	4	28.1	27.3	38
Pen No. 2	3-31-15	83	4- 6-15	95.1	4	58.2	55.4	46
Pen No. 3	3-31-15	47	4- 6-15	97.8	1	34.7	34.0	16
Fourth Hatch								
Pen No. 1	4-23-15	136	4-30-15	88.2	16	13.3	11.7	16
Pen No. 2	4-23-15	123	4-30-15	96.7	4	43.7	42.2	52
Pen No. 3	4-23-15	60	4-30-15	88.3	7	24.5	21.6	13

Fifth Hatch

Pen Number	Date Set	No. of Eggs Set	Date Tested	Percent of Fertile Eggs	Sterile Eggs	Percent Fertile Eggs Hatched	Percent All Eggs Hatched	Healthy Chicks
Pen No. 1	6- 3-15	85	6-10-15	96.4	3	21.9	21.1	18
Pen No. 2	6- 3-15	64	6-10-15	100.0	0	37.5	37.5	24
Pen No. 3	6- 3-15	53	6-10-15	94.3	3	28.0	26.4	14

Sixth Hatch

Pen No. 1	6-21-15	123	6-28-15	85.3	18	39.0	33.3	41
Pen No. 2	6-26-15	71	7- 3-15	49.2	36	28.5	14.0	10
Pen No. 3	6-26-15	34	7- 3-15	52.9	16	.....	.....	.....

Seventh Hatch

Pen No. 1	7- 3-15	40	7-10-15	97.5	1	79.4	77.5	31
Pen No. 2	7- 3-15	30	7-10-15	96.6	1	65.5	63.3	19
Pen No. 3	7- 3-15	19	7-10-15	94.7	1	11.1	10.5	2

Eighth Hatch

Pen No. 1	7- 7-15	45	7-17-15	91.1	4	63.4	57.7	26
Pen No. 2	7-10-15	40	7-17-15	92.5	3	81.0	75.0	30
Pen No. 3	7-10-15	28	7-17-15	82.1	5	43.4	35.5	10

Summary of incubation records from February 2, 1915, to July 10, 1915:

	No. of Birds	No. of Eggs Set	Percent of Fertile Eggs	No. of Sterile Eggs	Percent of Fertile Eggs Hatched	Percent of All Eggs Hatched	Healthy Chicks
Pen No. 1	10	711	89.5	74	32.8	29.3	206
Pen No. 2	10	535	90.8	49	48.7	44.2	237
Pen No. 3	9	334	87.7	41	31.0	27.2	91

At all times the eggs were incubated either by hot air machines, without sand trays, or by hot air machines with sand trays. Never was one pen put in a machine with a sand tray and another pen put in a machine minus this tray during the same hatch. No hot water machines were used.

It is difficult to tell just what was the cause of these poor hatches. The chances are it was due to faulty incubation, but, if it was, all machines received the same amount of care and had the same conditions to contend with, so that all of the pens received the same chance to show good results. It may be noted that while the fertility was in most cases fine, the power to live through the entire twenty-one days and get out of the shell seemed to be lacking.

It is interesting to note, however, that, while the fertility in Pen No. 2 was only slightly better than that of Pen No. 1, yet the percent of fertile eggs hatched and the percent of all eggs hatched was considerably greater in Pen No. 2 as compared with Pen No. 1.

The weather conditions were very bad; in fact, it was reported from all over the State that the last incubation season was the worst in the last twenty years. However, while this may explain the low vitality of the parent stock, and thus be shown in offspring unable to stand bad weather conditions, still it must be noted again that all three pens had the same conditions, and we must be governed in our conclusions by this fact.

The results obtained during this season show that an excess of cottonseed meal, such as fed in Pen No. 3, tended to reduce the fertility of these birds. The fact that there was only one male in this pen might lead some to believe that this was the cause of the lowered fertility, but our judgment and belief is that it had nothing to do with it.

On the other hand, in Pens Nos. 1 and 2, where the only difference was that in one pen, beef scrap was fed in the mash, and in the other cottonseed meal, the pen with cottonseed meal indicated a slight advantage in percent of eggs fertile.

The average percent of fertile eggs hatched and average percent of all eggs hatched was in favor of the cottonseed meal pen, being an advantage of 15.9% of fertile eggs hatched and an advantage of 14.9% of all eggs hatched.

