PRACTICES IN SWINE FEEDING

by J. H. Zeller and N. R. Ellis

Here the authors describe the various kinds of feeds and systems of feeding used in the United States, and tell how to use the different carbohydrate and protein supplements to get economical results; what to do to avoid soft pork; how to make sure of furnishing adequate amounts of minerals and vitamins; and how to meet the special needs of growth, pregnancy, and lactation.

Although the hog industry is based on corn, the hog can utilize a larger variety of feeds to greater advantage, perhaps, than any other farm animal. Small-grain crops—wheat, barley, oats, rye, and the kafirs—can be utilized as a major component of the swine ration, and root crops, such as peanuts, potatoes, and sweetpotatoes, are also of value. Byproducts of the fishing industry, the packing industry, and the industries milling wheat, rice, cottonseed, and soybeans are used in hog feeding; and byproducts of the dairy industry, such as skim milk, buttermilk, and whey, together with various kinds of home-grown forage and pasture crops, all play an important role in supplementing the cereal-grain ration.

The modern hog feeder uses the relation of prices between corn or other feeds and the selling price of hogs as an indication of when to increase or decrease his production program. The cost of feed alone, including pasture, is estimated to make up approximately 75 to 85 percent of the total cost of producing marketable hogs. The cost of feed varies greatly from year to year, or even within shorter periods. It varies also in different sections, owing to local conditions of supply and demand. With the price of feed playing such an important role in the production cost of hogs, the producer must always be alert to use locally available feeds, properly balanced, to give the most economical returns.

Whenever hog prices have been relatively high compared to the price of corn, farmers have usually increased their production of hogs. A year to a year and a half from the time such a decision was made the

increased supply of hogs reached the market, which soon became oversupplied, causing hog prices to drop. Hog producers then began to reduce their breeding operations. This tendency of the producers to readjust production to price always seemed to carry them too far in the opposite direction. This is the reason for the more or less regular cycles that have characterized hog prices.

The relation, then, between feed prices and selling prices of hogs tended to be self-perpetuating. Each period of favorable hog prices caused too great an expansion in production before prices became unprofitable, and each period of unfavorable prices caused too great a reduction before favorable prices were restored. Those farmers who had not varied their production from year to year or who had timed their expansion opposite to the majority were the ones who usually made the greatest profit.

Any leveling out of these cycles in hog production naturally will react favorably on the industry as a whole.

Changes in the type of hogs have been made to meet economic demands of consumers. Since the swine industry of the United States has been founded mainly on the corn crop as the basal feed, the lard type of hog has been predominant. The bacon-type breeds, as such, have been found in small numbers in scattered sections of the country but have not attained the popularity of the lard-type breeds. When consumer demand dictated the need for a hog with less fat and leaner hams and bacons, breeders have utilized the lard-type breeds in an endeavor to develop a type to meet the requirements.

**SWINE PRODUCTION IN THE UNITED STATES**

The United States is self-contained from the standpoint of swine production. Hogs can be raised in practically all sections of the country on a great variety of feeds that are usually produced locally. In this respect the system here differs from those found in some foreign countries. England, for example, imports large quantities of cereal grains and protein supplements for use in the feeding of hogs. Ireland depends to a certain extent on imports of cereal grains and other feeds to supplement the local potato and milk byproducts upon which its swine industry is largely based. The swine industry of Denmark has been built up as a byproduct of the dairy industry, with milk and whey supplementing home-grown and imported cereals. In recent years, Germany has been driving toward economic self-sufficiency in the swine industry, with a reduction of imports of cereals and a wider use of home-grown crops such as potatoes, sugar beets, and green forage. This results in a less concentrated ration.

Since hogs are produced and fattened in all the 48 States, there are naturally great differences in the feeds used and in methods of feeding and management. While the principles involved in feeding practices apply equally well to all parts of the country, the problem of production may be viewed from a sectional standpoint. The country may be divided into four major regions: (1) The Corn Belt, which includes the North Central States; (2) the South, which includes the South Central States; (3) the Atlantic coast region, which includes the North Atlantic and South Atlantic States from Maine to Florida; (4) the Western States. Figure 1 graphically defines the four regions.
and shows the number of hogs on farms January 1, 1939, as estimated by the Bureau of Agricultural Economics.

