

THE SWINE SANITATION SYSTEM AS DEVELOPED ALONG LINES SUITABLE TO CONDITIONS IN THE SOUTH BY THE BUREAU OF ANIMAL INDUSTRY,

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Experimental tests of the system of swine sanitation along lines suitable to conditions in the South were begun in Colquitt County, Georgia, in the spring of 1926. The project is a continuation of the work which had its beginning in Illinois, and is known as "The McLean County System of Swine Sanitation". The work is strikingly successful in the Middle West, in the prevention and control of the common roundworm in young pigs, by preventing and controlling losses by runts, and filth-borne diseases commonly present in hog lots and other premises long used by hogs. The Bureau recognized the importance of inaugurating the work at some point in the South where there was an interest in improving and protecting the swine industry in connection with general farm practices. Accordingly, Colquitt County was selected owing to local marketing and slaughtering facilities, and the offer of friendly cooperation by farmers, packers, the Bureau of Animal Industry Inspector in charge of meat inspection and his force, and others interested.

The difference between the Middle West and the South in climatic, soil, crops and pasture conditions, parasites present, and other factors in the management of hogs on the farm in the South was taken into consideration, in making the method of swine sanitation applicable to the swine industry of the Southeastern States.

The writers will not attempt in this report to discuss the life history of the common roundworm (*Ascaris suum*) of pigs. Readers are referred to bulletins on the subject as follows: "The Prevention of

Roundworms in Pigs, Leaflet No.5", and "The Swine Sanitation System as Developed by the Bureau of Animal Industry in McLean County, Illinois, Technical Bulletin No.44" issued by the U. S. Department of Agriculture, Washington, D. C.

Farm Survey.

The writers conducted a farm survey and field investigation in the spring and summer of 1926. Conditions of pigs as to worm infestation, losses from internal parasites, filth-borne diseases, and by "runty" condition of pigs were studied. The general management of hogs on the farm as to breeding, feeding and care was studied. The nature of the soil, climate and crops grown were given consideration in undertaking the establishment of the work. The survey was made with the assistance of the County Adviser, and the local Chamber of Commerce.

The farmers visited stated that they thought worm infestation was the main drawback to raising hogs. In inspecting herds, evidence of worm infestation in pigs in the way of "runts" and undeveloped animals were present in the majority of herds visited. "Filth-borne disease", "bull nose", and such conditions as "sore-mouth", "scour", and "mange" was rarely present in the herds visited. Later in the course of the work the above conditions were noted but they were not wide-spread nor generally present in swine herds. The absence of these conditions are accounted for by the pigs having large areas over which to run in fields and pastures. The filthy hog lot and mud wallow was the exception and not the rule on farms. The sandy loam soil does not favor these conditions.

In the survey collections were made of fresh droppings from pigs,

in composite specimens and from individual animals, and examined microscopically for worm eggs. The examination invariably would show positive to roundworm and other kinds of worm infestation. Post-mortem examination on pigs in the field and in the laboratory would show the roundworm and other intestinal worm infestation present. Worms were present in sufficient numbers in the majority of cases to cause great injury to pigs. Roundworms, nodular worms, lung worms, stomach worms, and kidney worms were found to be present in every herd from which an animal was examined. There was evidence that the worms present were doing injury to the growth and development of the animals. The evidence of worm infestation in the examinations made warranted the statement of the farmers, "that worm infestation was a serious drawback to raising hogs".

Farm Management of Swine.

Hogs kept under fence on the farm are generally confined to low-lying moist native permanent pastures. Lanes connecting the pasture with lots and premises nearer the residence are used for light feeding between crop seasons. Such premises used by hogs year after year is where it was found that the greatest injury was being done by parasites.

Hogs are not generally housed or confined in small lots. They may be given improvised shelter about sheds and barns. Sows before farrowing are generally placed in pastures where they will get the protection of timber and under growth. In such premises they will farrow their pigs. Later sows and litters are allowed to go with the main herd of older hogs, thus the young pigs are exposed to heavy worm infestation. The county is free range, however, enterprising hogmen keep their herds under fence in order that

breed improvement may be carried out. The improved standard breeds of hogs are used.

Soil and Climate.

Colquitt County, Georgia, is located in the higher lying portion of the Coastal Plain Region of the state. The soil is of the gray and yellow sandy loam type. The topography of the region is undulating and fairly well drained. The higher portion of the land is farmed, and the low lying, well shaded wet land is used for permanent pasture.

According to the reports of the U.S. Weather Bureau office located in an adjoining county, the average date of the last killing frost in this vicinity in the spring is March 14. The average date of the first killing frost in the fall is November 15, thus making a growing season of 246 days. The region is well below the snow line. The average annual normal rain fall is 52.35 inches. The average annual normal temperature is 67 degrees F.

The above data is mentioned because there is an important connection with climate, moisture and temperature that is recognized as being especially favorable to the development of parasites in swine and other farm animals.

Feeding, Grazing Crops and Marketing Hogs.

Corn, pea nuts and sweet potatoes in combination are the main feeds used for finishing hogs for market. These feeds are utilized mainly by allowing the hogs to harvest the crops in fall and winter, thus leaving a long period of light feeding for spring farrowed pigs. These feeds are supplemented in some instances with concentrates such as tankage. Hogs are marketed mainly in the fall and winter

months while feed is plentiful. The estimated average age of hogs when marketed, based on examination of the teeth during one week's kill at the packing plant, was found to range from 12 to 18 months, the average age appearing to be approximately 14 months. The number of hogs examined was 5308. In the survey the writers personally interviewed 28 farmers who were recognized as successful hogmen. Twenty-one of them said that raising hogs was profitable, and seven said it was unprofitable. It is seen that 75 per cent of the farmers quoted said raising hogs was profitable, and 25 per cent said that they lost money in raising hogs. It is evident that growing hogs in the region is quite satisfactory to farmers, and that hogs are a very important industry. The experimental tests of the swine sanitation system under conditions in this section of the country is considered to be timely and fully warranted.

The grazing crops consist of permanent native pastures in which pigs are generally farrowed. Winter oats and rye sown in the early fall are used for temporary grazing crops in late fall, winter and spring.

