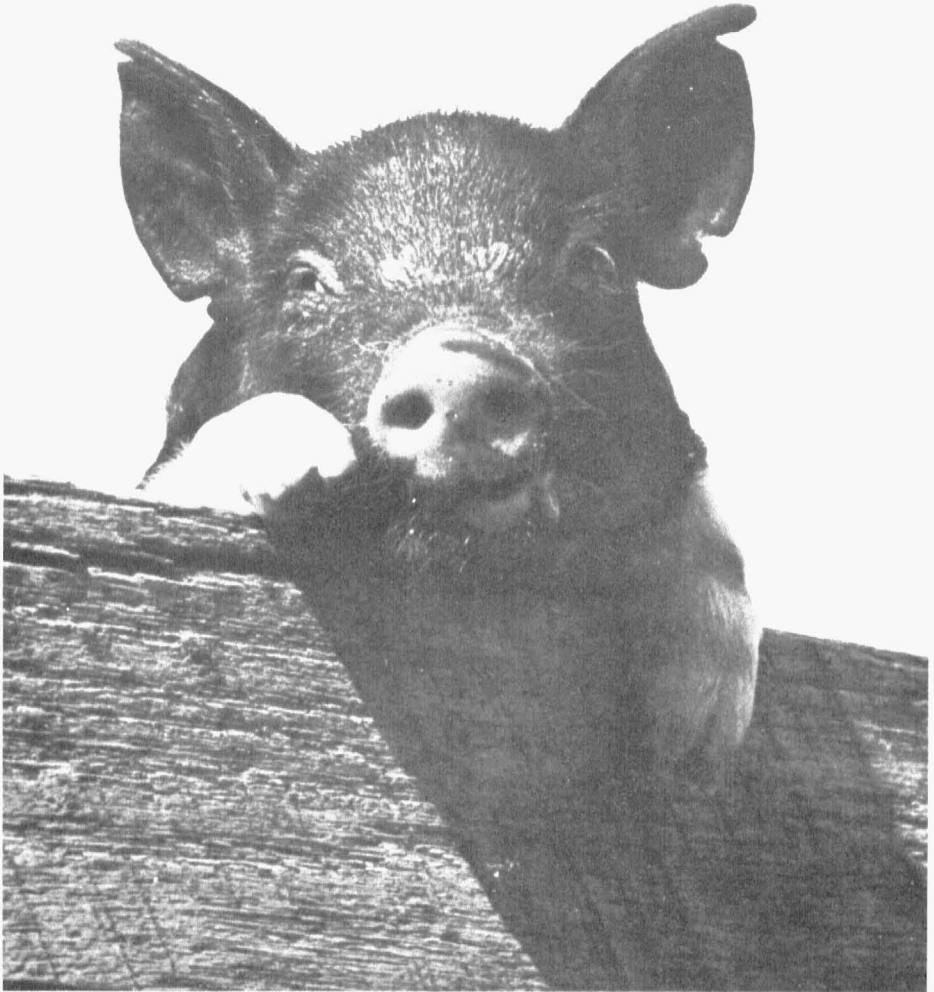


Pork Production in Missouri

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The sale of hogs is an important source of income for Missouri farmers. United States Department of Agriculture figures for the 10-year period from 1939 to 1948 show that an average of 5,833,000 pigs each year were raised to market age in this state. Another interesting fact about pork production in Missouri is that hogs are produced on more than two-thirds of all farms, and they have contributed from 20 to 29 per cent of the total cash income since 1924. Of the total farm income from livestock during the period from 1940 to 1944, about 31 per cent was derived from the sale of hogs. Since hogs contribute so much to the income of Missouri farmers, it is evident that any improvement in the efficiency of swine production will bring added profit to the farmers of this state.

The main reasons for growing hogs in Missouri are for a cash income or for pork products to be consumed in the home. When hogs are grown for the latter purpose, the number involved is usually small and not so much attention is paid to rate and economy of gains or market prices. In fact, hogs for farm meats may be fed refuse from the kitchen table and may be allowed to forage for much of their food.

Where hogs are produced in large numbers for a cash income on the farm, more careful attention is paid to those factors which affect the final profit from the market animal. For this reason, the commercial pork producer must strive to produce the market animal with a minimum of feed and labor. He must also pay attention to seasonal market trends. Should he fail to do this, he may lose 4 to 5 cents or even more per pound if his hogs are sold when prices are at the usual seasonal low level.

A number of factors, including selection of breeding stock and the system of breeding which is followed, may affect profits. Other important factors are feeding, management, and the control of disease and parasites.

SELECTION OF BREEDING STOCK

Careful attention should be paid to the selection of animals for the breeding herd. The herd from which these animals are obtained should have an outstanding production record. Young boars and gilts

This bulletin reports on Department of Animal Husbandry projects: No. 1, "Swine Vitamins"; No. 36, "Pork Carcass Factors"; No. 38, "Animal Reproduction"; No. 39, "Swine Improvement"; and No. 101, "Food Utilization." It also reports on unnumbered early studies in swine breeding, swine management, and swine feeding.

for the breeding herd should be selected from sows which have produced large litters of healthy, fast-growing pigs. This is an indication that the sow is prolific, a good milker, a good mother and that the pigs should make rapid and efficient gains. These are inherited characteristics which are passed from parents to offspring.

Both boars and gilts should possess at least 12 prominent, normally spaced nipples free from defects of any kind. Almost always the number of pigs a sow weans is no greater than the number of functional nipples she possesses. Since the gilts inherit one-half of any character-



FIG. 1. The number of pigs weaned is governed by the number of active nipples a sow has. In selecting gilts those with inverted or blind nipples should be discarded because it is an inherited characteristic.

istic from their sire and one-half from their dam, it is important that the boar as well as the sow should possess the proper number of normal nipples especially when some of his daughters may be kept in the breeding herd.

The animals selected for the breeding herd also should be picked to conform to present type standards. The meat type hog is popular at the present time because of the low price of lard on the market and the increased demand for lean cuts of meat. It is generally agreed that the middle-of-the-road type or one which is not too large and rangy nor too small, short and chuffy is the type to select and produce in the herd.

Breeds, and Starting With Purebreds

The purebred breeder, of course, must start a herd with purebred animals. The breed to select will depend on (1) the preference of the breeder, (2) the availability of breeding stock and (3) the popularity of the breed in the community. The breed must be popular in the community, for after all the purebred breeder must have a ready market for his surplus animals in order to make a success of the business. It has been said with much truth that no one breed is better than others because there are good as well as poor animals in all breeds. The important thing is to decide on the breed that is popular and adapted to local conditions, and then find the best producing strains within this breed for the breeding herd.

SYSTEMS OF BREEDING

The purebred breeder will naturally strive to produce the best animals possible by mating his most productive sows to a good herd sire of the same breed. Selection of the breeding animals on the basis of conformation, pedigree and performance are the tools for use in improving the purebred herd.



FIG. 2. Mastitis in sows may be due to infection of the udder or to improper care at weaning and farrowing time. Udders thus affected give little or no milk.

Crossbreeding refers to the mating of two pure breeds such as Durocs and Polands. For the commercial pork producer some advantage may be obtained from crossbreeding. Crossbred pigs usually gain faster, more of them survive to weaning and their feed requirement per unit of gain is lower than that of purebreds. Crossbred sows usually excel purebred sows in prolificacy, which is also an important factor to consider.

However, crossbreeding should be carried on in a systematic manner. In other words, only the best and most productive purebred lines within each breed should be used in the breeding herd. In addition, where crossbred gilts are mated to purebred boars of a third breed, both gilts and boars should be carefully selected for performance as is done with purebred animals.

CARE AND MANAGEMENT OF THE BREEDING HERD

The production of large, healthy litters of pigs at weaning is necessary for profitable pork production. This is true because it costs little more, or no more, to maintain a sow in the breeding herd which weans 8 to 10 large, healthy pigs than it does to maintain one that weans a fraction of this number. Thus, when large litters are produced, much less feed is chargeable against each pig at birth or at weaning than when small litters are produced. This is demonstrated by the data summarized in Table 1 which is calculated from records kept at the Missouri Agricultural Experiment Station on 48 sows and their litters.

TABLE 1 -- THE RELATIONSHIP BETWEEN LITTER SIZE AND FEED REQUIRED PER PIG AT BIRTH AND WEANING.

Number of pigs per litter	Feed per pig at birth*	Feed per pig at weaning*	Cost of feed per pig at weaning
2	342	686	\$22.64
4	171	343	\$11.32
6	114	229	\$ 7.56
8	86	172	\$ 5.68
10	68	137	\$ 4.52

*Not considering gains or losses of sows during this period. Feed costs were figured at \$3.30 per cwt.

Large, healthy pigs also seem to be less affected by adverse conditions such as disease, parasites and vaccination. Almost invariably the heavier and thriftier pigs at weaning reach market weight sooner than do the lighter, less thrifty pigs. This is demonstrated by data summarized in Table 2.

The production of large, healthy litters does not begin with the sow and litter at farrowing time, but it begins even before the sow

TABLE 2 -- THE INFLUENCE OF SIZE OF PIGS AT WEANING UPON THE TIME REQUIRED TO PRODUCE MARKET HOGS AT 225 POUNDS WEIGHT.

Weaning weight groups	Number of pigs	Age when weight was 225 lbs.
15-20 lbs.	3	214 days
20-25 lbs.	6	209 days
25-30 lbs.	18	200 days
30-35 lbs.	32	192 days
35-40 lbs.	35	181 days
40-45 lbs.	20	176 days
45-50 lbs.	20	171 days
50-55 lbs.	7	160 days

From Missouri Bulletin 461.

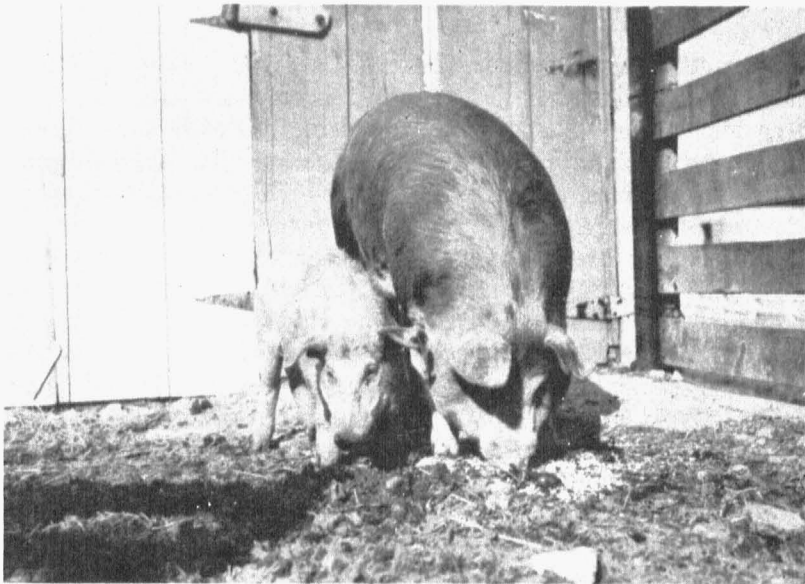


FIG. 3. These are pigs from the same litter fed under the same conditions. Size and thriftiness of entire litters as well as individual pigs should be considered when selecting breeding animals.

is bred. The care and management of both the sow and boar may affect litter size. It is necessary for the pork producer to recognize this fact and to care for his animals accordingly.

Care and Management of the Boar

The role of the boar in producing large litters is to furnish the male sex cells. These unite with the female sex cells at the time of mating to initiate the growth of the new individual pigs. In general, it is thought that fertile boars have little influence on litter size since they produce millions of viable spermatozoa at each mating for every egg

produced by the sow. However, some evidence is available which indicates that sows which are mated to boars of lowered fertility may produce smaller litters than those mated to fertile boars. This may be due to the failure of fertilization of some of the eggs or to an increased number of deaths of the pigs in the reproductive tract of the sow before farrowing time.

In addition to supplying the male sex cells which fertilize the eggs released by the sows, the boar also contributes one-half of the genetic make-up of the pigs. However, the influence of the boar does not fully express itself until after the pigs are weaned; it is overshadowed by the influence of the sow prior to that time. The genetic contribution of the boar is fully expressed when his sons and daughters are kept in the breeding herd.

A. Conditioning the Boar for the Breeding Season. The boar should be conditioned for the breeding season. This may be done by putting him on good pasture and increasing his daily feed allowance 2 to 3 weeks in advance of the breeding season. The boar also should be allowed plenty of exercise. Attention to these factors favors the production of a large number of viable spermatozoa.

B. Methods of Breeding. When the herd does not exceed 8 to 10 animals, the boar may be allowed to run with the sows during the breeding season. Such a system has the advantage of requiring little time and attention, sows are not missed when they come in heat and the boar takes plenty of exercise. The main disadvantage of this system, however, is that the time of mating is not always known. When sows farrow unexpectedly in the hog lots during cold weather in the early spring months, losses of baby pigs may be severe. The swine herdsman cannot always tell by observation when the sow will farrow, unless he has had considerable experience along this line, and even then he may not always guess correctly.

Hand breeding is a necessity when a large number of sows are to be bred to a single boar or when registered animals are involved and the date of breeding must be known. In practicing this system of mating, more time is required and the swine producer must know the signs of heat or estrus in sows in the herd. In general, the advantages of this system of breeding outweigh the disadvantages, and it can be used successfully in most large herds.

C. Number of Sows per Boar. Yearling and mature boars may perform 2 to 3 services per day during the breeding season. For best results, these services should be spaced so that there are a few hours of rest after each service.

Early spring pigs that are first used in the fall can usually breed 1 sow per day although occasionally they may breed 2. Young boars

sometimes refuse their food, rant and lose considerable flesh during the first breeding season. In such cases, they should be kept separate from the sows. Feeding the young boar with a barrow or a gilt that already has been bred will often stimulate his appetite and get him back on feed again.

