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# Agricultural Experiment Station

OF THE

AGRICULTURAL AND MECHANICAL COLLEGE,

AUBURN.

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## PIG FEEDING EXPERIMENTS.

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C. A. CARY, Veterinarian.

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## PIG FEEDING EXPERIMENTS.

BY C. A. CARY.

These feeding tests were made for the purpose of securing a ration—of which cotton seed or cotton seed meal should form one of the principal ingredients—that would not kill pigs and yet be a profitable food. At the same time it was our aim to attempt to determine the reason why cotton seed or cotton seed meal kills pigs; this part of the experiment was not fully carried out, because no pigs were killed by the feeding tests.

These tests must be considered as preliminary; because their number and the repetition of the same tests are insufficient to make fixed or definite feeding laws. In order to obtain definite conclusions, repeated and various tests must be made, and in connection therewith chemical analyses of the ration as fed and of the indigestible parts of the ration must be made.

In these tests we were controlled by limited means and difficulties in obtaining the foods desired at the time when needed. However, it was our intention to use such foods as were in season and most available to the farmer.

### FIRST EXPERIMENT. (See table No. I.)

In calculating the cost of the rations in the tests, made from April 28th to August 11, 1894, the following prices were used: Corn, 60 cents per bushel; cow peas, 60 cents per bushel; sweet potatoes, 50 cents per bushel; green oats, green rye and green sorghum, each at 25 cents per cwt.; wheat bran and cotton seed meal at \$20 per ton; cotton seed at 12½ cents per bush. Since I could find no digestible per-



centages of sweet potatoes I used those of Irish potatoes in calculating the nutritive ratio in all rations where sweet potatoes were used.

Pig No. I., during the entire feeding period of 105 days, received daily, 1 1-3 lbs. of ground corn; 1 2-3 lbs. of ground cow peas, and 2 1-10 lbs. of sweet potatoes. The nutritive ratio based on the pig weighing 125 lbs. is 1:4.2. The pig gained 73 lbs. at a cost of 6 4-5 cents per lb. It required 7 1-3 lbs. of the ration mixture (just as fed) to make 1 lb. of gain. This ration is too small in quantity; 2 lbs. of corn, 2½ lbs. of cow peas and 3 lbs. of sweet potatoes would make a ration in proportion to the size of the pig.

Pig No. II., from April 28th to August 11th (105 days), received daily 1 1-3 lbs. ground corn; 1 2-3 lbs. of ground cow peas and 2 1-10 lbs. of sweet potatoes. With the average weight of the pig at 84 lbs. the nutritive ratio is 1:4.6. The pig gained 71 lbs. in 105 days at a cost of 7 cents per lb. It required 7½ lbs. of the ration mixture (just as fed) to make 1 lb. of gain. This ration is the same as that for pig No. I.; but this pig being smaller makes the ration slightly less in quantity than that which is required.

Pig No. III., from April 28th to June 2d (35 days), received daily 1 1-5 lbs. of ground corn; 1½ lbs. of ground cow peas; 1 4-5 lbs. of green oats. With the average weight of the pig at 65 lbs., the nutritive ratio is 1:4.7. The cost of 1 lb. of gain is 6 cents. It required 8 2-3 lbs. of the ration mixture to make one pound of gain. The pig gained 17¾ lbs. in 35 days.

Pig No. III., from June 2d to Aug. 11th (70 days), was fed daily 1 3-5 lbs. of ground corn; 1 3-5 of ground cow peas, and 2 2-5 lbs. of green sorghum. With the average weight of the pig at 90 lbs. the nutritive ratio is 1:5.1. The pig gained 34 lbs. at a cost of 8 2-3 cents per lb., or 11 2-3 lbs. of the ration mixture.

Pig No. IV., from April 28th to June 2d (35 days), received daily 1 4-5 lbs. of cow peas; 1 4-5 lbs. of green oats, and 1 4-5 lbs. of green sorghum. The average weight of

the pig at 50 lbs. makes the nutritive ratio 1:3.6. The pig gained 18 lbs. at a cost of 6 1-3 cents per lb., or 10 2-3 pounds of the ration mixture.