The sanitation method of raising pigs under the climatic conditions and the opportunity of growing green grazing crops the year round has advantages that the farmers of the South may make use of more profitably by adopting the sanitary method of raising pigs.

The Sanitation System in Operation.

The system was inaugurated in the fall of 1926 under the terms of a verbal statement of understanding with farmers as follows:

1. That suitable grazing crops would be provided for sows and litters, for spring and fall farrowing.

2. That such grazing crops would be planted in fields that had been plowed and not used by hogs during the past year. The fields to be as far away from old hog lots and permanent pastures as possible.
3. That the sows would be placed in the clean fields three or four days before farrowing. Shelter and watering facilities to be provided.
4. That the pigs would be kept in the original clean field or some other clean field until at least four months of age. The sows to be removed when the pigs were 60 or 70 days of age.
5. That a reliable record be kept of the date and number of pigs farrowed, including the number of losses, their cause to be ascertained if possible.

The above were the five provisions under which the work was inaugurated. The writers at all times encouraged the use of the most practicable methods of improving and handling hogs.

Good type purebred boars were recommended for use at all times. It was urged that the breeding herds be given good attention as to feeding and care, in order that strong litters of pigs might be produced.

Breeding sows according to a schedule was urged in order that the litters would be farrowed within as short a period as possible, thus facilitating the use of clean fields for sanitary litters to an advantage, because of the more uniform age of pigs. Breeding sows according to a schedule aids in preventing litters from robbing each other, and creep pens, self feeders, feeds and equipment are made use of to a better advantage. Pigs of uniform age, thrive and do better, and are likely to be more profitable to the farmer.

The investigational survey of swine conditions showed the existence of rickets and associated deficiency diseases that might be corrected by a properly balanced ration, and the use of some simple mineral mixture. Ground lime rock and common salt mixed equal parts

by bulk with enough tankage added to flavor the mixture was recommended to be used by keeping it before sows and litters at all times. The mineral mixture aided in stimulating rapid growth and development in sanitary pigs.

An individual portable farrowing house, was designed to suit the climatic conditions, and was recommended for use in protecting litters against the chilly nights of fall and the cold rains of winter and early spring. All these things may be said not to be a part of the sanitation system, but they are essential things for the farmer to do in obtaining the best results in handling pigs under the methods of sanitation.

From the fall of 1926 to the spring of 1930, thirty two farmers cooperated in some degree in carrying out the system of swine sanitation on their farms. In addition, during the same period, eight farmers cooperated in allowing the use of their herds as checks. These latter farmers were to use their customary methods of raising, feeding and marketing hogs, giving no attention to sanitation. The owners of the check herds were classed above the average farmers of the locality.

The writers kept in close contact with all conditions on each farm by frequently visiting the premises, and noting conditions as to worm infestation, pigs farrowed, losses, number marketed and post-mortem examination at time of slaughter. The degree of cooperation on the part of all farmers in carrying out the work was classified as "Excellent", "Good" and "Fair".

Description of the Swing Sanitation System
suitable to the Coastal Plain Region.

In order to clarify some of the modifications made in the system of swine sanitation to make it suitable to conditions, the outline is described as follows:

1. Three or four days before farrowing the sow is placed in a field that has been plowed, and a grazing crop sown for sow and litter. The field must not have been used by hogs during the past year. A portable individual farrowing house is recommended to be provided and placed in the field for housing the sow and litter, which will protect them against chilly nights and cold rains common in fall, winter and early spring. Water may be provided by use of a shallow sand-point driven well or the sanitary watering barrel may be used. The sow will farrow her litter in this field thus the young pigs will not come in contact with worm contaminated hog lots, lanes and permanent pastures. This is the first step in controlling worm infestation, thereby preventing injurious effects of worms in newly-born pigs.
2. The pigs must remain in this or some other clean field until four months of age. The sow is removed at the time of weaning the pigs, (when 60 or 70 days or age). After the pigs are four months old they may be removed to any premises desired. However, it has been found best to keep the pigs on clean ground until marketed.

This method of handling sow and litter is a control measure for preventing serious injury to young pigs by the roundworm. The method is based on the life cycle of this parasite. The sanitation system goes even farther, the kidney worm, nodular worm, thornhead worm and lung worm are noticeably fewer and less injurious in sanitation pigs.

The soil of the Coastal Plain Region does not tend to adhere to the skin of sows, therefore, it is seldom necessary to wash sows before placing them in clean fields for farrowing. If the sow's body is soiled with mud she should be washed with water and soap. In the heavier soils of the South washing the sows should always be carried out.

Transferring the sow by conveyance to the clean field was found not to be necessary. The breeding herd is kept at all times in the open pastures or fields, therefore, sows may be driven into the clean fields with slight danger of conveying worm infection on her feet and skin to the field or to the pigs.

Permanent farrowing pens and houses are not in general use, therefore, are not considered in the sanitation method carried out in this region. Such equipment if existant is not a safe place to farrow pigs under the condition of climate in the Coastal Plain region.

Green Grazing Crops the Year Round.

Palatable green grazing crops are an outstanding feature favoring the adoption of the plan of swine sanitation. Fields that have been plowed, in which crops have been grown during the year are easily provided. In such fields, if not used by hogs within the past year, the sow may be placed to farrow her pigs.

The climate permits sowing summer grazing and winter grazing crops for pigs. Two litters per year is the general practice. Field peas, sorghum, velvet beans and millet for summer, and oats, rye and Austrian peas for fall and winter and spring grazing. These crops are utilized when at grazing height.

The oat crop is especially suited for grazing. The pigs can be farrowed in the oat field, and remain in it until the oats are matured. This common practice permits "hogging off" the oats. By this method the pigs are kept growing on clean ground away from heavy worm contaminated premises, and are ready for finishing on early corn. The early dent variety of corn may be planted the

majority of seasons the latter part of February, and be ready for well developed healthy pigs early in July. This method of handling sanitary pigs keeps them growing and makes it practicable to have them finished for market at the early age of six or seven months weighing around 200 pounds.

Results of work with sanitation pigs from 1926 to 1930.

The following tables show the results obtained from year to year. Since it was not possible nor practicable for the writers to make actual count of pigs at time of farrowing, it was necessary to take the owners figures. However, the writers, through systematic and regular visits to each farm are satisfied that the count is so nearly correct that the figures here recorded will have slight, if any, bearing on the results accomplished.