THE CORN BELT

The Corn Belt includes the 12 States comprising the North Central division. During 1936 this group of States produced 60 percent of the total corn crop of the country and had on farms January 1, 1937, 62 percent of the total hog population; and during 1937 they produced 72 percent of the total corn crop and had on farms January 1, 1938, 63 percent of the total hog population. Although an increase of over 3 million head from January 1, 1938, to January 1, 1939, is indicated, the percentage of the total hog population in the Corn Belt remained the same—63 percent. The relation of production of corn to production of hogs in the six States raising the largest numbers of hogs is shown in table 1. The relationship between the production of corn and the number of hogs on farms the following January, to be fed out, is fairly close. Even adverse conditions such as occurred during the drought of 1934 and again when weather conditions shortened the corn crop in parts of the area in 1936 did not disturb the relationship as much as might have been expected. The fact that the percentage of the total hog population produced in these States held rather constant during the 5-year period indicates that production did not wholly depend upon the corn crop.

Hog production is one of the main livestock enterprises throughout the Corn Belt. As a general rule it is profitable over a period of years. It fits into the operating plan used on most farms and aids in the marketing of a large part of the corn crop. On some farms hog production is the main livestock enterprise, while on others it is a side line to other livestock programs, such as raising beef cattle and dairying.
Table 1.—Relation of corn to production of hogs in 6 leading hog States, 1934–39

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<tr>
<th>State</th>
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<tr>
<td>Total, United States</td>
<td>1,194,240</td>
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<th>Proportion of entire crop produced by 6 States</th>
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<tr>
<td>1934</td>
<td>48.79</td>
<td>49.92</td>
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1 Preliminary figures.

While corn ranks first as the main cereal crop used in feeding hogs in the Corn Belt, other cereal grains such as wheat, oats, barley, and rye are used quite extensively, sometimes as a partial substitute for corn. In the northern section of the Corn Belt the small grains assume considerable importance in swine feeding.

Protein-rich feeds to balance the protein deficiency of the common farm grains are readily available to hog feeders in this region. By-products from the dairy industry, such as skim milk, buttermilk, and whey, furnish protein feeds of animal origin. Tankage, a byproduct of the packing industry, is manufactured in large quantities within the region and makes available an animal protein without excessively high transportation charges for long shipments.

The rise of the soybean to prominence in the farm program in the last 15 years in this region has made available a home-grown plant-protein supplement. Soybeans are grown on many farms and are used in various ways. Much of the harvested crop is milled, and the meal remaining after removal of the oil is used in hog feeding. Other proteins of vegetable or plant origin, such as cottonseed meal, linseed meal, and gluten meal, are often fed in combination with proteins of animal origin.

Pastures are used quite extensively as a further source of proteins, minerals, and vitamins. Permanent pastures of bluegrass, alfalfa,
and the clovers make grazing available during the growing season. Temporary pastures are used to furnish grazing at stated intervals or to supplement the permanent pastures.

The hog has also been used quite extensively in the Corn Belt in helping to harvest crops at different seasons of the year. Corn is fed not only on the cob, shelled, or as meal in the feed lot, but is hogged down by turning the hogs into the field and allowing them to harvest the crop. Soybeans are commonly planted with corn for hogging down. The supplemental feeding of a small amount of tankage daily with access to a mineral mixture completes a well-balanced ration.

Pigs weighing 75 to 100 pounds are used to follow steers in the feed lot and glean the waste that otherwise might be lost. The gains made by pigs following cattle increase the returns from the cattle-feeding enterprise. The method of feeding and amount of feed given to the cattle influence the requirements for additional grain and protein supplement for the hogs. Where cattle are fed largely on grain the practice of feeding a small amount of protein supplement to the hogs daily helps to balance the ration.

**THE SOUTH**

Approximately 20 percent of the total hog population on January 1, 1939, was found in the eight Southern States of Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas. In number of hogs this section ranks next in importance to the Corn Belt. Formerly hog production was retarded somewhat by the pre-eminence of the cotton crop. Because of the ravages of the boll weevil, together with campaigns for soil improvement, the hog is gradually finding a more important place in the new diversified agriculture in the South. In parts of the South small numbers of hogs that are allowed to shift for themselves on free range in the woods may still be found. This practice is decreasing, however. Farmers are realizing the importance of better feeding practices. The larger use of soil-improvement crops together with favorable climatic conditions makes possible year-round systems of grazing for hogs in many parts of the South. The past decade has seen many changes in systems of feeding and management, and as a result the South is now producing a much more desirable market type of hog.