Older boars should have their tusks removed each year before the breeding season. This may be done by placing a rope around the upper jaw back of the tusks and snubbing him to a post. Bolt cutters, hoof trimmers, or a hack saw are instruments suitable for doing this job. Attention to this detail may prevent serious injury to the herdsman for it is not unusual for grown boars to become irritable and to attack when the opportunity arises.

Patience and good judgment should be exercised in handling the breeding animals, for rough treatment may cause old boars to become vicious or young boars to become so timid that they will not mate readily during the breeding season.

The breeding crate may be used when large, mature boars are mated to smaller gilts, but usually the boar must be taught to use it. Although the use of the breeding crate requires more time it almost always guarantees a good service. Two bales of hay, one on either side of a gilt, may often serve as a satisfactory substitute for the breeding crate.

Care and Management of the Sow

The care and management of the sow is an important aspect of swine production. The sow not only controls litter size by the number of eggs she produces, but she also has a great influence on the pigs during two of their most critical periods of life. These critical periods are gestation, which lasts approximately 114 days, and lactation, which usually lasts another 56 days. In reality, then, the sow has an influence on the first 170 days of the pig's life, and the way she is cared for will influence the way the pigs perform.

A. Time To Breed. Whether the hog program calls for 1 or for 2 litters per year, it is always best to time the litters so they will reach market weight when prices are most favorable. (See Chart 1.) Late February and early March pigs that are full fed good rations on pasture during the summer months will usually reach the market in July, August and September when prices are at a seasonal peak. Fall pigs farrowed in August and September will usually reach the market in March and April when prices are also favorable. Attention to time of marketing is one of the most important aspects of swine production. During the past 5-year-period, from 1945 to 1950, there was a difference of \$8.90 to \$13.85 per hundredweight in the high and low prices for the year.

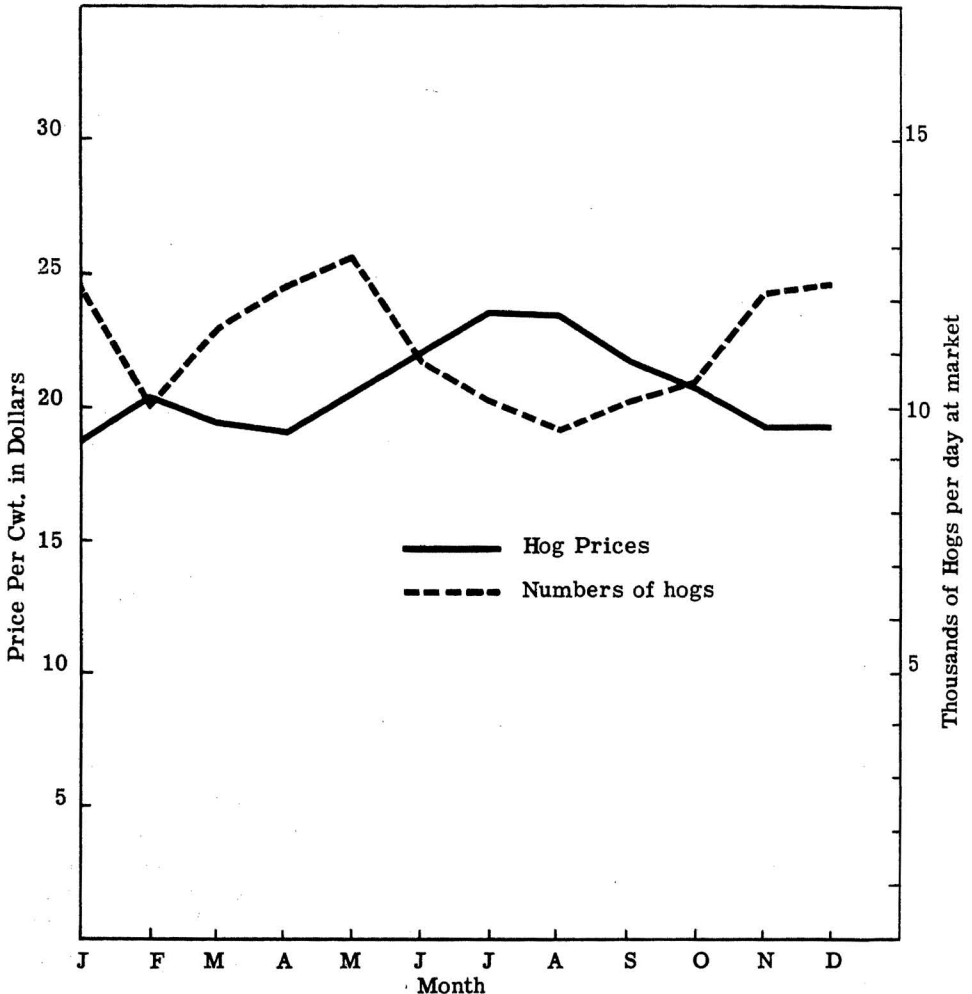


Chart 1. Average monthly receipts and top slaughter hog prices received at St. Louis during 1951-52.

B. The Heat Period (Estrus) in Swine. Well grown gilts will reach sexual maturity and come into heat for the first time between 5 and 6 months of age, although some may come into heat at an earlier age than this.

If gilts are old enough to come in heat and fail to do so, a number of factors may be responsible. In a few cases the gilt may come in heat and go out again without the herdsman noticing it or she may have been bred and the date not recorded. Other times, however, faulty nutrition may be involved. Gilts that are too fat or much too thin may fail to come in heat as readily as those in medium condition.

A few gilts which have failed to come in heat at the Missouri Experiment Station have been slaughtered and their reproductive tracts examined. Some of these animals have been found to possess "infantile" or underdeveloped reproductive tracts. Gilts with this defect would probably never come in heat during their life time, and it would be useless to keep them in the breeding herd.

Sows will often come in heat 3 or 4 days after the pigs are farrowed. Experimental evidence makes it doubtful if a large percentage of such animals would become pregnant if bred at that time because they usually do not ovulate, or release eggs from the ovary.

Sows will come in heat 3 or 4 days after the pigs are weaned unless they have been in heat while the pigs were nursing. The sow is usually bred at this time when 2 litters are produced each year. Sows can often be induced to come in heat while lactating if they are kept separate from the pigs for a few nights.

The average length of the heat period in gilts is between 40 and 45 hours, but may be close to 65 hours on the average in older sows. However, in individual cases there may be considerable variation from this average. If sows and gilts are not bred, or fail to conceive after being bred, they will come in heat again 18 to 24 days later.

C. The Gestation Period (Period of Pregnancy). The gestation period is the period of pregnancy or the interval between breeding and farrowing. Under normal conditions this period is about 114 days in length but may vary from 111 to 116 days.

D. Age To Breed Gilts. The age at which gilts should be bred will depend a great deal on their rate of growth and the time during the breeding season when they come in heat for the first time. It is generally agreed that gilts should weigh 200 pounds or be 7 to 8 months of age before they are bred. Data obtained at the Missouri Agricultural Experiment Station have shown that for each 10 days increase in age between 5½ to 9 months, 0.5 more pigs were found in the reproductive tract of gilts slaughtered 25 to 30 days after breeding. In other words, the older the gilts at breeding time the more pigs they should farrow. In some cases small gilts may be bred with good success, but under such conditions there is a greater possibility of their producing small and weak litters. They may also have difficulty at farrowing time.

E. Number of Eggs Produced by the Sow. The number of eggs produced by the sow at the time she is bred is a factor which controls litter size. For example, a sow which sheds only 4 eggs during the heat period cannot possibly farrow more than 4 pigs unless she produces identical twins, and this rarely happens. Individual sows of the same breeding and even from the same litter vary considerably

in the number of eggs they produce. Even the same sow may vary from one litter to the next in this respect. Experiments at the Missouri Agricultural Experiment Station in which sows and gilts were slaughtered shortly after they were in heat indicate that mature sows produce an average of 15.3 eggs as compared to 11.5 for gilts. Since the number of eggs produced also may be influenced by inheritance, only gilts from sows which have constantly produced large litters should be kept for the breeding herd.

F. Flushing the Sow. The practice of "flushing," or feeding the sow heavily to have her in a gaining condition at breeding time, is thought to increase the number of eggs she produces. There are times, however, when "flushing" might be impractical. It would probably be impractical to flush the sow and wean the pigs at the same time, for damage to the udder and teats of the sow could result from increased milk production when the pigs are weaned. Some pork producers, however, are of the opinion that merely stopping the milk flow by the removal of the pigs is similar to "flushing" because the sow will use the nutrients that had been used for milk production for increased gains after the pigs are weaned.

G. Number of Matings During the Heat Period. Two matings at intervals of 12 hours or more may increase the percentage of sows and gilts that settle during the first heat period. Experiments at the Missouri Experiment Station have shown that only 65.7 per cent of 79 sows mated once during the heat period became pregnant as compared to 85.1 per cent in another group of 82 sows which were mated twice at intervals of 12 to 24 hours. This was a difference of almost 20 per cent.

Other experiments showed that 0.7 to 1.9 more pigs were produced per litter when sows were mated twice. If the boar is being used heavily and each sow cannot be mated twice, it would probably be best to breed the sow on the second day of heat which is nearer to the time that the eggs are released from the ovary. Proper timing is important because the life of both male and female sex cells in the reproductive tract of the sow is very short.

H. Embryonic Death Losses. Experimental work at several of the experiment stations indicate that as many as 35 to 40 per cent of the eggs ovulated by the sow may fail to produce pigs at farrowing time. A number of factors probably are responsible for these losses although the causes are not definitely known. It is probable that proper nutrition of the sow during pregnancy will help reduce some of the prenatal death losses in pigs.

I. Feeding the Pregnant Sow. Proper feeding of the sow during the period of pregnancy influences the size and vigor of the pigs at

birth. The kind of feed is just as important as the amount. Care should be taken to supply feed which contains sufficient amounts of good quality protein, minerals, and vitamins (See page 24.)

The amount of feed should be controlled so that sows or gilts do not become too fat during the gestation period. Extremes in condition should be avoided. Mature sows should gain approximately 75 to 100 pounds and gilts 100-125 pounds during the period of pregnancy. The sow's feed allowance should be increased by one or two pounds per day during the latter one-third of pregnancy because the unborn pigs make most of their growth during that time. It is also possible that proper feeding is just as important during the first 25 to 30 days of pregnancy to prevent some of the large embryonic death losses during this part of gestation.

Care of the Sow and Litter

In general, getting the sow to farrow large litters is not as difficult a problem as saving the pigs that are actually farrowed. This is demonstrated by the fact that from 30 to 35 per cent of the pigs which are farrowed die before they reach weaning age. After weaning, another 5 to 10 per cent of the pigs are lost so that on the average only 6 out of every 10 pigs which are farrowed survive to market age. Records kept since 1924 by the U. S. D. A., however, show that the number of pigs saved per litter on farms in the United States has increased from slightly over 5 to about 6.5. Fall litters have almost always been larger than spring litters, which is probably due to better weather during the farrowing season and to the availability of pasture in the ration of the sow during the summer months. When compared to other states in the corn belt, Missouri ranks slightly above average in the number of pigs saved per litter. The yearly average usually runs from 6.5 to 6.7 pigs per litter saved on Missouri farms.

Death losses in pigs after farrowing are often due to causes that can be prevented by proper attention at that time. However, some of these losses cannot be prevented. Some of the most efficient swine producers in the state consistently wean 8 to 9 pigs per litter in their herds, and death losses from birth to market weight are only 10 to 15 per cent.

It has been reported that death losses in pigs after farrowing waste about one-seventh of all feed that is fed to hogs. If a pig dies at birth, it is usually considered that 140 pounds of feed is lost. This represents each pig's share of the feed eaten by the sow during the gestation period. If the pig dies at 8 to 10 weeks of age, about 260 pounds of feed is lost. There is no doubt, then, that the prevention of baby pig losses is necessary for profitable pork production.

Various experiment stations have shown that 90 per cent of the total baby pig losses occur within the first 3 days after farrowing. As a general rule, one-third of the pigs are lost the day they are farrowed, one-third the second day after birth, and the other one-third in decreasing proportion as the pigs become older.

Some Causes of Death Losses in Baby Pigs. A number of factors are responsible for death losses in baby pigs. About 15 per cent of the pigs farrowed are crushed or overlaid by the sow. Many pigs are crushed because sows are restless and nervous at farrowing time. The proper feeding of the sow before farrowing should help reduce the losses of this nature because well-fed sows produce stronger and healthier pigs. Attention to the disposition of the gilts when they are selected for the breeding herd should be helpful.

Many of the losses by crushing may be prevented by placing guard rails in the farrowing pen and by bedding the pens with small amounts of straw or other material. Care should be taken not to put too much bedding in the pen or the pigs may burrow beneath it where they cannot be seen by the sow. Pig brooders attract the pigs away from the sow especially during cold weather and there is less danger of their being crushed when brooders are used. Farrowing crates or stalls also have been reported to reduce losses in baby pigs from crushing.

A second important loss of pigs results whenever any are born dead. This may be due to the fact that the litters are too large or certain diseases may be present in the reproductive tract of the sow. Possibly improper feeding of the sow during the gestation period also is responsible for such losses.

Chilling of the pigs has been shown to be responsible for about 3 per cent of the death losses after farrowing. This can be prevented by proper care and attention during the farrowing season and the use of pig brooders in the farrowing pens when the weather is cold.

A certain percentage of baby pigs are starved or are very weak at birth; they often soon die from the lack of nourishment. Starvation of pigs often is due to the fact that the sow is a poor milker which may be an inherited characteristic. Proper selection of sows for the breeding herd will help eliminate inherited difficulties of this kind. Pigs often starve because there are too many pigs for the number of nipples the sow possesses. In such cases it might be well to move part of the litter to another sow which has farrowed about the same time.