Table 1. - Sanitary Pigs, 1926.

Number of farms-----	9
Number of sows-----	46
Number of pigs farrowed-----	3330
Number of pigs to pasture-----	252
Number of pigs lost on pasture from accident-----	7
Number of pigs lost on pasture from disease-----	3
Number of pigs marketed-----	197
Number of pigs kept on farms-----	6
Number of pigs showing no record of sale-----	39

Laboratory record of the examination of feces for worm eggs.

Number of fecal examinations made-----	58
Number and kind of worm eggs found:	
Roundworm-----	2824
Nodular worm-----	60
Stomach worm-----	201
Hook worm-----	2
Thornhead worm-----	5
Lung worm-----	3

Additional information derived from Table 1. shown in percentages:

Number of pigs lost at farrowing time-----	78
Percentage of pigs lost at farrowing time-----	23.7
Percentage of pigs saved at farrowing time-----	76.3

Percentage of pigs lost from accident and disease----- 3.
 Percentage of pigs farrowed, raised and marketed----- 73.3

The average age of the pigs when marketed was 8 months and 27 days.

The average live weight was 190 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	197
Number of pigs examined postmortem at time of slaughter--	150
Number of livers normal-----	74
Number of livers parasitic-----	76
Number of carcasses free of kidney worms-----	141
Number of carcasses infested with kidney worms-----	9
Percentage of livers normal-----	49.3
Percentage of livers parasitic-----	50.7
Percentage of carcasses free of kidney worms-----	94.
Percentage of carcasses infested with kidney worms in the kidney region-----	6.

Fifty two out of the 150 pigs slaughtered were further examined for intestinal and other internal parasites. The examination for intestinal parasites was made by opening the bowel and screening and washing the contents. The worms^{found} were counted. The kind of worms and their location were as follows:

Kind	Number	Location
Roundworms	281	Small intestines
Hook worms	2	Small intestines
Lung worms	199	Lungs
Nodular worms	236	Large intestines
Thornhead worms	10	Small intestines
Whip worms	53	Large intestines
Gullet worms	4	Esophagus
Stomach worms	49	Stomach

In the 52 pigs examined 7 were found free and 45 infested with the roundworm (*Ascaris suum*).

Table 2. - Sanitary Pigs 1927.

Number of farms-----	20
Number of sows-----	303
Number of pigs farrowed-----	2297
Number of pigs to pasture-----	1929
Number of pigs lost on pasture from accident-----	111
Number of pigs lost on pasture from disease-----	112
Number of pigs marketed-----	1460
Number of pigs kept on farms-----	22
Number of pigs showing no record of sale-----	224

Laboratory record of examination of feces
for worm eggs.

Number of fecal examinations made-----	199
Number and kind of worm eggs found:	
Roundworm-----	12,552
Nodular worm-----	26
Stomach worm-----	66
Strongyloides-----	52
Whip worm-----	3
Thornhead-----	3
Lung worm-----	1

Additional information derived from Table 2
shown in percentages.

Number of pigs lost at time of farrowing-----	368
Percentage of pigs lost at time of farrowing-----	16.
Percentage of pigs saved at farrowing time-----	83.9
Percentage of pigs lost from accident and disease-----	9.7
Percentage of pigs farrowed, raised and marketed-----	74.2

The average age of the pigs when marketed was 8 months and
29 days. The average weight was 166 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	1460.
Number of pigs examined postmortem at time of slaughter-	892
Number of livers normal-----	219
Number of livers Parasitic-----	670
Number of carcasses free of kidney worms-----	564
Number of carcasses infested with kidney worms-----	308
Identity of 3 livers and 20 carcasses lost.	

Percentage of livers normal-----	24.15
Percentage of livers parasitic-----	75.1
Percentage of carcasses free of kidney worms-----	63.2
Percentage of carcasses infested with kidney worms----	34.5

241 out of the 892 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms found and their locations were as follows:

Kind	Number	Location
Roundworms	1117	Small intestines
Lung worms	slight to excessive	Lungs
Thornheads	172	Small intestines
Stomach worms	slight	Stomach
Nodular worms	760	Large intestines
Whip worms	5	Large intestines
Strongyloides	20	Small intestines

In the 241 pigs examined 58 were found free and 183 infested with the roundworm (*Ascaris suum*).

Table 3.-Sanitary Pigs 1928.

Number of farms-----	20
Number of sows-----	181
Number of pigs farrowed-----	1329
Number of pigs to pasture-----	1084
Number of pigs lost on pasture from accident-----	58
Number of pigs lost on pasture from disease-----	104
Number of pigs marketed-----	847
Number of pigs kept on farms-----	16
Number of pigs showing no record of sale-----	59

Laboratory record of examination of feces for worm eggs.

Number of fecal examinations made-----	72
Number and kind of eggs found:	
Roundworm-----	1801
Nodular worm-----	58
Stomach worm-----	262
Thornhead-----	5

Additional information derived from Table 3 shown in percentages.

Number of pigs lost at time of farrowing-----	245
Percentage of pigs lost at time of farrowing-----	18.4
Percentage of pigs saved at time of farrowing-----	81.5
Percentage of pigs lost from accident and disease-----	12.1
Percentage of pigs farrowed, raised and marketed-----	69.3

The average age of the pigs when marketed was 9 months and 3 days. The average weight was 151.5 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	847
Number of pigs examined postmortem at time of slaughter-----	264
Number of livers normal-----	18
Number of livers parasitic-----	246
Number of carcasses free of kidney worms-----	144
Number of carcasses infested with kidney worms-----	120
Percentage of livers normal-----	6.8
Percentage of livers parasitic-----	93.1
Percentage of carcasses free of kidney worms-----	54.5
Percentage of carcasses infested with kidney worms-----	45.4

68 out of the 264 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms found and their location were as follows:

Kind	Number	Location
Roundworms	339	Small intestines
Nodular worms	688	Large intestines
Hook worms	106	Small intestine
Stomach worm	35	Stomach
Thornheads	26	Small intestines.

In the 68 pigs examined 19 were free and 49 infested with the roundworm (*Ascaris suum*).