The feeds vary somewhat according to localities. Although corn can be grown in the South, it does not assume the importance in swine feeding that it does in the Corn Belt. The yield per acre is much smaller because of climatic and soil conditions.

Grain sorghums, which produce a fair crop on soil too thin for corn, are similar to corn in composition and are substituted where they are available. Kafir, milo, sorgo, and feterita are of importance in swine feeding in Oklahoma and Texas.

One of the southern crops associated closely with pork production is the peanut. Hogs are used to glean the peanut fields after the crop is harvested or are turned into the field to harvest the entire crop.

Byproducts from the rice industry such as rice bran, rice polish, and brewers' rice are utilized in hog feeding, especially in Arkansas, Louisiana, and Texas. Both rice bran and rice polish, because of their high fat content, produce soft pork unless fed in small amounts
in combination with other nonsoftening concentrates, such as corn or brewers’ rice.

Of the root crops used in this area for swine feeding, sweetpotatoes are of most importance. They can be grown on soil that is sandy and too thin for good corn production. Hogs are used to clean up the fields after sweetpotatoes have been dug.

Various locally produced protein concentrates are available, including tankage, shrimp meal, and milk byproducts, all of animal origin, and cottonseed meal, peanut meal, and ground alfalfa, of plant origin.

THE ATLANTIC COAST REGION

The 17 States in the Atlantic coast region had on farms on January 1, 1939, approximately 13 percent of the total hog population. Only 2.5 percent were in the 9 North Atlantic States. Pennsylvania alone accounted for over half the number in that area. The 8 States in the South Atlantic group accounted for 10.5 percent of the total number of hogs. Georgia and North Carolina were the principal hog-growing States in the southern part of the region.

The majority of swine enterprises in the North Atlantic States are small, and most producers feed only a few pigs for home use. In Pennsylvania hogs are maintained in small units on a large number of farms. Most farmers raise a surplus for sale each year, thereby augmenting their cash returns. Most farms have a diversified livestock program with the hog used as a side line to cattle feeding, dairying, or other enterprises. In addition, hogs are used to glean the fields and consume a variety of feeds that otherwise might be wasted. Grain crops such as corn, barley, oats, and rye are marketed through hogs. The general plan of feeding follows closely the practices in the Corn Belt. Protein supplements of tankage, fish meal, middlings, and skim milk are used to supplement the grain ration. Pasture crops of alfalfa, the clovers, soybeans, rape, and winter rye are commonly used.

The principal feeds used in fattening hogs in the South Atlantic region are somewhat similar to those used in parts of the South, especially in Arkansas, Mississippi, and Alabama. Corn is used in the dry lot, or for hogging down alone or in combination with peanuts or soybeans. The protein supplements available are fish meal, cottonseed and soybean meals, tankage, and milk byproducts.

Peanuts are used extensively as a hog feed in parts of Georgia and Florida and are usually grazed alone or in combination with corn. Sweetpotatoes and chufas are both grazed in the same States.

Year-round systems of crop rotation are being worked out for different sections so that hogs can be grown and fattened on mature crops. Usually such crops as corn, peanuts, sweetpotatoes, soybeans, and oats are planted at different times to furnish a succession of mature grazing crops.

Pasture crops are important since they can be utilized during a relatively large part of the year and furnish a variety of home-grown protein and mineral supplements at a reasonable price. Crops used to advantage are alfalfa, the clovers, rape, soybeans, cowpeas, Sudan grass, winter oats, rye, and sorgo. Sudan grass and sorgo pastures are of value because their dense stands permit much heavier grazing than such crops as soybeans and cowpeas. Limited feeding of corn to pigs on green
forage to weights of 75 to 100 pounds is practiced in some sections. At these weights pigs are turned into the fields to hog down corn.

A large number of hogs in the Atlantic coast region are grown and fattened on garbage near the larger cities. Most garbage is more or less a balanced ration and no supplemental feed is required. Some feeders, however, supplement the garbage with feeds such as corn, barley, and middlings in order to obtain faster gains. Some garbage feeders follow the plan of raising their own pigs. The sows are usually fed on garbage and the pigs are started on garbage as sucklings. Some feeders, on the other hand, purchase pigs weighing 75 to 100 pounds and finish them on garbage. Hogs relish raw garbage more than cooked garbage. However, recent investigations conducted by the Zoological Division of the Bureau of Animal Industry show that the occurrence of trichinae in hogs fed raw garbage is eight times as great as that in hogs fed cooked garbage. Cooking the garbage helps to destroy such organisms.