Our records show that cottonseed meal fed in a mash, such as millrun 6 pounds, corn meal 6 pounds, cottonseed meal 3 pounds, bone meal 1 pound, with a grain allowance of wheat 20 pounds, kafir 20 pounds, or a untritive ratio of 1:4.5, does not reduce fertility, and it does seem to improve the hatchability of the eggs.

SEASON OF 1915-16

In order to determine if possible whether it really was the effect of cottonseed meal that caused the increase in percent of fertile eggs hatched and percent of all eggs hatched, or whether it was the difference in stock, the birds were arranged as follows:

Pen No. 1—Beef Scrap.—Five hens from the original Pen No. 1 and five hens from the original Pen No. 2, with one instead of two of the original males in Pen No. 1.

Pen No. 2—Cottonseed Meal.—Five hens from the original Pen No. 2 and five hens from the original Pen No. 1, with one male instead of two of the original males in Pen No. 2.

Pen No. 3—Excess Cottonseed Meal.—All of original Pen No. 3, including the male, were carried along as before.

Pen No. 4—Beef Scrap.—Five of the pullets raised from the hatch of original Pen No. 1, and five of the pullets raised from the hatch of the original Pen No. 2, and one cockerel from the hatch of Pen No. 1.

Pen No. 5—Cottonseed Meal.—Five of the pullets raised from the original Pen No. 1, four of the pullets raised from the hatch of original Pen No. 2, and one cockerel from the hatch of Pen No. 2.

Pen No. 6—Excess Cottonseed Meal.—Four pullets from the hatch of Pen No. 3, and one cockerel from hatch of Pen No. 3.

Pens Nos. 1 and 4 were fed beef scrap, the same as original Pen No. 1, with a nutritive ratio of 1:4.5.

Pens Nos. 2 and 5 were fed cottonseed meal, the same as original Pen No. 2, with a nutritive ratio of 1:4.5.

Pens Nos. 3 and 6 were fed cottonseed meal in excess, the same as original Pen No. 3, with a nutritive ratio of 1:3.5.

Every effort was made to divide the good layers, as shown by trapnest records, in the case of Pens. Nos. 1 and 2 equally between the two pens.

The management of these pens was practically the same as during the first season. Houses and yards were all of the same size. This year most of the hatching was done in a mammoth incubator, and better results seem to have been obtained. The idea of using the same type of machine was also carried out.

TABLE VII
INCUBATION RECORD
First Hatch

Pen Number	Date Set	No. of Eggs Set	Date Tested	Percent of Fertile Eggs	No. of Sterile Eggs	Percent of Fertile Eggs Hatched	Percent of All Eggs Hatched	Healthy Chicks
Pen No. 1	2- 6-16	10	2-13-16	60.0	4	33.3	20.0	2
Pen No. 2	2- 6-16	9	2-13-16	88.8	1	75.0	66.6	6
Pen No. 3	2- 6-16	10	2-13-16	70.0	3	28.5	20.0	2
Pen No. 4	2- 6-16	10	2-13-16	70.0	3	57.0	40.0	4
Pen No. 5	2- 6-16	10	2-13-16	90.0	1	66.6	60.0	6
Pen No. 6	2- 6-16	11	2-13-16	90.9	1	50.0	45.5	5

Second Hatch

Pen No. 1	2-15-16	11	2-22-16	62.7	4	42.8	27.2	3
Pen No. 2	2-15-16	12	2-22-16	100.0		66.6	66.6	8
Pen No. 3	2-15-16	15	2-22-16	93.3	1	50.0	46.0	7
Pen No. 4	2-15-16	28	2-22-16	92.8	2	50.0	46.4	13
Pen No. 5	2-15-16	22	2-22-16	86.3	3	53.1	45.4	10
Pen No. 6	2-15-16	20	2-22-16	100.0		40.0	40.0	8

Third Hatch

Pen No. 1	2-27-16	35	3- 6-16	85.7	5	66.6	57.1	20
Pen No. 2	2-27-16	31	3- 6-16	100.0		70.9	70.9	22
Pen No. 3	2-27-16	28	3- 6-16	100.0		60.7	60.7	17
Pen No. 4	2-27-16	41	3- 6-16	82.9	7	58.8	48.7	20
Pen No. 5	2-27-16	23	3- 6-16	100.0		69.5	69.5	16
Pen No. 6	2-27-16	25	3- 6-16	100.0		72.0	72.0	18