A small percentage of pigs are eaten by the sow at farrowing time. A sow eats her pigs because she has a craving for flesh and certain bone forming elements. Such losses usually can be prevented by feeding plenty of protein and minerals and well-balanced rations during

the gestation period. The dead pigs and after-birth also should be removed from the pen as soon as possible after the sow has completed farrowing. This helps prevent the sow from tasting flesh so that she is less likely to develop the flesh-eating habit. When a sow begins to eat her pigs it is best to send her to market, for once the habit has been established it seems to persist from one litter to the next.

Other factors are known to cause death losses in baby pigs. Some losses are caused by scours, sour mouth, thumps, and worms. Usually these can be controlled or prevented by following a strict swine sanitation program.

Preparations for Farrowing

Cleaning the Farrowing Pen. Several days in advance of the farrowing season, all farrowing pens should be inspected to see that the guard rails are in place and that the brooders or heat lamps are adjusted and ready for use in cold weather. Each pen should be thoroughly cleaned and disinfected. Scrubbing the pens with a solution of boiling hot lye water (1 can of lye to 20 gallons of water) will help destroy many of the germs and worm eggs. Each pen should be thoroughly scrubbed to remove dirt and other debris from cracks in the floor and in the sides of the pen. The lye in the solution helps to remove the dirt, but it is the boiling water that actually destroys the germs and worm eggs. It also is well to disinfect the pen to control those disease-producing organisms which are not destroyed by the hot water.

After the pen is thoroughly cleaned, it should be bedded lightly with a good bedding material such as straw, timothy hay, or ground corn cobs. Care should be taken not to pile the bedding too high. This is especially true when straw or hay is used because some of the small pigs may burrow beneath the piles of bedding so that they cannot be seen by the sow. As a result, they may be overlaid or crushed to death. However, too little bedding is almost as bad as too much. Enough bedding should be used to cover the floor and to keep the pigs from contacting the cold, wet floor especially during very wet and cold weather.

Preliminary Care of the Sow Before Farrowing. The sow should be removed from the rest of the breeding herd and brought to the farrowing pen about 4 to 5 days before she is due to farrow. (See Table 3.) This usually will be about the 109th to 110th day after she was bred. When the sow is brought into her farrowing quarters a few days ahead of time, she becomes acquainted with the new surroundings and with the herdsman so that she is much quieter when she does farrow. As a result, there is less danger of her stepping on the pigs or crushing them because of nervousness. Another reason why the sow should be brought into the farrowing pen early is to prevent her from having

pigs outside in the cold during the early spring months. Whenever this happens almost all the pigs in the litter may be lost due to chilling.

TABLE 3 -- BREEDING TABLE FOR SWINE
(Based on 114-Day Period of Pregnancy)

Date Bred	Date to Farrow	Date Bred	Date to Farrow	Date Bred	Date to Farrow
Jan. 1	Apr. 25	May 7	Aug. 29	Sept. 10	Jan. 2
Jan. 8	May 2	May 14	Sept. 5	Sept. 17	Jan. 9
Jan. 15	May 9	May 21	Sept. 12	Sept. 24	Jan. 16
Jan. 22	May 16	May 28	Sept. 19	Oct. 1	Jan. 23
Jan. 29	May 23	June 4	Sept. 26	Oct. 8	Jan. 30
Feb. 5	May 30	June 11	Oct. 3	Oct. 15	Feb. 6
Feb. 12	June 6	June 18	Oct. 10	Oct. 22	Feb. 13
Feb. 19	June 13	June 25	Oct. 17	Oct. 29	Feb. 20
Feb. 26	June 20	July 2	Oct. 24	Nov. 5	Feb. 27
Mar. 5	June 27	July 9	Oct. 31	Nov. 12	Mar. 6
Mar. 12	July 4	July 16	Nov. 7	Nov. 19	Mar. 13
Mar. 19	July 11	July 23	Nov. 14	Nov. 26	Mar. 20
Mar. 26	July 18	July 30	Nov. 21	Dec. 3	Mar. 27
April 2	July 25	Aug. 6	Nov. 28	Dec. 10	April 3
April 9	Aug. 1	Aug. 13	Dec. 5	Dec. 17	April 10
April 16	Aug. 8	Aug. 20	Dec. 12	Dec. 24	April 17
April 23	Aug. 15	Aug. 27	Dec. 19	Dec. 31	April 24
April 30	Aug. 22	Sept. 3	Dec. 26		



FIG. 4. The farrowing pens should be scrubbed with boiling hot lye water before the sow is brought in for farrowing. This treatment destroys worm eggs as well as disease organisms.

It is just as important to wash the sow and remove the dirt from the various parts of her body as it is to clean and disinfect the farrowing pen. The sow should be washed with warm, soapy water and her udder should be sponged off just before she farrows. The dirt should be removed from between the toes and other parts of the body before she is placed in the farrowing pen. Washing the sow in this manner removes any worm eggs and organisms that might be harbored on various parts of the body in the dirt from filthy, worm-infested hog lots.

The herdsman should keep close watch for signs of farrowing after the sow is brought into the farrowing pens. There are several indications that the sow will farrow in a short while. When milk appears in the udder or teats, the sow will usually farrow within 24 hours. Just before farrowing, sows usually will make a bed in the pen; and they may become very nervous and restless.

Certain changes should be made in the manner of feeding the sow starting about 3 days before she is due to farrow. The grain ration should be reduced by about one-half and one-half of this should be replaced with wheat bran or some other bulky food which prevents constipation. Sows that become constipated may suffer from mastitis or other similar troubles during the lactation period.



FIG. 5. The sow should be thoroughly washed with soap and water to remove filth and disease organisms before she is placed in the clean farrowing pen.

Care of the Sow at Farrowing. In severe weather the herdsman should be on hand at all times while the sow is farrowing. As soon as the pigs arrive they should be removed from the surrounding membranes, and the nose and mouth should be cleared of mucous so that the pigs can breath normally. The baby pigs also should be helped to nurse so that they get some of the first milk or colostrum as quickly as possible. This first milk acts as a laxative and also contains vitamins and antibodies which help the pigs in their fight against infectious organisms later in life.

If the sow is nervous or irritable after farrowing, the pigs should be removed from the pen and returned every 2 or 3 hours to nurse until the sow becomes quiet and less nervous. The herdsman also should make certain, during the first week, that the pigs are getting enough milk for proper growth. If the sow does not have enough teats for each pig in the litter, the extra pigs should be transferred to another sow, provided one is available, that has pigs of about the same age. However, if some of the pigs are very runty or weigh less than 1.5 pounds, they probably should be destroyed. Very small and runty pigs usually die before they are weaned anyhow, and those which do survive make very slow and inefficient gains to market weight.

Gilts sometimes have difficulty farrowing their first litter. The herdsman should be on hand when gilts farrow so that help may be given if the pigs are not born after a period of prolonged labor. If a pig lodges in the pelvic region, it will die in 30 to 60 minutes unless delivered. If the pig is not removed in 2 to 3 hours the next one may be born dead. In fact, if the pigs lodge in the pelvis for 24 hours or longer the gilt as well as the entire litter may be lost.

In cold weather during the early spring, pig brooders are especially helpful in saving pigs. The brooders keep the pigs from chilling and attract them away from the sow except during the nursing period so that there is less danger of their being overlaid. Experiments conducted at Purdue University showed that 1.5 more pigs per litter were saved by brooders when sows farrowed during February and March. The pigs born to sows in pens where brooders were used also averaged 1.4 pounds more per pig at weaning time.

It is not necessary to construct or purchase expensive brooders. A 250-watt infra-red heat bulb made of pyrex so that it does not break when moisture touches it is satisfactory. After the first 2 days a 100-watt infra-red bulb is satisfactory and cheaper to operate. However, certain precautions should be taken when heat bulbs are used. They should be kept at least 2½ feet above the floor of the pen so that they will not scald or burn the baby pigs. It also may be advisable to protect the bulbs by means of metal reflectors. The wiring of the farrow-

ing pens should be examined carefully before the heat bulbs are connected because there is some danger of fire if the wires are exposed and are not connected properly.

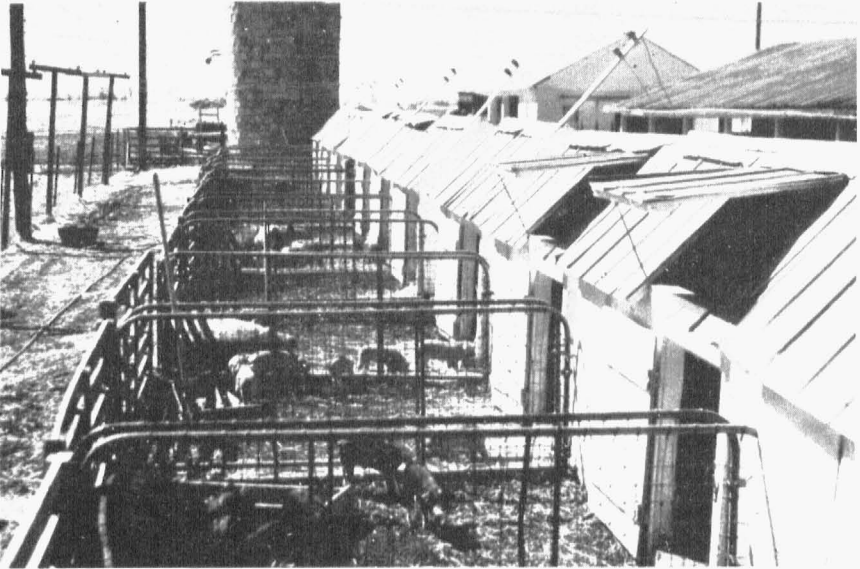


FIG. 6. A battery of portable hog houses with hurdles located near a source of water and electricity is suitable for farrowing quarters in early spring.

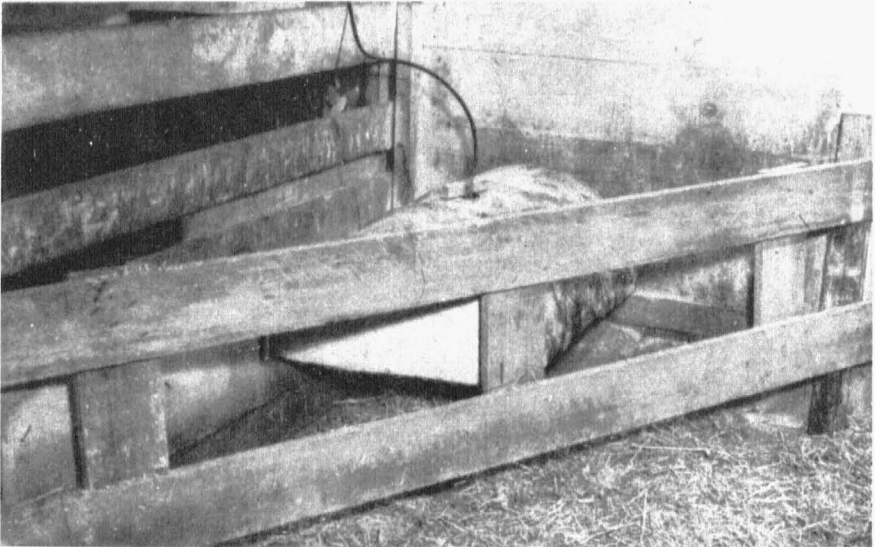


FIG. 7. Heat bulbs if properly handled and located are suitable for pig brooders when the weather is cold

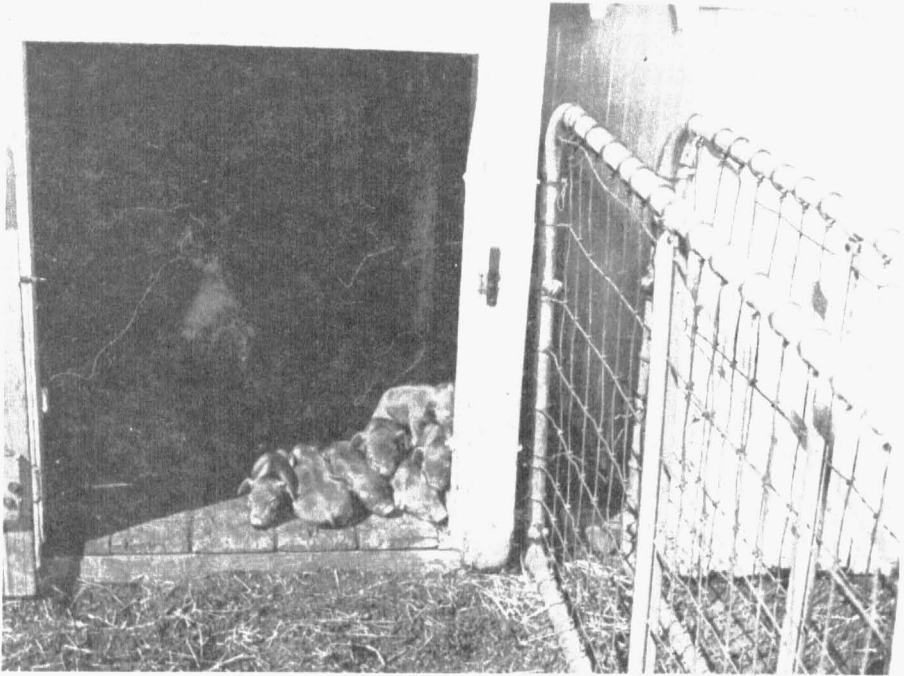


FIG. 8. Guard rails in farrowing houses or pens will save baby pigs from being crushed by the sow.