THE WESTERN STATES

Less than 5 percent of the total hog population on January 1, 1939, was found in the 11 States of the region west of the Corn Belt and the South. A large part of this region is mountainous, arid, or a plain and range country better adapted to sheep and cattle than to hogs. Eighty-five percent of the hogs raised in the region are found in California, Idaho, Colorado, Oregon, and Washington.

The feeds used, alone or in combination, in making up the basal ration are corn, barley, wheat, rye, oats, and hog millet. The grain sorghums—kafir and milo—and rice bran and rice polish, byproducts of the rice-milling industry, are used to some extent. All these feeds except corn should be ground or rolled for most economical returns in the ration for growing and fattening hogs. Protein supplements of animal origin fed in this area are fish meal, tankage, and skim milk. The plant proteins, such as wheat middlings, alfalfa, linseed meal, cottonseed meal, and soybean meal are of more importance, however.

In California, barley is the principal cereal grain used. The grain sorghums, rice bran, and rice polish are also fed. The climate of California is mild and pasture is available most of the year. Alfalfa grows well and furnishes a legume of excellent quality to supplement grains and animal protein. A large number of hogs are fed garbage in the vicinity of the larger cities under conditions similar to those on the Atlantic coast. Some feeders are grain-feeding the garbage-fed hogs prior to marketing in order to improve the product. Low-grade fruits and vegetables are sometimes utilized in swine feeding. Raisins, figs, and prunes are carbohydrate feeds and usually give best results when combined with barley or the grain sorghums and supplemented with a protein concentrate. Tuber and root crops such as artichokes, sweetpotatoes, beets, and potatoes fed in combination with other feeds furnish nutrients and add variety to the ration.

FEEDS FOR ENERGY AND FATTENING

The chief sources of heat and energy in the diet are the carbohydrates and fats. Materials rich in these substances are popularly called fattening feeds. Carbohydrates are found in abundance in the cereal
grains, corn, wheat, barley, rye, oats, and other farm-grown feeds that make up the basal part of the swine ration. Fat is supplied in small amounts in the cereal grains and in protein supplements of both animal and plant origin. Certain hog feeds, including peanuts and soybeans, are high or moderately high in fat. The fuel value of fat in the ration is about 2.25 times as great as the fuel value of an equal weight of carbohydrates or protein. In the fattening animal, the fats in the diet are utilized to form body fat. Swine are unusually efficient, however, in converting sugars and starches into body fat.

Corn is a carbohydrate feed, and because of its deficiencies in protein, minerals, and vitamins, it needs to be supplemented with feeds high in these nutrients. Hogs fed on corn alone usually gain slowly and require a large amount of feed per unit of gain. White corn, especially, is deficient in vitamin A and for young pigs in dry lot or hogs on winter rations deprived of access to pasture it should be supplemented with at least 5 percent of alfalfa-leaf meal or good-quality alfalfa hay in addition to an animal protein supplement of skim milk, tankage, or fish meal. If young pigs are raised to a weight of 100 pounds on normal rations containing a generous supply of vitamin A, they may store enough of the vitamin in their bodies to permit economical gains of approximately 100 pounds before malnutrition troubles develop if they are changed to a white-corn ration. Corn may be fed on the cob or shelled and produces good results when fed in properly balanced rations to all classes of hogs. Usually it does not pay to grind corn for hogs unless it is desirable to combine it in definite proportions with other feeds, in which case it is easier to make a more uniform mixture with ground corn.

The grain sorghums, kafir, milo, sorgo, feterita, and others, grown in regions where climatic and soil conditions are unfavorable for corn, have approximately 90 percent of the feeding value of corn. Experiments have shown that better gains are produced when the grains are ground and fed dry rather than soaked.