Pig No. IV., from June 2 to August 11 (70 days), was fed daily 2 2-5 lbs. of cow peas; 2 4-5 lbs. of green sorghum, and 2 2-5 lbs. of sweet potatoes. The pig gained 29 lbs. at a cost of 10 5-6 cents per lb. or 18 lbs. of the ration mixture. With the average weight of the pig at 75 lbs. the nutritive ratio is 1:3.6.

Pig No. V., from April 28 to June 2 (35 days), received daily 1 1-5 lbs. of crushed cotton seed; 1 1-5 lbs. of ground cow peas, and 2 1-10 lbs. of green oats. With the pig weighing 50 lbs. the nutritive ratio is 1:3.9. The pig gained 20 lbs. at a cost of 4 1-5 cents per lb. or 7 4-5 lbs. of the ration mixture.

Pig No. V., from June 2 to August 11 (70 days), received daily 2 lbs. of crushed cotton seed; 1 1-5 lbs. of ground cow peas, and 2 1-5 lbs. of green sorghum. The average weight of the pig at 70 lbs. makes the nutritive ratio 1:5. The pig gained 21 lbs. at a cost of 9 cents per lb. or 20 lbs. of the ration mixture.

Pig No. VI., from April 28 to August 11, received daily 1 2-5 lbs. of crushed cotton seed; 1 2-5 lbs. ground cow peas, and 2 1-10 lbs. of sweet potatoes. With the average weight of the pig at 70 lbs. the nutritive ratio is 1:4.2. The pig gained 49 lbs. at a cost of 7 cents per lb. or 10½ lbs. of the ration mixture.

Pig No. VII., from April 28 to June 2, was fed daily 3-10 lbs. of cotton seed meal, 1½ lbs. of wheat bran, and 3 3-5 lbs. of green oats. The average weight of the pig at 46 lbs. makes the nutritive ratio 1:4. The pig gained 5 lbs. at a cost of 21 cents per lb. or 38 lbs. of the ration mixture. On May 30 this pig refused to eat, and was apparently sick.

From June 2 to August 11, Pig No. VII. received daily 3-10 lbs. of cotton seed meal; 1½ lbs. of wheat bran, and 3 3-5 lbs. of green sorghum. The average weight of the pig at 50 lbs. makes the nutritive ratio 1:4.5. The pig gained

8 lbs. at a cost of  $26\frac{1}{4}$  cents per pound or  $47\frac{1}{4}$  lbs. of the ration mixture. On August 4 this pig almost entirely refused to eat and grew worse until August 11, when the test closed and the pig was turned out to pasture and fed corn; upon this ration it made an average fat hog in 4 months.

Pig No. VIII., from April 28 to June 2, received daily 3-5 lb. of cotton seed meal; 1 1-5 lbs. of ground corn and 3 lbs. green oats. The average weight of the pig at 50 lbs. makes the nutritive ratio 1:4.7. In 35 days the pig gained  $15\frac{1}{2}$  lbs. at a cost of 6 1-6 cents per lb., or 10 4-5 lbs. of the ration mixture. On May 30 this pig refused to eat, but gradually improved until it manifested no signs of illness.

Pig No. VIII., from June 2 to Aug. 11, received daily 3-5 lb. of cotton seed meal; 1 1-5 lbs. of ground corn and 3 lbs. of green sorghum. The average weight of the pig at 70 lbs. makes the nutritive ratio 1:4.5. In 70 days the pig lost 6 lbs. This ration should have contained 1 lb. of cotton seed meal,  $2\frac{1}{2}$  lbs. of corn and 4 lbs. green sorghum. On July 28 and August 4 this pig refused food. It was evidently sick. It gradually grew worse until August 11 when the experiment was closed. Very probably it would have died had it not been turned out and given other food. This pig soon recovered after being turned into a pasture and fed corn. In fact, it became a fine "porker" in 4 months after the close of the experiment.

#### SECOND EXPERIMENT. (See Table No. II.)

In determining the cost of the food in the rations used in the feeding tests, made from March 30 to June 29, 1895, the same prices were used as for the test in 1894.

The green rye gave out on April 27, and it was our intention to follow the green rye with green oats or green sorghum; but owing to unavoidable conditions those foods could not be secured.