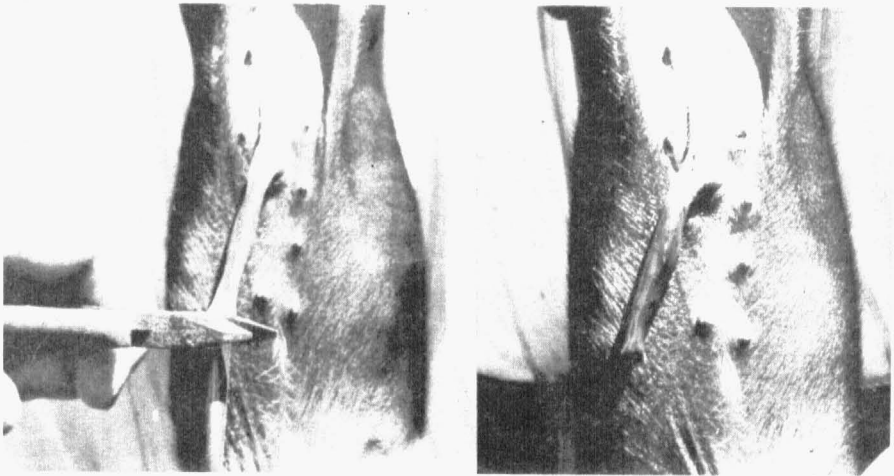


FIG. 9. Soon after farrowing the navel cords of the pigs should be clipped and dipped in iodine to prevent infection.

Sloping floors in farrowing pens also have been shown to save pigs at farrowing time. On such floors the sow usually lies with her head or back up the slope and the pigs gravitate to the lower end of the pen where there is less danger of their being crushed by the sow than when the floors are level. The slope should be about 1 inch per foot, or if the farrowing pen is 10 feet long there should be a drop of 10 inches from one end to the other. Many hog producers find farrowing crates very useful for saving pigs. Plans for these may be obtained by writing to your College of Agriculture.

Remove the Needle Teeth. Baby pigs are born with 2 teeth on either side of each jaw which are called needle or wolf teeth. These teeth have very sharp, flat edges, and if they are not removed the udder of the sow may be injured or the pigs may cut one another when they fight for the nipples at nursing time. The needle teeth should be



FIG. 10. Baby pigs are born with two sharp needle or wolf teeth on either side of both jaws. These should be clipped half way between the sharp end and the jaw taking care not to splinter the teeth or injure the gums. Precautions of this nature prevent injury to the pigs and the sow's udder.

removed shortly after birth. They can be clipped with a pair of pliers about one-half of the distance from the point to the base of the tooth near the gums. Care should be taken not to splinter or injure the gum because this may cause irritation and it might become infected. If this should occur, the injury from removing the teeth might be greater than if they had not been removed in the first place.

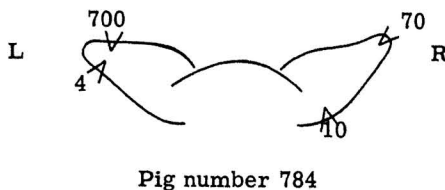
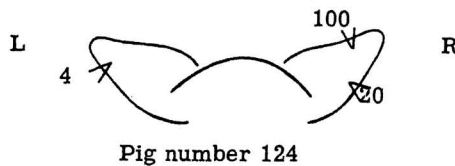
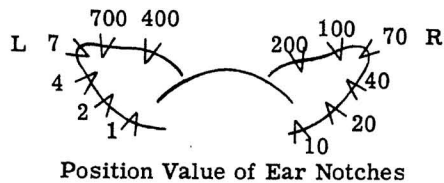


FIG. 11. Some system of ear marking the pigs for identification purposes should be used for production testing. The above system makes it possible to give each pig a specific number. Thousands of pigs can be marked by this system without duplication.

Ear-Notch the Pigs. When purebred animals are produced or where the pigs must be identified throughout life, each pig should be ear-notched shortly after birth. A number of systems are used for ear-notching pigs, but the one shown in Figure 11 is a good system to use for giving each pig a specific number. Identifying the pigs is absolutely necessary when they are reported for production registry. It also is necessary when weights at market time are obtained and when gilts are selected on the basis of weight for age.

Feeding the Sow after Farrowing. The sow must be fed promptly after she farrows if she is to wean healthy, vigorous pigs. The sow is usually feverish for a period of 24 hours or more after she farrows, and she should be given only warm water to drink during that time. On the second day after farrowing, the sow should be offered the same type of ration she was fed before farrowing or a thin slop of shorts, bran or ground oats. The sow's feed then should be gradually increased until she is on full feed at the end of 2 or 3 weeks. Sows that are brought back on full feed too quickly may suffer digestive disturbances, the udder may become hard and feverish or they may give too much milk for the very small pigs so that they scour and become unthrifty.

Prevent Nutritional Anemia. Pigs which are farrowed on concrete floors, or left there for 2 or 3 weeks, may become anemic. This is especially true of pigs farrowed early in the spring or late in the fall. Pigs which are anemic have a pale wrinkled skin that may become thick and puffy. Their hair coat often becomes very rough and stands on end; they seem to have difficulty in breathing and may develop the thumps. If the anemia becomes too severe the pigs may go into convulsions and die.

Anemia develops because of the lack of hemoglobin in the red blood cells. Baby pigs are born with only small stores of iron and copper in their body. These mineral elements are necessary for the formation of the hemoglobin in the red blood cells. Sow milk alone does not contain enough iron and copper to meet the needs of the pigs for the building of the blood cells.

Anemia may be prevented when pigs are kept on concrete by swabbing or spraying the udder of the sow 2 or 3 times each week with a mixture prepared by dissolving 1 pound of ferrous sulfate in 1 quart of hot water. This practice should be continued until the pigs are moved to pasture or begin to eat dry food. Anemia also may be prevented by placing sod or soil in the pen for the baby pigs. Traces of iron and copper are present in the soil, and the pigs eat enough of it to get the mineral elements they need to build the red blood cells. Of course, soil should be supplied from areas where hogs have not been fed for a number of years so that it will be free of round worm eggs and certain other disease organisms.

Anemic pigs may suffer permanent injury and continue to make slow and inefficient gains to market weight. For that reason, it is best to prevent this disease rather than to try to treat it once it has developed.

Baby Pig Disease. This is a highly fatal disease of new-born pigs which usually strikes 24 to 72 hours after farrowing. The affected

pigs often appear normal at birth but soon begin to shiver, become weak and lose their appetite. The pigs may burrow under the bedding, lapse into a coma and die.

Pigs affected with this disease have a lower than normal level of sugar (glucose) in the blood. The actual cause of the disease is unknown, but it is thought that improper feeding of the sow during pregnancy may be a causative factor.

This disease may be prevented to a certain extent by feeding pregnant sows well-balanced rations containing good quality protein, minerals and vitamins. Keeping the pigs warm during extremely cold weather by means of brooders also might be important in the prevention of this disease.

Many affected pigs may be saved by injecting 10 c.c. of a sterile solution of 10 per cent glucose into the peritoneal cavity during the early stages of the disease. Frequent forced feeding of a teaspoon of corn syrup diluted with 2 parts of water is a good treatment if begun soon after the first symptoms of the disease appear.

Hairless Pig Disease. Sows which are fed iodine-deficient rations during pregnancy may carry their pigs to full term but many of them may be born without hair. Such pigs are usually born dead or are



FIG. 12. Sows and their pigs should be moved to clean pasture as soon after farrowing as possible.

very weak and die soon after birth. The birth of hairless pigs caused by an iodine deficiency should not be confused with those which are aborted prematurely. Pigs which are aborted may be born without hair, but they are usually small and are not carried for the entire 114 days as is the case when a gestation ration is deficient in iodine. It is not known if iodine deficiencies exist in Missouri, but it is possible that they may exist in certain localized areas.

Losses from iodine deficiencies may be prevented by feeding iodized salt to the sow during pregnancy. Iodized salt can be purchased from almost any feed store in the state.

Raising Orphan Pigs by Hand. In some farrowing seasons a sow may farrow more pigs than she can raise or in some instances she may die and leave orphan pigs. Extra baby pigs should be moved to another sow that has a smaller litter of about the same age as the orphan pigs. If no sow is available it is possible to raise the orphan pigs by hand, when certain precautions are taken.

Baby pigs should be kept warm at all times when they are raised by hand. They also should be fed some colostrum or the first milk from their mother or some other sow soon after farrowing. This first milk is rich in vitamins and proteins and helps the pigs to build resistance against disease. A substitute sow's milk may be prepared by thoroughly mixing 2 quarts of fresh, whole cow's milk, 3 ounces of cream, 3 ounces of corn syrup and 1 egg. Only fresh materials should be used and all utensils as well as the milk should be kept as clean as possible.

The milk may be fed to the pigs by means of a nipple on a bottle, but the pigs may be taught to drink from a pan rather easily. The milk should be warmed to body temperature before it is fed and the pigs should be given plenty of warm, fresh drinking water in addition to their milk. Feed about 1 ounce of the substitute milk per pig every 2 hours during the first day and 2 ounces every 3 hours until the pigs are 5 days of age. After that time the feeding periods can be further apart and the amount of milk to be fed can be gradually increased.

The pigs should be fed a grain mixture and some green feed as soon as they will eat these materials. When the pigs begin to eat dry feed, sweet skim milk may be substituted for the original product.

If the very small pigs are kept on a board or concrete floor, a small amount of dirt or sod from clean ground should be placed in the pen to prevent anemia. The dirt or sod should be taken from an area where hogs have not been grazed for several years so that it will be free of worm eggs and disease organisms which may be harmful to the very young pig.

Recently the use of synthetic sow's milk in raising baby pigs has received nation-wide publicity. These synthetic milks usually are pre-

pared from dried milk powder, lard, minerals, vitamins and certain antibiotics. Some reports indicate that pigs can be taken from the sow at 2 days of age and raised successfully on these products. A number of synthetic products are now on the market along with brooders built especially for rearing baby pigs. Further information on this subject may be obtained from your county agent or Agricultural College.

Castration. Pigs may be castrated at any time during their lives, but it is best to perform this operation when they are about 3 to 4 weeks of age. Castration should always be done at least 10 days before vaccination or 15 or more days afterward. When pigs are castrated at a young age, they are much easier to handle and the wounds heal much more rapidly than later in life. The pigs seem to withstand castration much better while still nursing the sow than after they are weaned.

Warm, bright, sunny weather is best for castrating pigs. The pigs should be free of mud and dust to prevent possible infection from that source. When the operation is performed the hands should be cleansed, and the knife or razor blade that is used should be rinsed with a disinfectant. The scrotum should also be washed and disinfected before the incision is made. Very small pigs may be picked up by the rear legs with their heads hanging downward. It often helps to grasp the small pigs between the knees to restrict their movement so that the operation can be performed more easily. With the fingers and thumb, hold the testicles firmly and cut the skin with a very sharp knife. Separate the testicle from the surrounding tissue, pull away the cord and cut it off up near the body. Disinfectant should not be poured into the wound, but the outside of the wound may be wiped off with a sponge or damp rag. The cut should be made low enough so that it will drain properly. This speeds the healing process.

Pigs should be examined closely for a scrotal hernia before they are castrated. If they do have a scrotal hernia only skilled operators or veterinarians should perform the operation. The reason for this is that some of the intestines of the pig are present in the scrotum and if proper precautions are not taken, they may be cut when the incision is made or they may fall out after castration causing the death of the pig.

Vaccination. Hog cholera is still one of the most destructive diseases that affect swine. Even so, some owners still take a chance and do not vaccinate their pigs but sooner or later, when such a program is followed, hog cholera will strike the herd. For this reason, it is always best to vaccinate the pigs to prevent the disease. It is preferable to vaccinate pigs for cholera after they are 4 weeks of age and before they are weaned. Between the ages of 4 and 8 weeks is the best

time because the period of exposure to cholera is shortened, and the pigs seem to be in better condition while still nursing the sow. They acquire a certain amount of immunity to the virus from their mother's milk. The cost of vaccinating small pigs is also less because more serum must be given as the pig becomes larger and heavier. The serum is the most costly product used in vaccination for cholera.

A number of different products are used for immunization against hog cholera at the present time. The single treatment consists of injecting blood serum alone. The main disadvantage of this treatment is that immunity lasts for only 2 to 3 weeks. The double treatment includes vaccination with both serum and virus and gives lifetime immunity. However, when the virus is used for vaccination, it should be remembered that the pigs are injected with the disease-causing agent and pigs which are double-treated should not be run with others which have not been vaccinated or immunized until the disease has had time to pass through the system of the vaccinated pigs.

Certain tissue vaccines have been used to a considerable extent on the farm in recent years. The main disadvantage of these vaccines is that the pigs must not be immunized until 2 weeks after they are weaned and another 3 weeks is required before the pigs become immune. Thus, the length of time the pigs are exposed to cholera is increased. Another important disadvantage is that immunity lasts only about 6 months. Breeding animals treated with tissue vaccines should be revaccinated every 6 months if kept in the herd. The period of immunity is considered to be long enough for market hogs. The tissue vaccines contain the deactivated virus which cannot cause the disease but does cause immunity to develop. This is a decided advantage in many instances.

Vaccination and castration should not be done at the same time since the presence of the virus in the body of the pig is thought to cause wounds to heal much more slowly than normal. It is a good plan whenever possible to castrate at about 4 weeks of age and vaccinate at about 6 weeks.

Creep-Feeding Pigs. Pigs should be offered some dry feed or grain by the time they are 3 weeks of age. They can either be self-fed with the sow when a good ration is fed or they can be supplied another ration in troughs using a creep.

The production of milk by the sow usually reaches a peak and begins to decline at about the third week after farrowing. At this time the pigs are growing rapidly and their need for nutrients in addition to milk becomes greater.