Fourth Hatch

Pen Number	Date Set	No. of Eggs Set	Date Tested	Percent of Fertile Eggs	No. of Sterile Eggs	Percent of Fertile Eggs Hatched	Percent of All Eggs Hatched	Healthy Chicks
Pen No. 1	3- 1-16	24	3- 8-16	100.0		45.8	45.8	11
Pen No. 2	3- 1-16	24	3- 8-16	75.0	6	55.5	41.6	10
Pen No. 3	3- 1-16	24	3- 8-16	91.6	2	50.0	45.7	11
Pen No. 4	3- 1-16	24	3- 8-16	91.6	2	54.5	50.0	12
Pen No. 5	3- 1-16	24	3- 8-16	95.8	1	47.7	45.7	11
Pen No. 6	3- 1-16	24	3- 8-16	100.0		54.1	54.1	13

Fifth Hatch

Pen No. 1	4-18-16	48	4-25-16	89.5	5	48.8	43.7	21
Pen No. 2	4-18-16	32	4-25-16	96.8	1	35.4	34.3	11
Pen No. 3	4-18-16	29	4-25-16	93.1	2	33.3	31.0	9
Pen No. 4	4-18-16	54	4-25-16	96.2	2	51.9	50.0	27
Pen No. 5	4-18-16	31	4-25-16	96.7	1	53.3	51.6	16
Pen No. 6	4-18-16	27	4-25-16	100.0		25.9	25.9	7

Sixth Hatch

Pen No. 1	4-26-16	50	5- 1-16	94.0	3	59.5	56.0	28
Pen No. 2	4-26-16	50	5- 1-16	92.0	4	54.3	50.0	25
Pen No. 3	4-26-16	36	5- 1-16	88.8	4	53.1	47.2	17
Pen No. 4	4-26-16	33	5- 1-16	72.7	9	46.6	33.3	11
Pen No. 5	4-26-16	27	5- 1-16	100.0		33.3	33.3	9
Pen No. 6	4-26-16	12	5- 1-16	100.0		50.0	50.0	6

Seventh Hatch

Pen No. 1	5- 9-16	72	5-16-16	97.2	2	57.1	55.5	40
Pen No. 2	5- 9-16	72	5-16-16	84.7	11	49.1	41.6	30
Pen No. 3	5- 9-16	64	5-16-16	93.7	4	41.6	39.0	25
Pen No. 4	5- 9-16	72	5-16-16	93.0	5	64.1	59.7	43
Pen No. 5	5-13-16	60	5-20-16	83.3	10	38.0	31.6	19
Pen No. 6	5-13-16	24	5-20-16	95.8	1	21.7	20.8	5

One other test for nothing more than fertility resulted as follows:

TABLE VIII

Pen No.	Date Set	No. of Eggs Set	Date Tested	Percent of Fertility	No. of Sterile Eggs
Pen No. 1	3-21-16	56	3-28-16	100.0	
Pen No. 2	3-21-16	58	3-28-16	100.0	
Pen No. 3	3-21-16	43	3-28-16	100.0	
Pen No. 4	3-21-16	66	3-28-16	100.0	
Pen No. 5	3-21-16	52	3-28-16	76.0	12
Pen No. 6	3-21-16	32	3-28-16	100.0	

The poor showing of Pen No. 5 in Table VIII may be due to the fact that the male was under the weather about this time, and certainly was not in good breeding condition.

Another additional test, eliminating Pens Nos. 3 and 6 because of the small number of eggs obtainable, resulted as follows:

TABLE IX

Pen Number	No. of Eggs Set	Percent of Fertile Eggs	No. of Sterile Eggs	Percent Fertile Eggs Hatched	Percent of All Eggs Hatched	Healthy Chicks
Pen No. 1	49	97.9	1	47.9	46.9	23
Pen No. 2	57	94.7	3	29.6	28.0	16
Pen No. 4	50	94.2	2	54.1	52.0	26
Pen No. 5	36	83.3	6	36.6	30.5	11

Following is the summary of results obtained in the season of 1915-16:

TABLE X

Pen	No. of Birds	No. of Eggs Set	Percent Fertile Eggs	No. of Sterile Eggs	Percent Fertile Eggs Hatched	Percent of All Eggs Hatched	Healthy Chicks
No. 1 ...	10	250	90.0	23	55.0	50.0	125
No. 2	10	230	90.0	23	54.1	48.6	112
No. 3	9	206	92.2	16	46.3	42.7	88
No. 4	10	262	88.5	30	56.0	49.6	130
No. 5	9*	197	91.3	2	48.3	44.4	87
No. 6	9**	243	98.5	17	43.9	43.3	62

*Two of these birds died, No. 17 on December 27, from roup, and No. 20 on December 2, from an obstruction in the intestines.