Table 4.-Sanitary Pigs 1929.

Number of farms-----	19
Number of sows-----	164
Number of pigs farrowed-----	1392
Number of pigs to pasture-----	1175
Number of pigs on pasture lost from accident-----	48
Number of pigs on pasture lost from disease-----	40
Number of pigs marketed-----	900
Number of pigs kept on farms for breeding-----	16
Number of pigs showing no record of sale-----	171

Laboratory record of examination of feces
for worm eggs.

Number of fecal examinations made-----	78
Number and kind of eggs found:	
Roundworm-----	1001
Stomach worm-----	320
Nodular worm-----	21
Lung worm-----	1
Hook worm-----	4
Thornhead-----	3
Whip worm-----	2

Additional information derived from Table 4
shown in percentages.

Number of pigs lost at time of farrowing---	217
Percentage of pigs lost at farrowing time-----	15.6
Percentage of pigs saved at farrowing time-----	84.4
Percentage of pigs lost from accident and disease---	6.3
Percentage of pigs farrowed, raised and marketed-----	78.

The average age of the pigs when marketed was 6 months and 18 days. The average weight was 151.5 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	900
Number of pigs examined postmortem at time of slaughter-----	441
Number of livers normal-----	117
Number of livers parasitic-----	322
Number of livers identity lost 2.	

Number of carcasses free of kidney worms-----	321
Number of carcasses infested with kidney worms-----	118
Number of carcasses identity lost----2	
Percentage of livers normal-----	26.5
Percentage of livers parasitic-----	73.
Percentage of carcasses free of kidney worms-----	72.8
Percentage of carcasses infested with kidney worms-----	26.7

120 out of the 441 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms found and their number and location were as follows:

Kind	Number	Location
Roundworms	671	Small intestines
Thornheads	11	Small intestines
Lung worms	slight to extensive	Lungs
Hook worms	119	Small intestines
Whip worms	77	Large intestines
Nodular worms	slight to extensive	Large intestines
Strongyloides	3	Small intestines
Stomach worms	7	Stomach

In the 120 pigs examined 30 were free and 90 infested with the roundworm (*Ascaris suum*).

Table 5.-Sanitary Pigs 1930.

Number of farms-----	15
Number of sows-----	78
Number of pigs farrowed-----	700
Number of pigs to pasture-----	566
Number of pigs lost on pasture from accident-----	14
Number of pigs lost on pasture from disease-----	14
Number of pigs kept on farms for breeding-----	538

Laboratory record of examination of feces for worm eggs.

Number of fecal examinations made-----	32
Number and kind of eggs found:	
Roundworm-----	441
Nodular worm-----	123
Hook worm-----	1
Stomach worm-----	168
Whip worm-----	3
Thornhead-----	1
Lung worm-----	1

Additional information derived from Table 5 shown in percentages.

Number of pigs lost at time of farrowing-----	134
Percentage of pigs lost at time of farrowing-----	19.1
Percentage of pigs saved at time of farrowing-----	80.8
Percentage of pigs lost from accident and disease-----	44.
Percentage of pigs farrowed kept on farms-----	76.8

During the period covered by the foregoing tables, 772 sows farrowed 6048 pigs. 1042 pigs were lost at time of farrowing, a loss of 17.2 per cent.

Investigation of the losses were found to be from such causes as, overlying, chilling, born weak, disappeared, stillborn and drowned. These losses are in no way chargeable to defects in the sanitation system.

The tables show that the farmers, after charging off losses at time of farrowing had a prospect of raising 5006 pigs. However, before the pigs reached the age for marketing 238 of them were lost from accidental causes, and 273 had died from disease.

The accidental cause of losses are known to be as follows: Killed and crippled by other hogs, overlaid on account of no equipment for protection of sow and litter. The losses from disease are known to be as follows: Mal-nutrition, farrowed weak, plant poisoning, pneumonia and cholera.

The losses from diseases such as nutritional conditions, and weakness in young pigs are controlable only through proper attention to the sow before and after she has been bred. Avoiding such poisonous plants as the young growing cockle burr, and vaccinating against cholera will in a large measure prevent losses from such causes. Pneumonia was not observed in young pigs 3 or 4 weeks of

age. It developed in pigs 4 to 6 months of age in dry times and dusty conditions of premises. The disease showed in underfed pigs making them more readily subject to bacterial infection. The disease in part at least, might be charged to defects in the sanitation system. However, losses of this kind was always greater with farmers that were classified as good to fair cooperators in carrying out the system of sanitation.

The losses from accident and disease being 8.4 per cent, and at time of farrowing 17.2 per cent make a total loss of 25.6 per cent of the pigs farrowed. These losses must be mainly prevented by the farmers themselves, by adopting better and more modern methods of raising pigs. The sanitation system of raising pigs was not designed to wholly protect against such losses.

The 32 farmers that cooperated in some degree in carrying out the sanitary method of raising ^{pigs} were able to raise and market 74.3 per cent of the pigs farrowed.

The following table shows the percentage of sanitation pigs that went to pasture that were marketed and saved.

Year	Percentage
1926	96.
1927	88.4
1928	85.
1929	92.5
1930	95.

The tables, showing "Number of pigs no record of sale" are pigs on farms dropped from the work or pigs disposed of in dissolving partnership with tenants, and tenants moving etc. These pigs are known to have been raised.

The McLean County System of Swine Sanitation is based primarily, on the life history of the roundworm (*Ascaris suum*)

of young pigs. In these tests further information as to the effects of the control measure on this parasite were ascertained. Fecal examinations were frequently made of the sanitation pig herds for worm eggs. The final postmortem findings at time of slaughter of sanitation pigs were noted and recorded.

The tables show that 439 examinations of fecal material were made from sanitation herds for worm eggs. The specimens collected were composite and represented at least 10 pigs. The following table will best show results.

Year	Number of examinations	Number of roundworm eggs
1926	32	441
1927	78	1001
1928	72	1801
1929	199	12552
1930	58	2834

The above examinations of feces was begun at the time the pigs were 45 to 60 days of age.

Roundworms (*Ascaris suum*) found on postmortem examination of sanitation pigs at time of slaughter.