Suckling pigs make very efficient gains for the grain they consume. Therefore, the creep ration can be more costly than ordinary

rations. It should be palatable, complete, and concentrated for best results. Examples of creep rations are given in Table 7.

Weaning the Pigs. When only one litter per year is produced in the breeding herd and the sows are to be sold after the pigs are weaned, the pigs may be weaned at 10 to 12 weeks of age. In producing 2 litters per year, however, it is necessary to wean the pigs at 8 weeks of age because the sow should be rebred as soon as possible. Pigs that are 8 weeks of age are old enough to grow and gain weight satisfactorily on a good grain ration, especially if they have become used to grain before they are weaned.

The grain ration of the sow should be decreased 2 to 3 days before the pigs are weaned to slow the production of milk. Sows on good pasture may be separated from the pigs and fed pasture alone until milk production ceases. It is usually best to wean all of the pigs in a litter at the same time rather than to wean a few pigs at a time. However, a few swine producers wean each pig as it reaches a certain weight (40 pounds) so that the smaller pigs receive more of the milk and grow faster. Such a system has been reported to work satisfactorily.

If the sow's udder becomes too distended after the pigs are weaned, it is often advisable to return the pigs to the sow and let them nurse once or twice to prevent inflamed udder and caked teats.

Just after the pigs are weaned is a good time to cull the sow herd. Only those sows which have weaned large, healthy litters should be kept in the breeding herd. Sows which have done a good job of raising pigs and which have given a lot of milk may be very thin and appear to be of poor conformation. This should be taken into consideration when the herd is culled. Some hog producers follow a plan whereby they sell all mature sows which have weaned less than 6 pigs. They also sell sows with mean dispositions and defective udders and those which are poor milkers.

Sows that are to be sold on the market after the pigs are weaned should be allowed 2 to 3 weeks for their udders to dry before they are sent to market. Otherwise, they may be sold at a lower price because of the condition of the udder. Very thin sows will usually make very rapid and fairly efficient gains for a short period after the pigs are weaned, provided they are placed on a full feed after milk production has ceased.

FEEDS AND FEEDING

Feed costs represent 80 per cent or more of the total cost of producing pork. Therefore, the use of production methods whereby less feed is required per unit of gain increases the profits from the swine enterprise. For growth and reproduction, the body needs heat and energy, proteins, minerals, vitamins and water. These must be supplied in large enough amounts and in proper ratio in the feed to obtain maximum results.

Nutrient Requirements of Swine

Carbonaceous or Energy Feeds. The larger portion of most swine rations consists of energy-producing feeds such as corn and other grains. These feeds contain concentrated stores of starch and similar



FIG. 13. Good legume pasture for growing-fattening pigs saves both grain and protein supplement and maintains the fertility of the soil.

compounds which are used as fuel for running the machinery of the body much as gasoline furnishes energy for running the motor of automobiles and tractors on the farm. Increases in weight in older animals are due largely to the deposition of fat supplied by a surplus of energy-producing feeds. When the pig eats more of these feeds than he needs to run the body, a considerable amount of energy is stored as body fat which is actually a reserve provided by nature to be available if and when food becomes scarce.

TABLE 4 -- THE VALUE OF VARIOUS GRAINS AS COMPARED TO CORN FOR GROWING-FATTENING PIGS.

Kind of feed	Amount to feed*	Preparation	Value as a percentage of corn
Shelled yellow corn	All of grain	None	100
Yellow ear corn	All of grain	None	100
Ground shelled corn	All of grain	Ground medium fine	104
Moldy shelled corn	All of grain	None	88-89
Whole oats	1/4 to 1/3 of ration	None	70-75
Whole oats	1/4 to 1/3 of ration	Ground fine	100
Whole oats	All of grain	Ground fine	79
Hulled, rolled oats	All of grain	Ground fine	140
Whole wheat	All of grain	None	100-103
Whole wheat	All of grain	Ground coarsely	109-110
Wheat shorts	1 lb. per head per day	None	100
Wheat shorts	All of grain	None	85
Barley	All of grain	None	83
Barley	All of grain	Rolled or ground	90
Rye**	All of grain	Ground	60-90
Grain sorghums	All of grain	Ground	90
Hominy feed	50% of grain	Ground	100
Bakery waste (bread etc.)	All of grain	None	75-80

*Amount of feed for best results.

**Rye is quite variable in value and probably should be fed in a mixture with other grains.

1. *Corn.* Corn is the most important grain or energy food that is fed to hogs. It is rich in energy, low in fiber and is very palatable to hogs; they like its nutty flavor. On the farm, corn usually is fed on the ear or is shelled and fed with a protein supplement by means of a self-feeder. Numerous experiments have shown that when ground corn was compared to shelled corn, the pigs receiving the ground corn ate slightly larger amounts and gained a little faster although practically the same amount of feed was required per unit of gain. Therefore, it probably does not pay to grind corn for hogs up to the usual market weight of 225 pounds, but it will pay to grind the corn medium fine for heavier market hogs and breeding animals, especially when the corn is very dry and hard.

Corn and cob meal should not be fed to growing-fattening pigs; it is too bulky and their gains will be slower and less economical than when shelled or ground corn is fed. However, corn and cob meal may be fed to pregnant brood sows because a more bulky ration is desirable for such animals.

Yellow corn and white corn have about the same feeding value except that yellow corn contains vitamin A (carotene) and white corn does not. Nevertheless, a large portion of the vitamin A value of yellow corn may be lost after a storage period of 7 to 8 months.

Moldy corn often can be fed to hogs without any poisonous effect, but such corn may contain less nutrients than that which is not moldy. Its value as a feed will depend a great deal on how much it has molded or rotted.

2. *Oats.* Oats contain slightly more protein than corn but supply less energy per 100 pounds. The quality of oats also is quite variable and light oats with large amounts of hull have much less feeding value than heavy oats. Because of the large amount of hulls normally contained by oats, they should not make up more than one-fourth to one-third of the grain in the ration. If fed at this level, they are equal to corn pound per pound. When oats are fed as the only grain to growing-fattening pigs, their value is only 70 to 75 per cent that of corn. This is true because the rate and economy of gains of the pigs will be greatly reduced.

Bred sows and gilts can be fed equal parts of ground oats and corn with good results, but the amount of oats should be reduced to one-fourth to one-third of the grain for lactating sows on pasture.

Oats should be ground medium fine for hogs. Experiments have shown that their value is increased by 25 per cent on the average by grinding. Soaking oats does not seem to be a satisfactory substitute for grinding.

Rolled hulled oats (or oat groats) make an excellent grain for creep feeding pigs. They are very palatable and are high in energy content. However, hulled oats are too expensive to feed as the only grain to growing-fattening pigs up to market weight although they are an excellent feed and produce faster and more efficient gains than corn.

3. *Wheat.* Numerous experiments have shown that good quality wheat is slightly superior to corn as a feed for growing-fattening pigs. In these experiments, 100 pounds of wheat was equal in feed value to 105 to 110 pounds of corn. Good quality wheat is very palatable and can replace all of the corn in the ration provided it is cheap enough. However, sometimes pigs on wheat tend to go off feed so that in such instances wheat should be fed in a mixture with other grains.

It probably does not pay to grind wheat for self-fed, growing-fatten-

ing pigs. They take more time to chew it thoroughly than when they are hand fed. Wheat should be coarsely ground when hand fed because the pigs don't chew it so thoroughly. Wheat that is too finely ground may form a paste in the pig's mouth and may not be utilized to the fullest extent.

4. *Barley.* Good quality barley is an excellent feed for growing-fattening pigs. It produces a good carcass with a fat that is firm and hard. In Canada and Europe barley is the grain more often fed to swine and is highly valued because it produces an excellent bacon. Barley can be fed as the only grain in swine rations although it does not produce quite as rapid and economical gains as corn. Most experiments show that good quality ground barley is worth about 90 to 95 per cent as much as shelled yellow corn. Barley is richer in protein than corn and, therefore, less supplement is needed to balance the ration. However, hogs self fed barley and supplement (free choice) often will eat more supplement than they actually need. For this reason barley and protein probably should be mixed and fed as a single ration.

Grinding barley increases its value by about 18 to 20 per cent. Rolling or crushing of barley is a satisfactory substitute for grinding but soaking is not.

Barley, like oats, varies considerably in value. Poorly filled barley with too much hull is of considerably less value than that which has plump, well-filled grains. Scabby barley should not be fed as the only grain to either pigs or sows; it is unpalatable and may be poisonous. It may be fed in small amounts in grain mixtures, however.

5. *Rye.* Rye is not an important feed for swine but can be used to advantage when it is available. Good quality rye has about 90 per cent of the value of corn for pigs. Poor quality rye is worth only 65 to 70 per cent as much as corn. Experiments have shown that rye is quite variable in palatability, and for this reason should be fed in combination with other grains rather than as the only grain in the ration. Since rye is a small, hard seed it will probably pay to grind it medium fine before it is fed to hogs.

Rye sometimes contains ergot in varying amounts; satisfactory results cannot be obtained with feeds containing this material. Considerable caution should be followed in feeding rye to pregnant sows, for if ergot is present, it may cause the sows to abort.

6. *Grain Sorghums.* Grain sorghums make an excellent grain for swine and are worth at least 90 per cent of the value of corn. Sweet sorghum grains are not usually as valuable for growing-fattening pigs as are the grain varieties because they may lack palatability. Some experiments indicate that the sweet sorghum grains are worth only 68 to 70 per cent as much as an equal weight of corn.

Grain sorghum should be ground medium fine for pigs that are hand fed or for breeding animals. It usually does not pay to grind sorghum grain when self fed to growing-fattening pigs up to market weight of 225 pounds.

Protein Supplements for Swine. Feeds rich in protein must be included in the swine rations in order to obtain the most rapid and efficient gains. The main functions of proteins are to build new tissue such as the muscle and organs in the process of growth and to replace worn-out tissues which are broken down from the operation of the machinery of the body. Young, growing animals require more protein in their rations than older ones because they are building more new tissue and muscle.

Protein feeds of good quality also must be supplied in swine rations to obtain the most rapid and efficient gains. Proteins are complex compounds made up of simpler compounds known as amino acids. The proteins in the feed are broken down into amino acids in the digestive tract of the pig and are absorbed by the body where they are rebuilt into the protein (muscle and organ tissue) in the body cells. Some proteins in the feeds do not contain all of the amino acids needed to build body proteins, and only slow and inefficient gains are made when they are feed. These are called poor quality proteins. Other feeds may contain proteins which supply most of the amino acids needed to build body tissues and, therefore, are called good quality proteins.

In general, all vegetable proteins except soybean meal are of poor quality whereas those from an animal source such as tankage, fish meal or milk by-products are of good quality. Since most of the protein feeds are seldom lacking in the same essential amino acids, mixtures of protein feeds are thought to supply better quality proteins than a single feed.

1. *Tankage.* Tankage has long been a popular protein supplement for balancing farm-grown grains for swine. Standard digester tankage is guaranteed to contain 60 per cent crude protein, but it may vary considerably in feeding value and in palatability. Those products which contain glandular material have higher feeding value than those which contain a larger portion of hide, hair, hoof and bone. The latter materials contain proteins which are not readily digested and utilized by the animals. Fresh tankage also is superior as a feed to old tankage that has become rancid during storage, especially when the weather is hot.

Tankage can be fed free-choice with corn in a self-feeder and the pigs will balance their own ration without eating too much of the protein.

2. *Meat Scraps.* This is a product that is very similar to tankage in composition except that the protein content of tankage has been

brought up to the standard 60 per cent level by the addition of blood meal and a material called "stick." Meat scraps containing 50 to 55 per cent protein is equal in value to 60 per cent tankage because of the higher nutritive value of the protein it contains.

3. *Dead Animal Tankage.* This product is produced by rendering plants which process dead animals. Tankage of this kind is used mostly for fertilizer although some is fed to livestock. Disease is no problem when this tankage is fed to swine, provided it has been properly processed. In the rendering process, the material is heated at high temperatures so that it should be thoroughly sterilized.

Tankage that is made from material that has decomposed before processing is of low value and may even be injurious to the hogs that eat it. For best results, when dead animal tankage is fed to swine, it should be purchased from a reputable firm which is known to produce a good product.

4. *Fish Meal.* Good quality fish meal is superior to tankage and meat scraps as a protein supplement for swine. The reasons for this are that it contains excellent quality protein and considerable amounts of the B-complex vitamins such as riboflavin, niacin and B₁₂. Fish meal contains an average of 63 per cent protein. It has considerable value in creep rations and in rations for weanling pigs fed in dry lot. Since it is more expensive than tankage, it seldom is used as the only protein but is fed at the rate of 5 to 10 per cent of the protein mixture.

5. *Skim Milk and Buttermilk.* Skim milk and buttermilk are of similar composition and are very efficient supplements to cereal grains for swine. These products are rich in minerals and furnish excellent quality proteins. Hogs fed corn and skim milk usually gain more rapidly than when a ration of corn and fish meal is fed.

Skim milk and buttermilk have their greatest value when just enough to balance the corn or other grain in the ration is fed. The amount that is needed to balance the ration will depend on the age of the pigs and whether or not pasture is available. Small pigs just after weaning should be fed some shorts or other protein-rich feed along with the milk and grain. This is necessary because very small pigs do not have the capacity to drink enough milk to balance the grain in the ration.

From the time pigs weigh 40 to 50 pounds, and until they reach market weight, 6 to 8 pounds of skim milk and all the corn they will eat will generally produce rapid and efficient gains. When hogs are fed on good pasture, 3 to 4 pounds of skim milk per head per day should be sufficient to balance the ration. Of course, if plenty of skim milk or buttermilk is available there is no harm in feeding the pigs all they will drink.

It is best to feed skim milk fresh, but sour skim milk can be fed with good results. However, sour milk should not be fed one time and fresh milk the next or the pigs may suffer from digestive disturbances.