Pig No. I., from March 30 to June 29, was fed daily  $3\frac{1}{2}$  lbs. of corn. In 91 days the pig gained 25 lbs. at a cost of 13 3-5

SECOND EXPERIMENT. TABLE NO. II.

No. of Fig.	DAILY RATION FED TO EACH FIG.	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Total gain.	Cost of each lb. of gain.	Nutritive Ratio.
		March 30.	April 1.	April 6.	April 13.	April 20.	April 27.	May 4.	May 11.	May 18.	May 25.	June 1.	June 8.	June 15.	June 22.	June 29.				
I.	Corn.....3½ lbs.	67½	60	60	68	70	71	75	78	79	81	81½	83	87	90	92½	25	13.3-5	1:10.3	
II.	Ground Corn.....2½ lbs	47	46	45½	47	45	46½	50	51	53	53½	53½	54½	56	58	58½	11½	32	1:8	
	Crushed Cotton Seed..3½ "																			
III.	Ground Corn.....2½ lbs.	60	60	60	60	55	55½	64	63	65	66	67	69	71	81	83	23	16	1:7.8	
	Crushed Cotton Seed..3½ "																			
IV.	Ground Cow Peas.....2½ lbs.	78	73	71½	75	79½	86	96	96	97	97	97½	101	103	106	107½	29½	12½	1:4.4	
	Crushed Cotton Seed..4 "																			
V.	Crushed Cotton Seed..4½ lbs.	71	68½	70½	65	62	60	55	53	51	51	51½	53	55	56½	58	lost 13		1:6.7	
VI.	Crushed Cotton Seed..3½ lbs.	70	69½	68	63	63	63½	70	69	67	67½	67½	69	71	73	76	6	7¾		
	Green Rye.....3½ "																			
VII.	Crushed Cotton Seed...3 lbs.																			
	Ground Cow Peas.....3 "	65½	64	70	72	72	73	81	81	82	83½	83	83½	84	87	88½	23	14½		
	Green Rye.....3½ "																			
VIII.	Crushed Cotton Seed...3 lbs.																			
	Ground Cow Peas.....3 "			47½	53	51	51½	60	61	61	61½	62	63½	65	66		19½	19½		
	Green Rye.....3½ "																			
IX.	Crushed Cotton Seed...3 lbs.																			
	Ground Corn.....3 "	58	55½	61	62	64	65	68	70	70	71	71	73	73½	75	77	19	38½		
	Green Rye.....3½ "																			
X.	Wheat Bran.....3 lbs.																			
	Green Rye.....4 "	60	66½	71	71	69	70	73	74	73	73½	73	74	76	77	79	19	19.2-5		



cents per lb., or  $12\frac{3}{4}$  lbs. of corn. The nutritive ratio is 1:10.3. This pig was of common stock.

Pig II., from March 30 to June 29, received daily  $2\frac{1}{2}$  lbs. of ground corn, and  $3\frac{1}{2}$  lbs. of crushed cotton seed. In 91 days it gained  $11\frac{1}{2}$  lbs. at a cost of 32 cents per lb. or 47 lbs. of the ration mixture. With the average weight of the pig at 52 lbs., the nutritive ratio is 1:8. This ration contains too much cotton seed. Corn  $3\frac{1}{2}$  lbs. and cotton seed  $1\frac{1}{2}$  lbs. would make a better ration. This pig was from common stock. It was turned into a pasture at the close of the test and in the fall was fed corn. About Jan. 1, 1896, it weighed 216 lbs.

Pig No. III., from March 30 to June 29, received daily  $2\frac{1}{2}$  lbs. of ground corn and  $3\frac{1}{2}$  lbs. of crushed cotton seed. With the average weight of the pig at 70 lbs., the nutritive ratio is 1:7.8. The pig gained 23 lbs. at a cost of 11 cents per lb., or  $23\frac{2}{3}$  lbs. of the ration mixture. The gain is better than that of pig No. II.; yet there is too much cotton seed in the ration. This pig was turned into a pasture at the close of the test and in the fall it was fed corn. It was of common stock, and weighed about Jan. 1, 1896, 164 lbs.