Year	Number of pigs	Number free	Number infested
1926	52	7	45
1927	241	58	183
1928	68	19	49
1929	120	30	90
Total-----	481	114	367

Percentage of sanitary pigs examined at time of slaughter free of roundworms-----	23.7
Percentage of sanitary pigs found infested with roundworms at time of slaughter-----	76.3

The number of roundworms found ranged from one or two to as high as 176 in one pig. The 481 pigs examined for roundworms were out of a total of 1747 pigs examined postmortem at time of slaughter. The average age is based on the total number.

Therefore, the average age of the pigs examined was 9 months and 5 days. The average live weight was 179 pounds per head. None of the pigs examined were under 4 months of age.

The sanitation system of raising and handling pigs saves time and feed. The method is a control measure against worms and a protection to the health of pigs. The following table shows the year, number, average age and weight of sanitation pigs when sold for slaughter.

Year	Number	Average age	Weight
1926	175	9 months 1 day	192 lbs
1927	1204	9 months 21 days	182 lbs
1928	655	10 months 11 days	172 lbs
1929	723	7 months 6 days	177 lbs
1930	None marketed		

In order to secure more accuracy in conducting the experimental tests with sanitation methods 8 check herds were used for comparative data with the sanitation herds. Pigs in the check herds were raised with no attention to sanitation.

Results of work with check herds from 1926 to 1930 are shown from year to year in the tables following:

Table 6.--Check pigs 1926.

Number of farms-----	3
Number of sows-----	16
Number of pigs farrowed-----	97
Number of pigs to pasture-----	88
Number of pigs lost on pasture from accident-----	6
Number of pigs lost on pasture from disease-----	27
Number of pigs marketed-----	41
Number of pigs kept on farms-----	3
Number of pigs showing no record of sale-----	11

Laboratory record of the examination of
feces for worm eggs.

Number of fecal examinations made-----	7
Number and kind of worm eggs found:	
Roundworm-----	385
Stomach worm-----	86
Nodular worm-----	7
Whip worm-----	1

Additional information derived from Table 6
shown in percentages.

Number of pigs lost at farrowing time-----	9
Percentage of pigs lost at farrowing time-----	9.2
Percentage of pigs saved at farrowing time-----	90.7
Percentage of pigs lost from accident and disease----	34.
Percentage of pigs farrowed, raised and marketed----	56.7

The average age of the pigs when marketed was 11 months. The average weight was 187 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	41
Number of pigs examined postmortem at time of slaughter(3 examined on farms)-----	44
Number of livers normal-----	5
Number of livers parasitic-----	35
Identity of 4 livers lost-----	
Number of carcasses free of kidney worms-----	29
Number of carcasses infested with kidney worms-----	15
Percentage of livers normal-----	11.3
Percentage of livers parasitic (4 lost)-----	79.5
Percentage of carcasses free of kidney worms-----	65.9
Percentage of carcasses infested with kidney worms---	34.

Eleven out of the 44 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms found and their location were as follows:

Kind	Number	Location
Roundworms	37	Small intestines
Nodular worms	452	Large intestines
Lung worms	slight to extensive	Lungs
Thornhead worms	43	Small intestines
Stomach worms	slight to extensive	Stomach

In the 11 pigs examined 6 were found free and 5 infested with the roundworm (*Ascaris suum*).

Table 7.-Check pigs 1927.

Number of farms-----	5
Number of sows-----	65
Number of pigs farrowed-----	383
Number of pigs to pasture-----	351
Number of pigs on pasture lost from accident-----	17
Number of pigs on pasture lost from disease-----	104
Number of pigs marketed-----	230
Number of pigs kept on farms-----	none
Number of pigs showing no record of sale-----	none

Laboratory record of the examination of
feces for worm eggs.

Number of fecal examinations made-----	29
Number and kind of worm eggs found:	
Roundworm-----	352
Nodular worm-----	7
Stomach worm-----	4

Additional information derived from Table 7
shown in percentages.

Number of pigs lost at farrowing time-----	32
Percentage of pigs lost at farrowing time-----	8.3
Percentage of pigs lost from accident and disease	31.6
Percentage of pigs farrowed, raised and marketed-	60.

The average age of the pigs when marketed was 10 months and
14 days. The average weight was 187. pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	230
Number of pigs examined postmortem at time of slaughter-----	183
Number of livers normal-----	15
Number of livers parasitic-----	168
Number of carcasses free of kidney worms-----	111
Number of carcasses infested with kidney worms---	67
Number of carcasses identity lost-----5	
Percentage of livers normal-----	8.1
Percentage of livers parasitic-----	91.8
Percentage of carcasses free of kidney worms-----	60.6
Percentage of carcasses infested with kidney works	36.6

Fifty three out of the 183 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms found and their location were as follows:

Kind	Number	Location
Roundworms	92	Small intestines
Nodular worms	241	Large intestines
Lung worms	slight to extensive	Lungs
Stomach worms	slight	Stomach
Thornhead worms	489	Small intestines
Hook worms	2	Small intestines

In the 53 pigs examined 6 were free and 47 infested with the roundworm (*Ascaris suum*).

Table 8.--Check pigs 1928.

Number of farms-----	6
Number of sows-----	40
Number of pigs farrowed-----	281
Number of pigs to pasture-----	251
Number of pigs lost on pasture from accident-----	13
Number of pigs lost on pasture from disease-----	73
Number of pigs marketed-----	165
Number of pigs kept on farms-----	none
Number of pigs showing no record of sale-----	none

Laboratory record of the examination of feces for worm eggs.

Number of fecal examinations made-----	22
Number and kind of eggs found:	
Roundworm-----	297
Stomach worm-----	14
Thornhead-----	2
Nodular worm-----	16
Strongyloides-----	11

Additional information derived from Table 8 shown in percentages.

Number of pigs lost at farrowing time-----	30
Percentage of pigs lost at farrowing time-----	10.6
Percentage of pigs lost from accident and disease	30.6
Percentage of pigs farrowed, raised and marketed-	58.7

The average age of the pigs when marketed was 11 months and 12 days.