Both skim milk and buttermilk are deficient in vitamin A because the butter fat has been removed. This vitamin is soluble in the fats and is removed when the milk is separated or when the butter is churned. Pigs not on pasture should be given some green hay along with corn and skim milk. Good quality legume hay supplies vitamin A (carotene) as well as other nutrients that are needed for proper growth.

The money value of skim milk and buttermilk has been determined in numerous experiments. In general, it has been found that when enough of these products are fed to balance the ration, 100 pounds of skim milk or buttermilk is equal in value to one-half bushel of corn. The value may be greater than this for pigs up to 50 to 60 pounds and may be less when pigs are fed on good pasture or are fed more milk than is needed to balance the ration.

6. *Dried Skim Milk and Dried Buttermilk.* These products are dried at the factory mostly for human consumption. One pound of the dried product is equal in value to about 10 pounds of the liquid. The dried products are usually too expensive to feed except possibly to very small pigs up to 50 to 60 pounds in weight. Even then the amount should be limited to 5 to 10 per cent of the ration or the expense will be prohibitive.

7. *Semi-Solid Buttermilk.* This product is produced by removing some of the moisture from the original buttermilk. It usually takes 3 pounds of semi-solid buttermilk to equal 1 pound of the dried product. This feed makes an excellent supplement for very young pigs in dry lot. However, it is usually more expensive than other protein supplements because of its bulk which results in high transportation costs.

8. *Whey.* Whey is a by-product of cheese making. It is not a rich protein feed like skim milk or buttermilk because much of the protein is removed in the process of cheese making. However, the protein remaining in the whey is of excellent quality.

Pigs fed corn and whey also should be fed some protein-rich feed such as wheat shorts, soybean meal or linseed meal. When fed to swine, whey is worth approximately one-half of the value of skim milk; that is, 100 pounds of whey is worth about $\frac{1}{4}$ bushel of corn.

Dried whey contains about 12 to 13 per cent protein and 1 pound of this material is equal to 13 to 14 pounds of liquid whey.

9. *Raw Soybeans.* Raw soybeans contain about 38 per cent protein and are one of the richest sources of this nutrient of all seeds grown on the farm. However, raw soybeans have very definite limitations as a feed for swine. If soybeans are fed in large enough amounts to balance the ration for growing-fattening pigs, soft pork may be produced. This effect is lessened somewhat if pigs in dry lot weigh 125 pounds before soybeans are fed or if they weigh at least 75 pounds when fed on pasture.

Experiments have shown that raw soybeans are inferior to soybean meal in nutritive value. Cooking or roasting the beans increases their value by making some of the amino acids more available. Cooked soybeans, however, still contain oil and will produce soft pork. Cooking the beans is expensive and requires considerable labor; it is probably best to sell soybeans and purchase soybean meal to feed to swine.

10. *Soybean Oil Meal.* This protein feed, when properly processed, is the best of all vegetable proteins for swine. Since in processing the soybeans, the oil is removed and the meal is thoroughly cooked, the objections to raw soybeans are not applicable to the meal.

Soybean meal contains protein of excellent quality and rivals tankage in this respect. Soybean meal has about 75 per cent the value of tankage if properly supplemented and produces pork carcasses of good quality.

Soybean meal is so palatable that when it is fed with grain, free choice as the only protein supplement, hogs may eat twice as much as they need to balance the ration. Several methods may be used to prevent overeating of soybean meal when it is fed as the only supplement. One-half to three-fourths of a pound of soybean meal per head per day can be hand-fed when this is possible, or if the soybean meal is self fed it should be mixed with some less palatable feed.

Some mixtures to self-feed are:

1. One part soybean meal to 1 or 2 parts tankage or meat scraps.
2. Two parts soybean meal to 1 part of ground alfalfa hay.
3. Two parts soybean meal to 1 part of wheat shorts.
4. One part soybean meal to 1 part ground oats.
5. Nine parts of soybean meal to 1 part of mineral mixture.

Soybean meal is a poor source of calcium, phosphorus and salt so these must be supplied when the protein supplements contain largely soybean meal. This is in definite contrast to tankage and meat scraps which as a general rule contains adequate amounts of these mineral elements.

Recent experiments at the Missouri Station have shown that a corn-soybean meal ration for pigs in dry lot is usually improved by the addition of certain B-complex vitamins (niacin, pantothenic acid and riboflavin) and an antibiotic supplement containing aureomycin. Good quality pastures usually make up the vitamin deficiencies of corn and soybean meal, but they do not replace the antibiotic. In fact pigs in dry lot, fed corn and soybean meal, fortified with B-vitamins and aureomycin made faster and more economical gains in 2 experiments than pigs on pasture which were fed the same ration without the B-complex vitamins.

In other recent experiments at the Missouri Station, pigs fed corn and soybean meal in dry lot made very slow gains, scoured considerably and suffered with a dermatitis or skin infection. Such a condition was not encountered when the soybean meal was replaced with tankage or when pigs were fed soybean meal on pasture. Until more is known about the value of soybean meal for swine and why such a condition develops, it might be well to use this protein feed in combination with meat scraps or tankage when pigs are fed under dry lot conditions.

11. *Linseed Oil Meal.* Linseed oil meal contains about 35 per cent protein and has always been popular as a feed for livestock. It is very palatable, slightly laxative, and also seems to have a conditioning effect on livestock. Linseed oil meal is not satisfactory as the only protein supplement for swine because it contains protein of poor quality. However, it is an excellent feed when fed in combination with other proteins and especially those of animal origin. Linseed oil meal gives good results when included in the trio-type mixture and may replace all or part of the soybean meal if its market price is not too high.

12. *Cottonseed Meal.* Cottonseed meal is that part of the cotton seed or kernel that is left after the oil is removed. It contains between 40 and 45 per cent crude protein.

Cottonseed meal is not safe as the only protein supplement for swine because it contains varying amounts of a poisonous substance known as gossypol. Experimental results indicate that no ill effects from this substance are encountered when cotton seed meal makes up no more than 9 to 10 per cent of the complete ration.

Cottonseed meal gives excellent results in rations for swine when fed in combination with tankage or meat scraps, which contain better quality protein. Cotton seed meal has a slightly constipating effect which somewhat counteracts the laxative effect of soybean meal when the two are fed in combination. Cottonseed meal produces a firm pork.

13. *Wheat Bran.* This feed contains about 15 to 16 per cent crude protein. Even though its protein is of somewhat better quality than that of corn, it is not equal to that of soybean meal and tankage. Wheat

bran is popular in stock feed largely because it is mildly laxative and contains a considerable amount of bulk. For this reason it is especially useful in rations for breeding animals for a few days before and a few days after they give birth to their young. Wheat bran is not often used in rations for growing-fattening pigs because of its bulkiness and high fiber content which would decrease the rate and economy of gains, if fairly large amounts were included in the ration.

14. *Wheat Shorts or Middlings.* Wheat shorts or middlings give excellent results when fed in combination with corn and animal proteins. For pigs on pasture, however, it usually does not pay to add wheat shorts to corn and tankage, unless shorts are cheaper per pound than corn. When wheat shorts or middlings are much cheaper than corn, this feed can be used as a grain substitute although it has only about 85 per cent the value of corn for growing-fattening pigs.

Wheat shorts or middlings also contain protein of poor quality and unless pigs are on good pasture, it should be fed in combination with other feeds such as soybean meal, tankage or meat scraps which contains better quality protein.

15. *Corn Gluten Feed.* Corn gluten feed contains about 25 per cent protein and is a by-product of the starch making industry. Since it is made from corn it contains poor quality protein. It also is unpalatable, and for best results must be mixed with other feeds which are more palatable and which contain better quality proteins. Corn gluten feed should be fed only when lower in price than corn and even then should not make up more than 10 to 15 per cent of the ration.

16. *Corn Gluten Meal.* Corn gluten meal is similar to corn gluten feed except that it does not contain so much corn bran. As a result, it contains more protein (40 per cent). This protein is also of poor quality and should not be used as the only protein supplement. However, it gives good results when fed to swine in combination with equal parts of tankage or meat scraps.

Vitamin Supplements for Swine. Although they are required in very small amounts, a number of vitamins are essential for normal growth and reproduction of swine. Some of the vitamins are present in feeds that are normally supplied to swine; others may be deficient.

Vitamins A and D often may be deficient in swine rations during the winter months. Good quality legume pasture supplies large amounts of vitamin A (carotene) as well as other vitamins. Vitamin D is synthesized through the action of sunlight on the animal's body. Therefore, pigs exposed to sunlight when on pasture seldom, if ever, suffer from a vitamin D deficiency. In the winter months when young, growing animals are kept indoors away from sunlight, a deficiency of vitamin D may occur unless it is supplied in the feed.

Good quality alfalfa hay or meal will supply adequate quantities of vitamins A and D. Rations for growing-fattening pigs in dry lot should contain 5 to 10 per cent of alfalfa meal, whereas bred sows and gilts should receive 10 to 15 per cent in their rations.

Certain B-complex vitamins are required by swine for normal growth and reproduction. The ones most likely to be deficient in dry lot rations are riboflavin, niacin, and pantothenic acid. Pasture is an excellent source of all of the B-complex vitamins with the possible exception of B₁₂. However, B₁₂ is found in the soil in varying amounts. Alfalfa hay or dehydrated alfalfa meal will supply most of the vitamins of the B-complex group.

Missouri experiments as well as those from other stations indicate rather clearly that vitamin B₁₂ is essential for proper growth and reproduction in swine. This vitamin occurs in varying amounts in animal proteins such as fish meal, skim milk and meat scraps. To guard against possible deficiencies of B₁₂, at least 25 per cent of the protein supplement should consist of animal protein or a B₁₂ concentrate should be fed to supply ample amounts of this vitamin.

1. *Pasture.* Good legume pasture supplies directly or indirectly most of the vitamins needed by swine. It also supplies considerable amounts of good quality protein which may reduce the amount needed in the ration. Poor quality pasture is a poor source of vitamins.

2. *Sun-Cured Legume Hay.* Good quality, sun-cured legume hay supplies many of the vitamins required by swine. The hay may be fed in racks free choice or may be ground and mixed with the supplement or the entire ration. Sun-cured hay is high in fiber but if of good quality it contains vitamins A and D and most of the vitamins of the B-complex group. It is lower in protein than dehydrated alfalfa meal.

3. *Dehydrated Alfalfa Meal.* Dehydrated alfalfa meal is processed in special plants built for that specific purpose. When dehydrated, the alfalfa plant is usually cut at a less mature stage than when cut for hay and is dehydrated rather quickly without loss of nutrients from leaching, bleaching, and shattering. For these reasons, dehydrated alfalfa meal contains more protein, more vitamin A (carotene) and less vitamin D than sun-cured alfalfa hay. It also usually contains more vitamins of the B-complex group.

4. *Distiller's Dried Solubles.* Distillers dried solubles are very good sources of the B-complex vitamins, and they also contain about 27 per cent protein although it is of poor quality. Distiller's dried solubles are of their greatest value when added to dry lot rations for sows and growing-fattening pigs at levels up to 12 per cent of the total ration.

5. *Dried Brewer's Yeast.* Dried brewer's yeast is made from yeast

filtered from beer after fermentation is complete. This product is very rich in most of the B-complex vitamins (except vitamin B₁₂) and is also thought to stimulate the appetite of some unthrifty animals. It contains up to 45 per cent protein which is of poor quality. The addition of brewer's yeast at a level of 4 to 5 per cent of the total ration for pigs in dry lot will supply a large part of the B-complex vitamins needed for growth and reproduction.

6. *Irradiated Yeast.* Irradiated yeast is especially rich in vitamin D, containing up to 4,000,000 units per pound of this vitamin. One-fourth pound of irradiated yeast per ton of feed supplies enough vitamin D to meet the requirements of swine.

7. *Cod Liver Oil.* Cod liver oil is a good source of both vitamin A and D and can be used in dry lot rations to supply these vitamins. Cod liver oil also contains considerable amounts of iodine which may be beneficial for swine in iodine deficient areas.

Minerals for Swine. A number of minerals are essential for normal growth and reproduction in swine. The most important of these are calcium, phosphorus, and sodium chloride (salt). Most well-balanced rations containing animal proteins may contain sufficient amounts of phosphorus but may be lacking in calcium and salt. A mineral mixture consisting of equal parts of steamed bone meal, ground limestone and salt should be fed free choice to swine at all times. When supplied in this manner, the hogs will usually obtain the minerals that are deficient in the ration from the supplement.

The question of whether or not trace minerals should be included in mineral supplements for swine in Missouri has not been finally answered. When the trace minerals are lacking in the soil, they may be lacking in the feed, and the animals fed on these feeds may suffer accordingly. Little or no evidence is available which indicates that certain trace minerals are deficient in feeds produced in Missouri. Yet, there is always a possibility that such deficiencies may exist. If in doubt about this problem, it might be well for the hog feeder to supply trace minerals to his hogs as a form of insurance, providing, of course, that the cost is not prohibitive.

Antibiotics for Swine. Best results are obtained when antibiotics are fed to growing-fattening pigs or to small pigs as soon as they are able to take feed in a creep. Apparently, when antibiotics are fed to sows at the ordinary level of 5 mg. per pound of ration, it does not pass through the milk to the pigs in sufficient quantities to be effective. For best results, the pigs must obtain the antibiotic from the ration. Probably there is little benefit derived from feeding antibiotics to bred sows and gilts. At least there is some evidence that feeding the antibiotic to the sow does not increase baby pig survival after birth.

Antibiotics have their greatest effect when fed to unthrifty pigs that are affected by certain types of scours or are infected with certain types of harmful bacteria. It is also probable that the hog raiser who feeds his hogs on the same ground year after year should get good results by feeding these materials.