**Two of these birds were stolen on the night of April 6.

In the case of Pen No. 5, the two birds which died had not laid an egg, so this record is really an accurate record of seven birds.

In the case of Pen No. 6, the birds were excellent producers and their record runs within a little over seven weeks of the record noted above, so the reader can make his own deductions.

A comparison of Pens 1, 2 and 3 for the two incubating seasons shows quite a disparity in results, but the average of the two years shows results which are interesting.

TABLE XI
Comparative summary:

Pen No.	Year	Eggs Set	Percent Fertile	Average	Sterile Eggs	Percent Fertile Eggs Hatched	Average	Percent All Eggs Hatched	Average	Healthy Chicks
Pen No. 1	1914-15	711	89.5	89.7	74	32.8	43.9	29.3	39.6	209
	1915-16	250	90.0		23	55.0		50.0		125
Pen No. 2	1914-15	535	90.8	90.4	49	48.7	51.4	44.2	46.4	237
	1915-16	230	90.0		23	54.1		48.6		112
Pen No. 3	1914-15	334	87.7	89.9	41	31.0	38.6	27.2	34.9	91
	1915-16	206	92.2		16	46.3		42.7		88

The following is a comparative summary of Pens Nos. 1 and 4, with beef scrap for the entire experiment, and Nos. 2 and 5, with cottonseed meal. It will be noted that Pens 3 and 6 are not included in this, due to the small number of birds in Pen No. 6.

TABLE XII
Comparative summary:

Pen Number	No. of Eggs Set	Percent of Fertile Eggs	No. of Sterile Eggs	Percent Fertile Eggs Hatched	Percent of All Eggs Hatched	Healthy Chicks	No. of Females in Pens	No. of Males in Pens
Pens Nos. 1 and 4	1223	89.6	127	42.3	37.9	464	20	2
Pens Nos. 2 and 5	1047	90.2	102	46.1	41.6	436	17	2

As will be seen, the difference is all in favor of cottonseed meal. While the difference is very slight in the percent of eggs that are fertile, there is quite a difference in the percent of fertile eggs hatched and the percent of all eggs hatched.

PART II

November 18, 1914, to November 17, 1915

At first the plan was to work all of the data gathered into one report, but the breeding part of the work indicated that cottonseed meal was superior to beef scrap in percent of fertile eggs hatched and percent of all eggs hatched, while in the feeding part the work indicated that beef scrap was superior as a laying ration. Therefore, it was thought best to present a separate set of figures showing the effect of these rations on egg production.

As was explained under "Plan of Experiment", feed was bought for the entire year in an effort to secure more accurate results when analysis was made by the Chemistry Department.

No further explanation of the experiment is necessary here as the reader must understand that the following is merely the report of the production of eggs by the various pens.

Cost of Feed

Wheat @ \$1.95 per cwt.
Kafir @ \$1.50 per cwt.
Corn meal @ \$1.70 per cwt.
Millrun @ \$1.35 per cwt.
Cottonseed meal @ \$1.50 per cwt.
Beef Scrap @ \$4.50 per cwt.
Medium grit @ \$1.65 per cwt.
Oyster shell @ \$1.25 per cwt.
Charcoal (small) @ \$3.50 per cwt.
Cracked bone (small) @ \$4.50 per cwt.
Fine salt @ \$.50 per cwt.

The above prices were paid mostly at Stillwater markets. If the reader is interested further as to the value of the tests in his locality he can do the same figuring with his home market prices as a basis. It will be seen that in some localities the returns would be greater.

Summary of feed consumed and cost from November 18, 1914, to November 17, 1915

TABLE XIII

Pen Number	Feed Consumed						Cost of Feed Consumed			Total Cost	Loss or* Gain
	Grain		Mash		Grit		Grain	Mash	Grit		
	Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.					
Pen No. 1	462	3	355	10	26	6	\$7.86	\$6.90	\$.37	\$15.13	G—\$ 5.05
Pen No. 2	482	1	320	10	22	3	8.15	5.14	.30	13.19	G— 1.35
Pen No. 3	448	14	175	5	20	10	7.63	2.84	.39	10.86	G— .46
	1393	2	851	9	69	3	\$23.64	\$14.88	\$1.06	\$39.58	G—\$ 6.86

*See "returns" in Table XIV.