The average weight was 186 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	165
Number of pigs examined postmortem at time of slaughter-----	110
Number of livers normal-----	none
Number of livers parasitic-----	110
Number of carcasses free of kidney worms-----	26
Number of carcasses infested with kidney worms-----	84
Percentage of livers normal-----	none
Percentage of livers parasitic-----	100.
Percentage of carcasses free of kidney worms-----	23.6
Percentage of carcasses infested with kidney worms---	76.3

Sixteen out of the 110 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms found, their number and location were as follows:

Kind	Number	Location
Roundworms	65	Small intestines
Lung worms	slight to extensive	Lungs
Thornhead worms	55	Small intestines
Whip worms	6	Large intestines
Strongyloides	30	Small intestines

In the 16 pigs examined 1 was free and 15 infested with the roundworm (*Ascaris suum*).

Table 9.--Check pigs 1929.

Number of farms-----	6
Number of sows-----	56
Number of pigs farrowed-----	433
Number of pigs to pasture-----	358
Number of pigs lost on pasture from accident-----	9
Number of pigs lost on pasture from disease-----	9
Number of pigs marketed-----	175
Number of pigs kept on farms-----	165

Laboratory record of the examination of feces for worm eggs.

Number of fecal examinations made-----	17
Number and kind of eggs found:	
Roundworm-----	169
Nodular worm-----	1
Stomach worm-----	14
Thornhead worm-----	1

Additional information derived from Table 9
shown in percentages.

Number of pigs lost at farrowing time-----	75
Percentage of pigs lost at farrowing time-----	17.3
Percentage of pigs lost from accident and disease-----	4.1
Percentage of pigs farrowed, raised and marketed-----	78.5

The average age of the pigs when marketed was 9 months and
22 days. The average weight was 171 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	175
Number of pigs examined postmortem at time of slaughter-----	108
Number of livers normal-----	5
Number of livers parasitic-----	103
Number of carcasses free of kidney worms-----	46
Number of carcasses infested with kidney worms-----	55
Number of carcasses identity lost--7	
Percentage of livers normal-----	4.6
Percentage of livers parasitic-----	95.3
Percentage of carcasses free of kidney worms-----	42.5
Percentage of carcasses infested with kidney worms----	50.9

Thirty one out of the 108 pigs slaughtered were further ex-
amined for intestinal and other internal parasites. The kind of
worms found, their number and location were as follows:

Kind	Number	Location
Roundworms	158	Small intestines
Thornhead worms	16	Small intestines
Stomach worms	slight	Stomach
Nodular worms	slight to extensive	Large intestines
Lung worms	slight to extensive	Lungs
Hook worms	2	Small intestines

In the 31 pigs examined 6 were free and 25 infested with the
roundworm (*Ascaris suum*).

Table 10.-Check pigs 1930

Number of farms-----	5
Number of sows-----	20
Number of pigs farrowed-----	170
Number of pigs to pasture-----	136
Number of pigs lost on pasture from accident-----	none
Number of pigs lost on pasture from disease-----	none
Number of pigs marketed-----	none
Number of pigs remaining on farms-----	136

Laboratory record of the examination of feces for worm eggs.

Number of fecal examinations made-----	5
Number and kind of eggs found:	
Roundworm-----	98
Stomach worm-----	5

Additional information derived from Table 10 shown in percentages.

Number of pigs lost at farrowing time-----	34
Percentage of pigs lost at farrowing time-----	20.
Percentage of pigs lost from accident and disease---	none
Percentage of pigs remaining on farms-----	80.

During the period covered by the foregoing check pig tables, 197 sows farrowed 1364 pigs. 180 of the check pigs were lost at time of farrowing. The percentage lost being 13.1

The losses were due to such causes as overlying, chilling, born weak and still-born. After charging off the losses at farrowing time the check pig farmers had a prospect of raising 1184 pigs. However, before the pigs reached the age for marketing 258 of them were lost from accident and disease.

The cause of losses from accident and disease was due to being crippled by older hogs, overlaid, etc. The losses due to disease was bowel troubles, parasites, pneumonia and cholera. The losses in check pigs from accident and disease was 18.9 per cent, and at

farrowing time 13.1 per cent, making a total loss of 32.1 per cent of the pigs farrowed.

The 8 farmers that raised pigs without any attention to sanitation, and cooperated in allowing the use of their herds as checks were able to raise and market 67.9 per cent of the pigs farrowed. The following table shows the percentage of check pigs by years that were saved, raised or marketed.

Year	Percentage
1926-----	56.7
1927-----	60.
1928-----	58.7
1929-----	78.5
1930-----	80.

Fecal specimens were frequently collected from the check herds and examined for worm eggs. The postmortem findings at time of slaughter were noted and recorded.

Since the McLean County System of Swine Sanitation is primarily based on the behavior of the roundworm (*Ascaris suum*) of young pigs the following data applies to this parasite only:

Year.	Number of examinations.	Number of roundworm eggs.
1926-----	7-----	385
1927-----	29-----	352
1928-----	22-----	297
1929-----	17-----	169
1930-----	5-----	98
Total---	80-----	1301

The specimens collected were composite and represented 10 pigs. The examination of feces begun when the pigs were 45 to 60 days of age.

The number of roundworms (*Ascaris suum*) found on postmortem examination of check pigs at time of slaughter were as follows:

Year.	Number of pigs.	Number of pigs free.	Number of pigs infested.
1926-----	11-----	6-----	5
1927-----	53-----	6-----	47
1928-----	16-----	1-----	15
1929-----	31-----	6-----	25
Total-----	111-----	19-----	92

Percentage of check pigs examined at time of slaughter free of roundworms-----	17.1
Percentage of check pigs found infested with roundworm at time of slaughter-----	82.8

The number of roundworms found ranged in number from 2 or 3 to as high as 35 worms in a single pig. The 111 check pigs examined for roundworms at time of slaughter were out of a total of 445 pigs. The average age of the 111 pigs was 10 months and 16 days. The average live weight was 182 pounds per head. None of the pigs examined were under four months of age.

The following table shows the annual number, average age, and live weight of check pigs marketed and slaughtered.

Year.	Number.	Average age.	Average live weight.
1926-----	41-----	11 months-----	187 lbs.
1927-----	230-----	110 months 14 days-----	187 lbs.
1928-----	165-----	11 months 12 days-----	186 lbs.
1929-----	175-----	9 months 22 days-----	171 lbs.
1930-----	none marketed.		