Pig No. IV., from March 30 to June 29, received daily  $2\frac{1}{2}$  lbs. of ground cow-peas and 4 lbs. of crushed cotton seed. The average weight of the pig at 93 lbs. makes the nutritive ratio 1:4.4. In 91 days the pig gained  $29\frac{1}{2}$  lbs. at a cost of  $12\frac{1}{2}$  cents per lb. or 20 lbs. of the ration mixture. Ground cow-peas 3 lbs. and crushed cotton seed 2 lbs. would be a better ration for a pig of the same weight. This pig was afterwards fed as No. III., and weighed about Jan. 1, 1896, 170 lbs.

Pig No. V., from March 30 to June 29, received daily  $4\frac{1}{2}$  lbs. of crushed cotton seed. The nutritive ratio is 1:6.7. In 91 days the pig lost 13 lbs. This pig apparently ate enough to prevent starvation. Yet it grew in frame work (bone, etc.), and when turned out to pasture and given corn, after the close of the test, made a hog that weighed 153 lbs. about January 1st, 1896.

Pig No. VI, from March 30 to April 27, received daily  $3\frac{1}{2}$  lbs. of crushed cotton seed and  $3\frac{1}{2}$  lbs. of green rye. The average weight of the pig at 67 lbs. makes the nutritive ratio 1:6.7. In 28 days the pig lost 6 lbs. Crushed cotton seed 2 lbs. and green rye 5 lbs. would have been a better ration for this pig.

Pig No. VI, from April 27 to June 29, received daily  $3\frac{1}{2}$  lbs. of crushed cotton seed. The nutritive ratio is 1:6.7. The pig gained  $13\frac{1}{2}$  lbs. at a cost of 5.9 cents per lb., or  $13\frac{3}{8}$  lbs. of crushed cotton seed. The pig did not eat all the ration at any time. It ate sufficient to maintain life and increase the size of the frame work of the body. It was not in the best of health all the time, but never exhibited signs of serious illness. After the close of the feeding test this pig was treated as pig No. III. It weighed 220 lbs. January 1, 1896. It was of common stock.

Pig No. VII, from March 30 to April 27, received daily 3 lbs. of crushed cotton seed; 3 lbs. of ground cow peas, and  $3\frac{1}{2}$  lbs. of green rye. With the average weight of the pig at 70 lbs., the nutritive ratio is 1:3.8. The pig gained  $7\frac{1}{2}$  lbs. at a cost of 18 4-5 cents per lb., or 35 lbs. of the ration mixture. Crushed cotton seed  $1\frac{1}{2}$  lbs.; ground cow peas 2 lbs., and green rye 4 lbs. would make a better ration.

Pig No. VII, from April 27 to June 29, received daily 3 lbs. of crushed cotton seed and 3 lbs. of ground cow peas. With the average weight of the pig at 80 lbs., the nutritive ratio is 1:3.7. The pig gained  $15\frac{1}{2}$  lbs., at a cost of  $14\frac{1}{2}$  cents per lb., or  $20\frac{1}{2}$  lbs., of the ration mixture. With the same after treatment as No. III, the pig weighed 170 lbs. January 1, 1896. This was an Essex pig.

Pig No. VIII, from April 6 to April 27, received 3 lbs. of crushed cotton seed; 3 lbs. of ground cow peas, and  $3\frac{1}{2}$  lbs. of green rye. With the average weight of the pig at 50 lbs. the nutritive ratio is 1:3.9. In 21 days the pig gained 4 lbs. at a cost of 25 3-5 cents per lb., or 49.9 lbs. of the ration mixture. Cotton seed 1 lb.; cow peas 2 lbs., and green rye 5 lbs. would make a better ration.

Pig No. VIII, from April 27 to June 22, received daily 3 lbs. of crushed cotton seed and 3 lbs. of ground cow peas. With the average weight at 58 lbs., the nutritive ratio is 1:3.6. The pig gained  $15\frac{1}{2}$  lbs. at a cost of 13 1-6 cents per lb. or  $17\frac{3}{4}$  lbs. of the ration mixture. Cotton seed 1 lb. and cow peas 2 lbs. would make a better ration. On June 22 this pig accidentally escaped from the pen and was killed by being chased too long in the heat of the day.