Summary of Egg Production

November 18, 1914, to November 17, 1915

The returns, it will be noted from Table XIV, were not very high, but this is due to the very poor market in Stillwater. In other parts of this State, while we get 15 cents for our eggs, they are getting 20 to 25 cents. Here again the reader can draw his own conclusions.

TABLE XIV

	Eggs Produced	Total Weight of Eggs Laid (in Grams)	Average Weight of Eggs Laid	Returns	Average Price Received	Weight of Birds							
						Start				Finish			
						Hens		Male		Hens		Male	
Lbs.	oz.	Lbs.	oz.	Lbs.	oz.	Lbs.	oz.						
Pen No. 1	1394	73693.8	52.80	\$20.18	.186	31	14	8	11	32	3	9	1
Pen No. 2	998	53301.2	53.40	14.94	.186	32	0	7	15	34	3	9	1
Pen No. 3	744	38489.0	51.70	11.32	.186	31	9	8	2	30	7	4*	13
	3136	165484.0		\$46.44									

*One male.

November 18, 1915, to May 17, 1916

The same idea of buying a large supply of feed at one time was carried out for this second year's work. The analysis resulted as follows, and the nutritive ratio of Pens Nos. 1 and 4, or 1:4.5 (beef scrap); Pens Nos. 2 and 5, or 1:4.5 (cottonseed meal), and Pens Nos. 3 and 6, or 1:3.5 (excess of cottonseed meal), will be found in Tables XVI, XVII and XVIII.

TABLE XV
Analysis of Feed

	Water	Ash	Protein	Fiber	Carbohy- drates	Fats
Wheat {						
Kafir }	14.24	1.64	12.94	3.32	66.31	1.55
Bone meal	8.60	62.41	24.39			2.50
Meat scrap	6.08	26.27	63.22	2.46		8.77
Cottonseed meal	8.21	5.33	39.31	12.54	26.41	8.20
Bran and Millrun (mixed)	10.94	4.75	17.38	7.69	56.00	3.24
Corn chop	12.39	1.45	10.06	3.52	70.14	2.44

TABLE XVI
Beef Scrap— Pens Nos. 1 and 4—Nutritive Ratio 1:4.5

	Protein	Carbohydrates	Fat
Grain Food			
Kafir 20 pounds* {			
Wheat (whole) 20 pounds }	5.1760	26.5240	.6200
Ground Food			
Millrun 7 pounds	1.2166	3.9200	.2268
Corn chop 10 pounds	1.0060	7.0140	.2440
Beef scrap 2 pounds	1.2644		.1754
Bone meal 1 pound .....	.2438	.0211	.0254
	8.9068	37.4791	1.2916

*The year's supply of whole grain had been mixed so the chemist analyzed the two together, with one result.

TABLE XVII
Ration for Pens Nos. 2 and 5—Nutritive Ratio 1:4.5

	Protein	Carbohydrates	Fat
Grain Food			
Kafir 20 pounds {			
Wheat (whole) 20 pounds }	5.1760	26.5240	.6200
Ground Food			
Millrun 8 pounds	1.3904	4.4800	.2592
Corn chop 7 pounds .....	.7042	4.9098	.1708
Cottonseed meal 3 pounds	1.1793	.7923	.2460
Bone meal 1 pound .....	.2438	.0211	.0254
	8.6937	36.7272	1.3214

TABLE XVIII

Rations for Pens Nos. 3 and 6—Nutritive Ratio 1:3.5

	Protein	Carbohydrates	Fat
Grain Food			
Kafir 20 pounds	5.1760	26.5240	.6200
Wheat (whole) 20 pounds			
Ground Food			
Millrun 3 pounds	.5214	1.6800	.0972
Corn meal 2 pounds	.2012	.14028	.0488
Cottonseed meal 10 pounds	3.9310	2.6410	.8200
Bone meal 1 pound	.2438	.0211	.0254
	10.0734	32.2789	1.6114

The feed bought at this time cost as follows:

30 Bushels of wheat @ \$1.00	\$ 30.00
35 Bushels of kafir @ \$.45	15.75
20 Bushels of kafir @ .50	10.00
200 Pounds corn chop @ \$1.10	2.20
300 Pounds millrun @ \$1.10	3.30
200 Pounds beef scrap @ \$3.25	6.50
300 Pounds cottonseed meal @ \$1.10	3.30
50 Pounds bone meal @ 3c	1.50
50 Pounds oyster shell	.50
50 Pounds charcoal	1.25
50 Pounds grit	.45
Total	\$ 74.75

SUMMARY
November 18, 1915, to May 17, 1916
TABLE XIX

	Eggs Produced	No. of Birds	Returns	Total Weight of Eggs Laid (in Grams)	Average Weight of Eggs (Grams)	Weight of Birds							
						Start				Finish			
						Hens		Male		Hens		Male	
Lbs.	oz.	Lbs.	oz.	Lbs.	oz.	Lbs.	oz.						
Pen No. 1	636	10	\$ 9.27	34432.9	54.16	32	1	4	14	31	10	5	12
Pen No. 2	552	10	8.21	30807.5	55.60	34	3	4	13	36	11	4	11
Pen No. 3	404	9	6.21	21803.6	53.90	29	6	4	11	29	2	4	13
				From December 13, 1915, to May 22, 1916									
Pen No. 4	730	10	10.85	37163.3	50.90	29	15	3	3	31	10	3	8
Pen No. 5	431	7	6.80	21192.9	49.40	19	6	2	9	21	8	3	11

TABLE XX

	No. of Birds	Feed Consumed						Cost of Feed Consumed			Total Cost	Loss or Gain
		Grain		Mash		Grit		Grain	Mash	Grit		
		Lbs.	Oz.	Lbs.	Oz.	Lbs.	Oz.					
Pen No. 1	10	274	9	108	9	16	8	\$ 4.05	\$ 1.64	\$.18	\$ 5.87	G—\$ 3.40
Pen No. 2	10	266	4	107	2	18	15	3.96	1.36	.22	5.54	G— 2.67
Pen No. 3	9	265	7	35	8	14	7	3.91	.50	.17	4.58	G— 1.63
Pen No. 4	10	210	5	96	15	13	4	3.02	1.44	.14	4.60	G— 6.25
Pen No. 5	7	176	8	51	0	10	10	2.41	.65	.11	3.17	G— 3.63

From the above it will be seen that beef scrap rations seem to be more economical to feed in spite of its greater cost. It more than pays for itself by apparently increasing the production, and hence the returns.

Following is a table showing total production and returns as well as costs for the entire experiment. The following is for Pen No. 1, seasons of 1914-15 and 1915-16; and Pen No. 4, season of 1915-16, both fed beef scrap or animal protein. Also for Pens Nos. 2 and 5 for the same periods, being fed the vegetable protein in cottonseed meal. Pens Nos. 3 and 6 are not shown, due to lack of birds, but it may be seen that these pens fed an excess of cottonseed meal do not enter in the comparison at all.

TABLE XXI

Pen Nos.	No. of Birds	Total Eggs Produced	Total Returns	Feed Consumed						Cost of Feed Consumed			Total Cost	Loss or Gain
				Grain		Mash		Grit		Grain	Mash	Grit		
				Lbs.	oz.	Lbs.	oz.	Lbs.	oz.					
1 and 4 ----	20	3396	\$40.00	947	7	561	2	56	2	\$14.93	\$ 9.98	\$.69	\$25.60	G—\$14.70
2 and 5 ----	17	2537	29.95	924	13	478	12	51	12	14.52	7.15	.63	22.30	G— 7.65

Further experiments are being carried out on much larger flocks to determine more exactly just which form of protein is best for egg production.

CONCLUSIONS

1. Cottonseed meal fed in combination with other feed to form a proper nutritive ratio, or even when fed in excess, does not lower the fertility of domestic fowls, but in many cases the fertility was higher than when beef scrap or animal protein was used.
2. The percent of fertile eggs hatched shows greatly in favor of cottonseed meal when compared with beef scrap if fed in a properly balanced ration, but when fed in excess gave rather poor hatching results.
3. The percent of all eggs hatched also shows in favor of cottonseed meal compared with beef scrap when fed in a properly balanced ration, but when fed in excess the results are very poor.
4. As a feed for production of eggs only, and not considering effect on hatchability, beef scrap is superior to cottonseed meal, and more than makes up for its greater cost by apparently causing greater production.
5. While records of the livability of chicks are not printed herewith, the author wishes to add that the mortality was a great deal higher in pens fed cottonseed meal, both the normal and excessive ration.