The average age of the 611 check pigs marketed and slaughtered was 10 months and 16 days. The average weight was 182 pounds per head.

General Summary, Sanitation Pigs from
Fall of 1926 to Spring of 1930.

In 4 years, on 32 different farms, 772 sows farrowed pigs of which 5006 were placed on pasture, making an average of 6.48 pigs per litter which survived the farrowing period and reached the pasture. If losses from accidents and diseases, including cholera are not considered the sanitation system was 100 per cent effective in protecting pigs from disease and making it possible to market them or hold them for any purpose desired.

Postmortem findings in sanitary pigs examined at time of slaughter were as follows:

Number of pigs examined-----	1747
Number of pigs in which the liver was normal-----	428
Number of pigs in which the liver was parasitic (5 lost)-----	1314
Percentage of livers normal-----	24.4
Percentage of livers parasitic-----	75.2
Number of carcasses free of kidney worms worms-----	1170
Number of carcasses infested with kidney worms--(22 lost)-----	555
Percentage of carcasses free of kidney worms-----	66.9
Percentage of carcasses infested with kidney worms-----	31.7

Sanitary pigs were further examined at time of slaughter for the presence of roundworms.

Number of pigs examined-----	481
Number of pigs free-----	114
Number of pigs infested-----	367
Percentage of pigs free-----	23.7
Percentage of pigs infested-----	76.2

General Summary, Check Pigs from
Fall of 1926 to Spring of 1930.

In 4 years, on eight different check pig farms 199 sows farrowed pigs of which 1184 were handled on the farm, making an average of 5.9 pigs per litter that survived the farrowing period. The check pigs were handled without any attention to sanitation.

Postmortem findings in check pigs examined at time of slaughter were as follows:

Number of check pigs examined-----	445
Number of livers normal----- (4 lost)-----	25
Number of livers parasitic-----	416
Percentage of livers normal-----	5.6
Percentage of livers parasitic-----	93.4
Number of carcasses free of kidney worms-----	212
Number of carcasses infested with kidney worms	221
Percentage of carcasses free (12 carcasses lost)	47.6
Percentage of carcasses infested-----	49.6

Check pigs were further examined at time of slaughter for the presence of roundworms.

Number of pigs examined-----	111
Number of pigs free-----	19
Number of pigs infested-----	92
Percentage of pigs free-----	17.1
Percentage of pigs infested-----	82.8

The experimental tests of the system of swine sanitation were conducted on the 32 farms by cooperation of the swine owner. It could hardly be expected that each of them could be induced to carry out the system of sanitation in detail, even under the immediate supervision of the writers, therefore, it was necessary to classify the work of each farmer as "excellent", "good" and "fair". By "excellent" is meant the farmer carried out all the essential details of the system of swine sanitation. By "good" is meant those that started out with part of the important details, failing later with the work. By "fair" is meant those who neglected most

of the important details of the work. One cooperater is classed as "excellent", 6 as "good" and 25 as "fair".

The work of the cooperater classed as "excellent", from the fall of 1926 to the spring of 1930, is reported in detail as follows:

Number of sows-----	58
Number of pigs farrowed-----	502
Number of pigs to pasture-----	420
Number of pigs lost on pasture from accident--	12
Number of pigs lost on pasture from disease--	18
Number of pigs marketed-----	302
Number of pigs kept on farms-----	16
Number of pigs still on farm-----	72

Laboratory record of examination of feces for worm eggs.

Number of fecal examinations made-----	65
Number and kind of eggs found:	
Roundworm-----	8591
Nodular worm-----	35
Stomach worm-----	50
Thornhead worm-----	1
Strongyloides-----	5

Two pigs of the herd after weaning them escaped to the feeding pens and pasture of an adjoining farm. The premises had long been used by pigs. The two pigs remained on the worm-infested premises for two days.

The writers soon noticed that the two pigs were not doing well, and did not compare with the thrifty condition of the herd. The animals were isolated and individual fecal examinations made which revealed 8027 roundworm eggs. Anthelmintics were administered. Roundworms were noticed to be passing with the bowel movements.

Four or five days after the anthelmintic had been administered to each pig fecal examinations were resumed and showed negative. The two pigs were then returned to the farm and placed with the

herd. It was noticed that the two pigs failed to do as well on the same feed as the rest of the pigs in the herd. This instance explains the high number of roundworm eggs reported in the herd handled by the cooperator classes as "excellent".

Additional information derived from the farmer classed as "excellent".

Number of pigs lost at time of farrowing-----	82
Percentage of pigs lost at time of farrowing-----	16.3
Percentage of pigs saved at time of farrowing-----	83.7
Percentage of pigs lost from accident and disease----	22.3
Percentage of pigs farrowed, raised and marketed-----	77.6

The average age of the pigs when marketed for slaughter was 6 months and 2 days. The average weight was 185.7 pounds per head.

Postmortem findings at time of slaughter.

Number of pigs marketed-----	302
Number of pigs examined postmortem at time of slaughter-----	214
Number of livers normal-----	86
Number of livers parasitic (2 livers lost)-----	126
Number of carcasses free of kidney worms-----	199
Number of carcasses infested with kidney worms-----	15
Percentage of livers normal-----	40.1
Percentage of livers parasitic (2 livers lost)-----	58.8
Percentage of carcasses free of kidney worms-----	93.
Percentage of carcasses infested with kidney worms---	7.

110 out of the 214 pigs slaughtered were further examined for intestinal and other internal parasites. The kind of worms, number and their location were as follows:

Kind	Number	Location
Roundworms	540	Small intestines
Lung worms	326	Lungs
Stomach worms	20	Stomach
Nodular worms	78	Large intestines
Thornhead worms	20	Small intestines
Whip worms	85	Large intestines
Strongyloides	slight	Small intestines (1 pig)

In the 110 pigs examined 35 of them were free of all worms, except one that showed 1 thornhead worm only. The remaining 75 pigs showed roundworm (*Ascaris suum*) infestation.