Experiments at the Missouri Station have shown that the average rate of gain may be increased by 15 to 30 per cent when antibiotics are added to the ration. On the average, a ton of feed containing the antibiotic produced about 31 pounds more pork than a similar ration without the antibiotic. Thus, on the basis of these experiments, if the amount of antibiotic added to a ton of feed costs no more than 31 pounds of pork, the feeder should break even.

Antibiotics are not added to rations in pure crystalline form but may be obtained in what is known as antibiotic supplements. Each pound of these supplements is guaranteed to contain a certain amount of antibiotic (usually 2 to 5 grams per pound).

From an economic standpoint, the proper dosage of the pure antibiotic is about 5 milligrams per pound of total ration. To obtain this level 4 to 5 pounds of an antibiotic supplement should be added to each ton of mixed feed. However, 1 to 2 pounds of antibiotic supplement per 100 pounds of protein supplement also would be satisfactory where grain is fed separately.

Pigs which are creep fed should receive 2 to 3 pounds of the antibiotic supplement per 100 pounds of total ration. This is especially true during the first few weeks of the suckling period when they begin to eat grain. At that time pigs probably do not eat enough of the ration to obtain an effective dosage of the antibiotic when a low level is fed.

The regular dosage of antibiotics should be doubled or possibly trebled for very unthrifty pigs suffering from some types of infection. However, it should be remembered that the use of antibiotics should not replace sanitation practices.

Several antibiotic supplements are manufactured for feeding purposes. Experimental results have demonstrated that those containing terramycin, aureomycin, or procaine penicillin fed at the recommended levels are the most effective in swine feeds.

Water for Swine. Water is one of the most important nutrients although it is the cheapest that is supplied to farm animals. Hogs should have access to clean water at all times, or should be watered twice daily. It is particularly important to supply plenty of water during the hot summer months because the hogs use it in keeping cool.

Hot Hogs Make Slow and Costly Gains. It is also very important to keep water from freezing in cold weather so that the hogs will get the amount they actually need for growth and maintenance. Some experi-

ments indicate that warming water in very cold weather increases the rate and economy of gains of the pigs.

Rations for Swine

It generally is agreed that there is no best ration for swine. By this statement it is meant that rations made from a number of different grains and protein feeds may give equally satisfactory results when fed to swine under practical conditions. For this reason the hog feeder often can formulate good rations for the various classes of swine from those feeds that are available on the farm at any given time. The dis-

TABLE 5 -- PROTEIN SUPPLEMENTS TO BE FED WITH GRAIN TO HOGS IN DRY LOT OR ON POOR PASTURE

Number of Supplement	Pounds of Each Feed	Feed	Approximate per cent of Protein
1	50	Soybean meal	40
	25	Meat scraps or tankage	
	25	Alfalfa meal or ground legume hay	
2	25	Soybean meal	38
	25	Linseed meal	
	25	Meat scraps or tankage	
	25	Alfalfa meal or ground legume hay	
3	25	Soybean meal	40
	25	Cottonseed meal	
	25	Meat scraps or tankage	
	25	Alfalfa meal or ground legume hay	
4	25	Soybean meal	34
	25	Wheat shorts or middlings	
	25	Meat scraps or tankage	
	25	Alfalfa meal or ground legume hay	
5	40	Soybean meal	42
	15	Fish meal	
	20	Meat scraps or tankage	
	25	Alfalfa meal or ground legume hay	
6	56	Soybean meal	44
	9	Fish meal	
	9	Dried milk	
	17	Meat scraps or tankage	
	1.5	Cod liver oil	
	6.0	Mineral mixture	
1.5	Vitamin B ₁₂ and antibiotic supplement		

- A. A mineral mixture of equal parts of ground limestone, steamed bone meal and salt can either be fed free choice or 6 pounds can be mixed with each 100 pounds of the protein supplement.
- B. When antibiotics are to be fed, mix one to two pounds of the supplement (antibiotic) with each 100 pounds of protein supplement.
- C. A special protein supplement (number 6) is recommended for very young pigs up to 75 to 80 pounds in weight.

cussion of the various feeds in the preceding pages should be helpful in using them efficiently in swine rations.

The cost and value of the various feeds for swine also are important in formulating satisfactory rations especially when many of the feeds used must be purchased on the market. It is a well-known fact that feeds vary in market value from year to year, depending a great deal on the current supply of that particular feed available for the feeding of livestock. For this reason corn may be the cheapest feed one year and the most expensive the next. Therefore, the knowledge of how to use various corn substitutes and how their actual feeding value compares with that of corn is important in profitable swine production.

The kind of rations fed to swine varies with the age and stage of production of this species of farm animal. Very small pigs that are growing rapidly need rations that are good sources of the required minerals, proteins, and vitamins. One of the most critical periods of a pig's life is from birth to about 80 pounds, and the nutrient requirements are very important during this stage of life. The period of growth from 80 pounds to market weight is less critical, and the ration need not be so complete as for younger pigs, although the best of rations should be fed always. Mature sows have less strict nutrient requirements than young, growing sows and gilts. This is especially true during

TABLE 6 -- PROTEIN SUPPLEMENTS TO BE FED WITH GRAIN TO HOGS ON GOOD QUALITY PASTURE

Number of Supplement	Pounds of Each feed	Kind of Feed	Approximate per cent crude Protein
1	75	Soybean meal	46
	25	Meat scraps or tankage	
2	25	Soybean meal	44
	25	Cottonseed meal	
	25	Linseed meal	
	25	Meat scraps or tankage	
3	50	Soybean meal	40
	25	Wheat shorts or middlings	
	25	Meat scraps or tankage	
4	25	Soybean meal	43
	25	Linseed meal	
	15	Fish meal	
	15	Wheat shorts	
	20	Meat scraps or tankage	

A. A mineral mixture of equal parts of ground limestone, steamed bone meal and salt should either be fed free choice or 6 pounds of the mixture should be mixed with 100 pounds of the protein supplements.

B. When antibiotics are to be fed, mix one to two pounds of the antibiotic supplement with each 100 pounds of the protein supplement.

the periods of pregnancy and lactation. Rations should be formulated for these animals with specific requirements in mind.

It is much easier to formulate good rations for hogs of all classes and ages on pasture than it is in dry lot. The reason for this is that good quality pasture supplies many of the good quality proteins, vitamins and minerals required by swine. When pasture is not available, these nutrients must be included in the rations in proper amounts in order to support maximum growth and reproductive efficiency.

Example rations for various classes and ages of hogs are given in the following tables. These rations have been formulated from various feeds commonly fed to swine in Missouri and consideration has been given to age and class of swine, method of feeding and whether or not the hogs are to be fed in dry lot or on good quality pasture.

TABLE 7 -- COMPLETE RATIONS FOR HOGS IN DRY LOT OR ON POOR QUALITY PASTURE.

Kind of feed	For Growing-Fattening Pigs					
	Weaning to 75 lbs.		From 75 to 150 lbs.		More than 150 lbs.	
Ground yellow corn	64.0	49.0	70.0	54.0	81.0	62.0
Ground oats		16.0		18.0		21.0
Soybean meal	14.0	13.0	7.0	6.0	4.0	4.0
Linseed oil meal			6.0	6.0	4.0	3.0
Wheat shorts or middlings						
Tankage or meat scraps	6.0	6.0	8.0	7.0	5.0	4.0
Fish meal	5.0	5.0				
Dehydrated alfalfa meal	9.0	9.0	8.0	8.0	5.0	5.0
Mineral mixture*	2.0	2.0	1.0	1.0	1.0	1.0

*Mineral mixture of equal parts steamed bone meal, limestone and salt.

If an antibiotic is included in the ration, add enough antibiotic supplement to supply at least 5 mg. of the pure antibiotic per pound of ration.

TABLE 8 -- COMPLETE MIXED RATIONS FOR HOGS ON GOOD QUALITY PASTURE

Kind of feed	For Growing-Fattening Pigs					
	Weaning to 75 lbs.		From 75 to 150 lbs.		More than 150 lbs.	
Ground yellow corn	78.0	60.0	82.0	64.0	89.0	69.0
Ground oats		20.0		21.0		22.0
Soybean meal (44% prot.)	5.0	5.0	8.0	7.0	5.0	4.0
Wheat shorts or middlings	3.0	3.0	4.0	3.0	2.0	2.0
Tankage or meat scraps	5.0	4.0	5.0	4.0	3.0	2.0
Linseed oil meal	5.0	4.0				
Fish meal (63% protein)	3.0	3.0				
Mineral mixture	1.0	1.0	1.0	1.0	1.0	1.0

If an antibiotic supplement is included in the ration, add enough of the antibiotic supplement to supply at least 5 mg. of the pure antibiotic per pound of ration.

TABLE 9 -- COMPLETE MIXED RATIONS FOR BREEDING ANIMALS ON PASTURE AND IN DRY LOT

Kind of feed	Pregnant and Lactating Sows			
	Dry Lot		On Good Pasture	
Ground yellow corn	74.0	56.0	88.0	66.0
Ground oats		18.0		22.0
Soybean meal	4.0	4.0	4.0	4.0
Wheat shorts	4.0	4.0	3.0	3.0
Tankage	6.0	6.0	3.0	3.0
Dehydrated alfalfa meal	10.0	10.0		
Mineral mixture	2.0	2.0	2.0	2.0
Mineral mixture of equal parts of ground limestone, salt and steamed bone meal.				

TABLE 10 -- THE APPROXIMATE AMOUNTS OF A 40 PER CENT PROTEIN SUPPLEMENT TO FEED TO BALANCE CORN FOR HOGS OF VARIOUS CLASSES AND AGES.

Section I. Fed in Dry Lot										
Approx. Live Wt. (Lbs.)	Market stock					Pregnant		Lactating		
	50	100	150	200	250	300	500	350	450	
Pounds of corn	71	77	84	87	90	80	90	80	80	
Pounds of protein supp.	29	23	16	13	10	20	10	20	20	
Pounds of protein supp. to hand feed per head per day to balance corn	.75	1.25	1.00	1.00	1.00	1.2	.75	2.2	2.5	
Section II. Fed on Good Quality Pasture										
Approx. Live Wt. (Lbs.)	Market stock					Pregnant		Lactating		
	50	100	150	200	250	300	500	350	450	
Pounds of corn	77	84	90	93	97	87	90	87	87	
Pounds of protein supp.	23	16	10	7	3	13	10	13	13	
Pounds of protein supp. to hand feed per head per day to balance corn	1.0	.75	.75	.5	.25	.75	.75	1.5	1.75	

Pasture for Swine

Importance of Pasture in Pork Production. The distinct advantages of the liberal use of pastures in the production of pork have long been recognized by pork producers. Even though hogs have a limited capacity to handle roughages of any kind they still can make efficient use of a certain amount of good quality pasture.

One of the most important advantages of pasture for swine production is that it saves in the amount of grain needed to produce market hogs. It has been shown that hogs which are limited-fed on pasture may require up to 38 per cent less grain than similar pigs fed in dry lot.

Pasture and forage crops also reduce the amount of high-priced nitrogenous or protein-rich feeds that are necessary to produce satisfactory gains. This is due to the fact that some of the legumes contain large proportions of good quality proteins when they are in an active stage of growth. As much as 30 to 50 per cent of the protein supplement

required to produce a hundred pounds of gain has been saved by feeding growing-fattening pigs on pasture. In addition, as much as 50 per cent of the concentrates needed by mature sows during gestation may be supplied by good legume pastures. Pastures also supply needed amounts of vitamins that are so essential for proper performance of both pigs and breeding animals.

Pigs fed on clean pastures (that free from diseases and parasites) make much more rapid and efficient gains than those that are fed on old ground or infested hog lots year after year. The increasing incidence of diseases in swine herds in the corn belt will no doubt emphasize the need for clean, good quality pasture in the pork production program in years to come.

Another important advantage of feeding hogs on pasture is that it helps to maintain soil fertility. By feeding hogs on pasture instead of in a small pen or barn yard, as much as 80 per cent of the fertilizing value of the feeds consumed may be saved. Where grains from other areas together with purchased protein feeds are fed, the soil fertility of the farm may increase rather than decrease.

Kinds of Pasture Crops for Swine. A number of pasture crops have been tested and their value has been determined for swine. A considerable amount of this work has been done at the Missouri Agricultural Experiment Station and has been reported in detail in Missouri Bulletin 247 entitled *Pastures for Hogs*. In these experiments the pigs in all lots were fed to gain about three-fourths of a pound per 100 pounds live weight per day. Feeding concentrates at the rate of 2 to 3 pounds per 100 pounds body weight gave the desired gains.

Results of Missouri experiments in which the values of different pastures were determined for swine are summarized in Table 11. Alfalfa ranked at the top followed by red clover and dwarf essex rape in that order. Ladino clover recently has received much attention as a pasture for swine and is gaining in popularity in Missouri and neighbor-

TABLE 11 -- THE VALUE OF VARIOUS PASTURE CROPS FOR SWINE (Missouri Experiments).*

Crop	No. of days pastured	No. of hogs per acre	Pounds of pork per Acre of forage	Value per acre with pork @ \$20 per cwt.
Alfalfa	163	10	592	\$118.40
Red Clover	130	12	449	\$ 89.80
Rape (Dwarf Essex)	82	23	395	\$ 79.00
Sorghums	87	15	275	\$ 55.00
Bluegrass	136	12	274	\$ 54.80
Soybeans	25	17	175	\$ 35.00
Cowpeas	32	13	149	\$ 29.80

*The rations of the pigs were limited to one-half to two-thirds of a full feed.

TABLE 12 -- SUGGESTED CROPS FOR AN ALL-YEAR HOG PASTURE IN MISSOURI.