Pig No. IX, from March 30 to April 27, received daily 3 lbs. of crushed cotton seed; 3 lbs. of ground corn;  $3\frac{1}{2}$  lbs. of green rye. With the average weight of the pig at 60 lbs. the nutritive ratio is 1:7.4. The pig gained 7 lbs. at a cost of 20 2-7 cents per lb. or 38 lbs. of the ration mixture. Crushed cotton seed 1 lb.; ground corn 2 lbs., and green rye 5 lbs. would have been a better ration.

Pig No. IX, from April 27 to June 29, received 3 lbs. of crushed cotton seed and 3 lbs. of ground corn. With the average weight of the pig at 70 lbs., the nutritive ratio is 1:8.3. The pig gained 12 lbs. at a cost of 23 cents per lb., or  $31\frac{1}{2}$  lbs. of the ration mixture. Corn 3 lbs. and cotton seed 1 lb.; or corn 3 lbs. and cotton seed 2 lbs. would have been better. This Essex pig was treated afterwards as No. III and weighed 186, January 1, 1896.

Pig No. X, from March 30 to April 27 (28 days), received daily 3 lbs. of wheat bran and 4 lbs. of green rye. With the average weight of the pig at 65 lbs., the nutritive ratio is 1:4.7. The pig gained 10 lbs. at a cost of 11 1-10 cents per lb., or 19 3-5 lbs. of the ration mixture.

Pig No. X, from April 27 to June 29, received daily 3 lbs. of wheat bran which has a nutritive ratio of 1:4.2. The pig gained 9 lbs. at a cost of 21 cents per lb., or 21 lbs. of the ration mixture. Bran and rye are apparently better and less expensive than bran alone. This Essex pig with the same after treatment as No. III, weighed 203, January 14, 1895.

## THIRD EXPERIMENT. (See Table III.)

In determining the cost of the rations in these tests, cotton seed was rated at  $12\frac{1}{2}$  cents per bushel, separated milk at 5 cents per gallon and whole milk at 20 cents per gallon.

It was our aim to make the entire test with separated milk and cotton seed, but owing to unavoidable circumstances whole milk was substituted for separated milk. It is very evident that whole milk at 20 cents per gallon can not be fed to pigs with profit.

At two periods during the test these pigs were slightly affected, but at no time were they seriously ill.

Pig No. I, from July 15 to September 2, received daily 6 lbs. of separated milk and  $3\frac{1}{2}$  lbs. of crushed cotton seed. With the average weight of the pig at 108 lbs., the nutritive ratio is 1:5.1. The pig gained  $11\frac{1}{2}$  lbs. at a cost of  $21\frac{2}{3}$  cents per lb. On August 15 this pig did not eat cotton seed and was evidently somewhat sick.

Pig No. I, from September 2 to October 21 (49 days), received daily 6 lbs. of whole milk and  $3\frac{1}{2}$  lbs. of crushed cotton seed. With the average weight of the pig at 126 lbs., the nutritive ratio is 1:6. The pig gained 19 lbs. at a cost 41 1-3 cents per lb. On September 19 this pig failed to eat the cotton seed and was slightly ill.

Pig No. II, from July 15 to September 2, received daily 6 lbs. of separated milk and  $3\frac{1}{2}$  lbs. of crushed cotton seed. With the average weight of the pig at 90 lbs., the nutritive ratio is 1:5.8. The pig gained  $12\frac{1}{2}$  lbs. in 49 days at a cost of 20 cents per lb. On August 15 this pig ate very little cotton seed.

Pig No. II, from September 2 to October 21, received daily 6 lbs. of whole milk and  $3\frac{1}{2}$  lbs. of crushed cotton seed. With the average weight of the pig at 100 lbs., the nutritive ratio is 1:5.7. The pig gained 8 lbs. in 49 days at a cost of 98 cents per lb. On September 19th, this pig refused to eat cotton seed.

THIRD EXPERIMENT. TABLE NO. III.