During the period covered by the cooperator classed as "excellent" 58 sows farrowed 502 pigs. 82 of which were lost at time of farrowing, a loss of 16.3 per cent. The cause of losses at time of farrowing were overlying, still-born, immaturity and strangulation. In the pasture the cause of losses from accidents were trampled by the sows and overlain. The losses from disease were cholera from using serum alone and not revaccinating in time; digestive disturbance, infection from castration and pneumonia. The loss ^{from} accidents and disease was 5.9 per cent, a total loss of 22.3 per cent of the pigs farrowed. This cooperator was able to market and save 77.6 per cent of the pigs farrowed. From the pasture, if the losses from accidents and disease are ^{not} considered, 92.8 per cent of the pigs placed on pasture were raised and marketed.

The following table will better show the value of the work done by the cooperator classed as "excellent".

Year	Percentage
1926	91.6
1927	81.4
1928	96.2
1929	98.6
1930	93.5

The above percentages represent the pigs that went to pasture that were marketed and saved.

From the fall of 1926 to the spring of 1930 the sanitation cooperator classed as "excellent", with 58 sows saved and marketed 6.7 pigs per litter. The check pig cooperators during the same period with 197 sows saved and marketed 4.2 pigs per litter.

Sanitation methods made it possible to save and market approximately as many pigs from 2 sows as the check farmers raised and marketed from 3 sows.

The 32 cooperators in sanitation work from the fall of 1926 to the spring of 1930, with 772 sows saved and marketed 5.8 pigs per litter, a net gain over the check farmer of 1.6 pigs per litter. The 32 cooperators in sanitation work raised and marketed approximately as many pigs from 3 sows as the check farmers raised and marketed from 4 sows.

The use of the sanitation system of raising pigs is for the purpose of controlling the roundworm including other internal parasites that do serious injury to young pigs. Filth-borne conditions in young pigs exposed to premises long used by hogs are largely avoided by the use of the sanitation method of raising pigs.

The sanitation system is simple in principle and practical in its application to the farm. The sanitation system is economical, because fewer sows are required to raise the same number of pigs. Sanitation pigs may be marketed at an earlier age, thus saving time and feed in producing the same amount of pork on the farm.

Definition of terms used: By livers normal is meant that the liver was healthy and wholesome in appearance, and apparently free of parasites; By livers parasitic is meant that the kidney worm was present in the liver or the organ had been invaded by this parasite, thus leaving scars and frequently abscesses in the liver; By carcasses free of kidney worms is meant that the kidneys, kidney fat and loin meat was free of parasites, normal and healthy in appear-

ence; By carcasses infested with kidney worms is meant that kidney worms were found in the kidneys, kidney fat and frequently in the loin meat, causing these otherwise edible products to be condemned under the U. S. meat inspection regulations.

Summary and Comparative Results.

These experimental tests of raising pigs under the sanitation system for the control of roundworms and some other harmful parasites of pigs, indicate that sanitation methods are effective under climatic conditions in Colquitt County, Georgia.

In 481 sanitation pigs examined at time of slaughter for roundworms, 114 were found free and 367 infested. The percentage of pigs found free was 23.7 and the percentage found infested was 76.2.

In 111 check pigs raised without any attention to sanitation that were examined at time of slaughter for roundworms, 19 of the pigs were found free and 92 infested with roundworms. The percentage of check pigs found free was 17.1 and the percentage found infested was 82.8.

The sanitation pigs had less roundworm infestation than the check pigs by 6.6 per cent.

In 1747 sanitary pigs examined at the time of slaughter, 428 pigs showed normal livers, and 1314 showed parasitic livers. The percentage of livers that were normal was 24.4 and the percentage of livers parasitic was 75.2

The carcasses of 1747 sanitary pigs examined at time of slaughter showed 1170 free and 555 infested with kidney worms. The percentage of carcasses free of kidney worms was 66.9 and the percentage infested was 31.7.

In 445 check pigs raised without any attention to sanitation examined at time of slaughter 25 of them showed normal, and 416 showed parasitic livers. The percentage of check pigs showing normal livers was 5.6 and the percentage showing parasitic livers was 93.4. Identity of 4 livers lost.

The carcasses of 433 check pigs raised without any attention to sanitation showed 212 pigs free of kidney worms at time of slaughter, and 221 infested with kidney worms. The percentage of check pig carcasses free was 47.6, and the percentage infested with kidney worms was 49.6. Identity of 12 carcasses lost.

The sanitation pigs had less parasitic livers than the check pigs by 18.8 per cent, and less kidney worm infestation in the carcass by 19.3 per cent.

The examination of 481 sanitary pigs at time of slaughter for thornhead worms 219 of these parasites were found. This finding shows that the sanitation pigs had an average of less than one half thornhead worm to each pig.

In 111 check pigs that had been raised without any attention to sanitation, examined at the time of slaughter 603 thornhead worms were found. The check pigs had an approximate average of 5 and one-half thornhead worms to each pig. The check pigs had approximately 11 times more thornhead worm infestation per pig than the sanitation pigs.

In 481 sanitary pigs examined at time of slaughter 2184 nodular worms were found, an average of 4 and one half nodular worms to each sanitation pig.

In 111 check pigs raised without any attention to sanitation

1293 nodular worms were found at time of slaughter, an average of 11.6 nodular worms to each check pig. The check pigs had almost three times more nodular worms than the sanitation pigs.

The average age of the sanitation pigs when marketed was 9 months and 5 days. The average live weight was 179 pounds per head.

The average age of the check pigs when marketed was 10 months and 16 days. The average live weight was 182 pounds per head.

The sanitation farmer had his pigs ready for market 41 days earlier than the check farmer. A 41 day feed bill was saved.

The sanitation cooperator classed as "excellent" in carrying out the sanitation system, marketed his pigs at an average age of 6 months and 2 days, and the average live weight was 185.7 pounds per head. The growing and feeding period was 4 months and 8 days less than the check pig farmer, and the weight was 3.7 more pounds per head.

Conclusions.

The Swine Sanitation System designed to control roundworms of young pigs in the Middle West is suitable and applicable to conditions in the South. The system is effective in the control of roundworms and in reducing kidney worm, thornhead worm and nodular worm infestation.

The sanitation system of raising hogs, if faithfully carried out enables the farmer to raise as many pigs from 2 sows as is raised and marketed from 3 sows where no attention is paid to sanitation.