Grazing time	January and February	March and April	May, June, July, Aug., Sept. & Oct.	November and December
(A) On sweet fertile soil	Bluegrass (not grazed previous summer or fall) OR Early fall seeded small grain OR Tall fescue-Ladino clover	Early fall seeded small grain OR Established timothy-lespedeza not grazed during winter	Alfalfa OR Alfalfa-brome OR Red-clover OR Ladino clover	Tall fescue-Ladino clover OR Early fall seeded small grain
(A ₁) On sweet soil of medium fertility	Bluegrass not grazed previous summer and fall OR Early fall seeded small grain	Same as above	2nd year sweet clover to July 15th then les-pedeza, 1st year sweet clover to October, then early seeded small grain pasture	Early seeded small grain OR Either timothy-lespedeza OR Bluegrass neither grazed during summer or early fall
(B) On sour fertile soil	See A ₁	Same as above until June	After June 1st, Dwarf Essex, rape OR Rape and oats	See A ₁
(B ₁) On sour soil, medium in fertility	See A ₁	Same as above until June	After June 1st, sudan grass OR timothy-lespedeza OR Red top-lespedeza	See A ₁

ing corn belt states. Results of experiments at Purdue University in which ladino clover was compared with alfalfa as a pasture for swine showed that pigs on ladino made the faster gains and ate 30 per cent less protein per unit of gain. Sixteen to 20 pigs were pastured per acre for a period of 84 to 96 days in these experiments. The use of ladino clover for hog pasture on many Missouri farms has shown that it is one of the best for swine of all classes and ages.

Sudan grass that is properly grazed and managed is an excellent forage for hogs. It has a carrying capacity about equal to that of alfalfa but has a much shorter growing period. Sudan grass is an excellent pasture crop to use during the hot summer months when other pastures may make poor growth or may need to be deferred.

Fall seeded Balbo rye is a valuable forage for the breeding herd or for growing-fattening pigs during the fall, winter and early spring months. In Illinois experiments on fertile soil with good stands of rye stocked with 10 fall pigs to the acre and carried to a final weight of 200 pounds, a total of 631 pounds of feed per acre was saved. During the winter months, an acre of well-grown rye also furnished pasture for 4 to 6 sows and replaced 100 pounds of concentrates and 490 pounds of legume hay in their rations.



FIG. 14. Pigs absolutely require plenty of shade during the warm summer months if they are to make rapid and efficient gains. Inexpensive shades of this sort are very satisfactory.

Wheat also is a good forage crop for swine and is even more palatable than rye. However, it does not make as much growth nor provide as much forage. In some areas of Missouri, winter barley and winter oats can be used as a winter pasture for swine in the place of rye and wheat.

By using various forage crops as suggested in Table 12, an all-year pasture system can be devised for hogs in Missouri.

Methods of Feeding on Pasture. A majority of the hogs that are fed on pasture are self-fed. Under such conditions, pasture is not utilized to its fullest extent although it is still a valuable addition to the ration. Self-feeding pigs on good quality pasture simplifies the problem of designing a satisfactory ration because the concentrates do not have to contain so many of the vitamins, proteins and minerals. This is true because even pigs on a full feed of concentrates usually will consume enough pasture to meet the requirements for these nutrients.

Less labor is required to self-feed hogs on pasture than to hand feed them, although the herd should be inspected daily no matter how they are fed. Swine on pasture that are self-fed grow more rapidly than those that are hand-fed or limited-fed and usually will sell on a higher market than pigs that grow more slowly and are marketed late in the fall. Since self-fed pigs go to market sooner there is also less risk involved, and the pigs are out of the way when the new fall pigs arrive.

The main advantage of limited feeding of pigs on pasture is that gains are cheaper. Probably the best method to follow when limited feeding is to be used is to full-feed the pigs until they weigh 75 to 80 pounds and then limit the concentrates to 2 or 3 pounds per 100 pounds of body weight until the pigs reach market weight. Such a system of feeding will grow the pigs rapidly through the critical period up to 75 to 80 pounds. In addition, when they reach this weight they will be large enough to consume and utilize forage to the maximum extent. Limited feeding during the latter stages of growth tends to make gains more efficient, and the market hog should contain less fat and more lean.

Pasture Management for Swine. Pigs on pasture should be supplied plenty of drinking water at all times. Automatic waterers are ideal for this purpose.

Plenty of shade also should be supplied the pigs during the summer months in order to insure rapid and economical gains. Inexpensive shades built of posts and poles as shown in Figure 14 are satisfactory if natural shade is not available.

It is often necessary to place rings in the noses of pigs when they tend to root the sod in the pasture. Well-balanced rations containing some animal protein and minerals tend to reduce rooting but will not prevent it entirely. Any good type of ring properly placed in the snout is satisfactory.



FIG. 15. Natural shade in hog pastures should be utilized whenever it is possible to do so.

Pastures should be clipped frequently during the summer months to prevent the forage from maturing and becoming too fibrous. Growing-fattening pigs will make better use of pasture that is clipped and kept in an actively growing state. Such pasture is richer in digestible nutrients (especially protein) than that which has matured.

Hogging Down Corn

If handled properly, hogging down corn is an economical method of utilizing this grain for fattening pigs. Some corn is wasted when the crop is harvested in this manner, but the saving in labor costs makes up for the loss. The fact that most of the manure is spread on the farming ground is another advantage for hogging down corn. This method of harvesting the grain works best when the season is reasonably dry.

Well-grown pigs that are not too fat and weigh between 90 and 125 pounds seem to be best adapted to hogging down corn. Pigs should run on areas they can clean up in 3 to 4 weeks rather than being turned on larger acreages. Before the corn is completely gleaned, the fattening pigs should be moved to new ground where grain is more readily available. Bred sows and gilts can be used to gather the remaining corn when the pickings begin to get slim.

Corn is ready to be hogged down when it is hard and dented. The pigs should become gradually accustomed to new corn and some ears should be knocked down so the pigs can find the corn and learn to knock down more stalks later on.

Pigs harvesting corn in the field should be supplied with water, minerals, proteins and plenty of shade. One of the protein supplements described in Tables 6 or 7 would be satisfactory. Natural shade and running water are ideal.

Sometimes soybeans are planted with corn that is to be hogged down, but such a practice usually is not economical. Sowing rye in the corn when it is "laid by" has been found to be a good practice where the corn is to be hogged down. Thus, grain and pasture with the needed vitamins are supplied in a single field.

Hogging Down Small Grains

The practice of hogging down small grains such as wheat, oats, rye and barley is not too popular. Experiments at various experiment stations have proved that such a method of harvesting the grain is not economical unless the grain has lodged and can't be harvested by ordinary methods. In the latter case where the hogs are turned in to the field to salvage the grain, the same management practices should be followed as for hogging down corn.

The small grains are ready to be hogged down when in the hard dough stage.

Pigs also can be used to salvage grain that is left by the combine or corn picker. Any gains made by pigs under such conditions are almost entirely clear profit.

INTESTINAL PARASITES OF SWINE

Large roundworms or ascarids (*Ascaris suis*) are probably the most injurious worm parasites which infest swine. Heavy infestations with roundworms often cause death losses in very young pigs and slow and inefficient growth in those which do survive. In some instances, certain pork cuts from hogs heavily infested with roundworms are condemned at slaughter.

The life cycle of the large intestinal roundworm has been described in detail and an understanding of how it progresses demonstrates clearly why sanitation is so important in producing healthy, worm-free pigs. Mature female roundworms in the small intestine lay eggs which pass from the pig's body in the feces. The eggs go through an incubation period in the soil before they develop to the infectious stage. The length of the incubation period is several weeks, depending on the weather and other conditions. When the eggs have developed to the infectious stage, they are picked up by the pigs from the ground or from the teats of the sow at nursing time. The eggs then hatch in the small intestine and burrow through the intestinal wall into the blood stream where they are carried to the liver, heart and lungs. It is during this stage of their life cycle that the small worms cause permanent damage to these organs. Heavy infestations of worms in the lungs may cause pneumonia, coughing and sometimes a condition known as "thumps." The worms in the lungs are coughed up, reswallowed and are carried to the small intestine where they grow to maturity completing the life cycle.

Most of the damage caused by intestinal roundworms may be prevented by following the McLean County System of swine sanitation. In practicing this system the sow should be thoroughly washed with soap and water to remove worm eggs and germs before she is brought into the farrowing pen. The farrowing pens should be scrubbed with boiling hot lye water and disinfected before the sow is brought into the pens. The pigs also should be moved to a worm-free pasture as soon after farrowing as possible and left there until they are 4 months of age. When a pasture rotation is followed, at least one year and preferably two should elapse between the time different crops of pigs graze on these fields. It is often recommended that the land be plowed at least once after each period that it is used for pasturing swine.

Treatment for Roundworm Infestations. Removal of the roundworms after they have grown to maturity in the small intestine is recommended for a number of reasons. Heavy infestations with these parasites may cause digestive disturbances in some animals resulting in poor utilization of food and subsequent slow growth. In addition, an animal heavily infested with mature roundworms is a carrier which

spreads worm eggs around the premises to reinfest other pigs. Removing female roundworms from infested pigs prevents further spread of eggs since each female worm is capable of producing millions of eggs during her life time. It should be remembered, however, that the removal of the mature roundworms does not repair the damage done to the lungs and other organs during the first part of the life cycle so that one should not expect the worming process to increase the growth rate of pigs except possibly in those animals which are very heavily infested. Furthermore, treatment for roundworms does not eliminate certain disease organisms from the body. These diseases may accompany roundworm infestations due to raising pigs in dirty, heavily infested hog lots.

Sodium fluoride is a cheap and effective drug to use for the removal of mature intestinal roundworms. It is easily administered but should be handled with care for it is poisonous to man as well as to animals. The ordinary technical grade is satisfactory for worming purposes.

For treatment, 1 part of sodium fluoride should be thoroughly mixed with 99 parts (by weight) of some dry, ground feed. The animals to be treated should be slightly underfed the day before treatment. The morning the animals are to be treated they should be given just as much of medicated feed as they would normally eat in one day. The morning following treatment the pigs should be returned to the regular feed although this may be mixed with the remaining portion of the medicated feed in case the pigs failed to eat all of it the day they were treated. When animals to be treated are not accustomed to dry, ground feed, they should be fed dry feed for a day or two before treatment. Pigs to be treated should be penned according to size to help insure their eating the proper amount of medicated feed.

Wormy pigs should be treated shortly after weaning and possibly again when they are 4 to 5 months of age. Pregnant sows should not be wormed, especially during the latter part of gestation. Sows should be wormed before being bred, if possible.

The following precautions should be followed in using sodium fluoride:

1. Always weigh the feed and sodium fluoride. Your guess might be wrong.
2. Thoroughly mix the feed and sodium fluoride before it is fed.
3. Feed the medicated feed only one day. Sodium fluoride is poisonous and should not be fed continuously over a long period of time.
4. Feed medicated feed dry — not as a slop.
5. Keep sodium fluoride away from children and pets to prevent poisoning.

Other worm expellents such as lye, phenothiazine and oil of chenopodium have been used in the past but are not as effective as sodium fluoride. Some commercial worm expellers also are satisfactory when directions are carefully followed. U. S. D. A. reports indicate that even milk and milk products may be effective in flushing mature roundworms from the intestinal tract of swine although this apparently does not prevent the small worms from passing through the liver, lungs and other organs during the early part of their life cycle nor do these products repair the damage done at that time.

EXTERNAL PARASITES OF SWINE

Lice. Hog lice are the most common external parasites causing economic losses in swine. They are blood sucking insects and when infestations in a herd are very heavy the pigs may become unthrifty and make slow inefficient gains. In addition, lice may carry certain diseases such as swine pox from one animal to another. When present in large numbers these insects are easily seen on various parts of the body especially around the ears and neck. The eggs (or nits) also are attached to the hair around the neck and ears and are easily recognized.

Hogs may be rid of lice rather easily by dipping, spraying or oiling with crude oil or old worn-out crank-case oil. The use of oil is satisfactory if the pigs are covered thoroughly on all parts of the body. A water sprinkler can be used to spread the oil over the pigs, and the pigs will help spread the oil on one another if they are crowded into a small pen at that time. Two treatments 10 to 14 days apart should be effective.

Swine should not be oiled on very cold days nor should they be oiled on extremely hot summer days if turned out into the direct sunlight.

Some of the newer chemicals are very satisfactory for ridding swine of lice. Lindane is one of the most effective and should be applied as a spray at the rate of 1½ pounds per 100 gallons of water or ½ teaspoon per gallon. Complete coverage of the body is necessary for best results. One application should control the lice but, if necessary, a second application should be given 10 to 14 days following the first.

Several commercial compounds are available for the control of hog lice and, if the directions of the manufacturer are carefully followed, are very effective.

Mange. Mange in swine is a skin disease caused by very small parasites known as mites. The mites burrow into the skin where they lay their eggs. These hatch in a few days. The entire life cycle of the mite is completed in 2 or 3 weeks. The mites cause intense itching and the pigs spend a considerable amount of time rubbing or scratching on

various objects for relief. Swine mange usually starts around the eyes, nose and ears but may affect any or all parts of the body. When the infestation becomes severe, the skin on the entire body may take on a crusted appearance. Mange does not cause death losses in swine but may cause considerable economic loss due to the unthriftiness and restlessness of the affected animals.

Mange may affect hogs at any time of the year, but it seems to be more prevalent in the winter months. It is advisable to treat breeding animals for mange before they go into their winter quarters.

Treatment for mange consists of spraying or dipping with some of the new sprays now on the market. Among these, lindane is highly recommended because it will control both lice and mange. Two pounds of lindane per 100 gallons of water or $\frac{2}{3}$ tablespoons per gallon is the recommended concentration. Pigs under three weeks of age should not be treated with lindane. A better practice is to treat sows for lice and mange 2 to 3 weeks before farrowing.