No. of Fig.	DAILY RATION FED TO EACH FIG.	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Weight	Total	Cost of	Nutritive
		July 15.	July 22.	July 29.	Aug. 5.	Aug. 12.	Aug. 19.	Aug. 26.	Sept. 2.	Sept. 9.	Sept. 16.	Sept. 23.	Sept. 30.	Oct. 7.	Oct. 14.	Oct. 21.	gain.	1 lb. of gain.	
I.	Crushed Cotton Seed.. 3½ lbs. "Separated" Milk..... 6 "	102	104	108	111	114	114½	116	113½	114	117½	123	129	136½	132	132½	30½	31½	
II.	Crushed Cotton Seed.. 3½ lbs. Separated Milk..... 6 lbs.	84	84	87½	91	94	94½	96	96½	95	98	103	102½	105	103	104½	20½	59	

## TESTS AT OTHER STATIONS.

According to feeding tests made by Curtis at the Texas Experiment Station, raw cotton seed, roasted cotton seed or boiled cotton seed will kill pigs in about six weeks after beginning to feed them. After two years of duplicate tests Curtis states that cotton seed is an unprofitable hog food, because hogs will not eat it. (See Bulletin No. 21, Texas Station.)

The Kansas Station gives the following results: "Cotton seed meal proved poisonous to pigs even though fed in small quantities. A mixture of one-fourth cotton seed meal was as disastrous as equal parts of these feeds. The pigs died in from three to eight weeks after being put on this feed, the larger ones holding out the longest. *Post mortem* examinations revealed in all cases severe inflammation and congestion of the intestines, lungs and heart. But cotton seed meal produces very rapid gains in both pigs and large hogs, and if the feed is changed before symptoms of disease appear, hogs can be fed cotton seed meal for a short time with the best results, and this experiment would indicate without subsequent deleterious effects." (See Bulletin 53, Kansas Station.)

*Why cotton seed or cotton seed meal kills pigs and hogs is not definitely known. At present the opinion most prevalent is that it is a result of the condition of the cotton seed or cotton seed meal. It is certain that cotton seed can undergo decomposition—possibly from various forms of germs. These germs when taken into the alimentary canal for some time, may, invade the tissues and produce the severe inflammation of the intestines and the peritoneum. This process may be explained in another way. The germs by their action on the cotton seed or the tissues may develop a poisonous product (ptomaine) which causes the inflammation and death. In either case it is the condition of the cotton seed or cotton seed meal that causes the death. Some one may ask: How is it with the roasted or boiled cotton seed where the germs are destroyed by the heat? The heat*

may not destroy the poisonous product, and in many instances the cotton seed is left in the pen and troughs of the pen long enough to begin to decompose before they are eaten. I am of the opinion that boiled or roasted cotton seed will not kill pigs if the seed are not allowed to begin to decompose in the pen before they are eaten. In other words the pen should be cleaned out as soon as the pig stops eating, after each time of feeding. Some have asserted that the lint on the cotton seed formed concretions or impactions in some part of the alimentary canal. I have never observed this and have only heard it asserted by persons whose ability to judge of such conditions was questionable.

Furthermore, some believe that the pig, when fed on nothing but cotton seed or cotton seed meal, starves to death. This may occur, but it failed to take place in the limited number of tests we have made.

From the tests that have been made here, it is very probable that combining crushed cotton seed with a liberal quantity of green rye, green oats, green sorghum, sweet potatoes or turnips, it can be fed to pigs and hogs without great danger, providing the cotton seed is not mouldy or decomposing or allowed to partially decay in the pen. It is also probable that crushed cotton seed can be combined with skimmed or separated milk.

Furthermore, it is quite evident that, after a pig reaches the weight of 50 lbs. cotton seed or cotton seed meal in combination with corn, or cow-peas, can be made a profitable pig ration up to the time of the premonitory symptoms of disease. As a rule this period varies between three and six weeks. The premonitory signs of disease, are weakness, staggering, fever, loss of appetite and few, if any, movements. When these symptoms appear, the pig should be turned into a pasture or the food should be changed to bran slops and corn or other healthy foods.

The details of these experiments were carried out by Mr. T. U. Culver, Superintendent of the Station Farm. Much credit is due him for the results obtained.