Wheat is usually regarded as a cash crop and milled for human consumption. There are times, however, when the relation between the price of wheat and that of corn makes it profitable to feed wheat to livestock. Pound for pound, good-quality wheat on the average is approximately 5 percent more efficient than corn in producing gains on hogs. Wheat is higher in protein and carbohydrates, contains less fat, and is slightly higher in total digestible nutrients than corn of the same dry-matter content. Since the protein in wheat is deficient only in the essential amino acid lysine, while corn is deficient in both lysine and tryptophane, usually less protein supplement is required to balance the ration when wheat is used. Wheat, like white corn, is deficient in vitamin A. Because the wheat grain is small and rather hard it should be ground for most economical utilization. Wheat may be fed as the sole grain or it may be combined with other grains. Wheat byproducts such as standard middlings, flour middlings, and red-dog flour are quite commonly fed to hogs in varying amounts as partial substitutes for corn. Generally speaking, wheat byproducts may replace up to one-third of the corn in the ration with good results. When wheat is low in price or damaged by insects it may be more profitable to market it through hogs than in other ways.
Barley is slightly higher in protein content than corn, but should be supplemented with animal protein feeds and pasture or dried-legume forage in order to furnish essential amino acids, minerals, and vitamins, especially vitamin A (555). The relative value of barley compared to corn in the swine ration depends on the weight of the barley per bushel. Experiments have shown that the efficiency of barley as a hog feed compared with corn ranged from 92 percent for heavy barley weighing 49 pounds per bushel to 74 percent for light barley weighing 41 pounds per bushel. Grinding barley before feeding improves its feeding value enough to more than pay the cost of the operation. Pound for pound, barley should be cheaper than corn when it is used as a hog feed, since it is not so efficient and an additional expense is incurred for grinding.

Oats are considered a good feed for growing pigs and for brood sows, but they are too high in fiber and too bulky to be used exclusively as the fattening ration for hogs. In addition it is known that a diet of oats needs to be supplemented in protein, vitamin A, and calcium. For fattening hogs oats are usually fed in combination with other grains such as corn, wheat, or barley. Grinding oats increases their feeding value for growing and fattening pigs. When good-quality ground oats, weighing 32 pounds to the bushel, do not make up more than one-third of the ration they are considered to be equal in feeding value, pound for pound, to corn. When oats make up more than one-third of the ration for fattening hogs their value decreases to 65 to 70 percent of the value of corn. Hulled oats usually are more expensive to prepare than ground oats. To be used profitably as a fattening feed for hogs, oats should be as cheap as or cheaper than corn, pound for pound.

Rye is often fed to hogs and is considered to have a feeding value approximately 90 percent that of corn. Usually best results are obtained when rye does not make up more than one-half the ration for fattening hogs. Equal parts of ground rye and corn or ground rye and ground barley properly supplemented with proteins of good quality give good results. Generally rye is not very palatable and hogs lose their appetite for it if fed too much. Usually the feed consumed daily by pigs on a rye ration decreases as the proportion of rye is increased. When rye is cheap in price compared with other grains it can be substituted economically for part of the grain concentrate in the ration.

The several byproducts of the rice-milling industry available for feeding hogs are classed as carbohydrate feeds. In limited amounts, rice bran is considered to have a feeding value about 90 percent of that of corn. Rice bran is high in fiber and because of its bulkiness should be fed in combination with corn or tankage. Not more than 50 percent of the ration should be made up of rice bran because of its tendency to produce soft pork.

Brewers' rice is made up of the small broken kernels of rice. It is similar to corn in composition. When properly supplemented with an animal protein such as tankage, fish meal, or skim milk, it produces gains comparable to those made on a corn ration. The carcasses of hogs fed on brewers' rice are very firm.

2 Italic numbers in parentheses refer to Literature Cited, p. 1075.
Molasses is sometimes used in the swine ration. It is considered to have a feeding value approximately 90 percent that of corn when it is substituted for corn up to about 20 percent of the ration. It is usually unsatisfactory when substituted for all the corn in the ration. When it is cheaper than corn or other grain, molasses may be substituted for a part of the grain in the ration. Molasses may cause scours in pigs unless they are started on it gradually and then fed it in limited quantities.

Sweetpotatoes are fed to a considerable extent in the South. They are high in starch in proportion to their protein and mineral content. Best results are usually obtained when pigs grazing sweetpotatoes are given approximately 2 pounds of grain a day per 100 pounds live weight in addition to a protein supplement of tankage or fish meal, and a mineral mixture. Hogs that have access to a soybean field when grazing sweetpotatoes need less protein supplement. It requires approximately 4 pounds of sweetpotatoes to equal 1 pound of grain when fed to hogs in dry lot, while approximately 5 pounds of sweetpotatoes are required to equal 1 pound of grain when the crop is hogged down.

White or Irish potatoes are not so important a source of carbohydrate in the hog ration in this country as in Europe. They are used as a hog feed when they have little value on the market and grain prices are high. It is necessary to boil or steam potatoes for hogs as they are not palatable in the raw state and in large amounts may cause scours. Pigs fed heavily on potatoes will not show the bloom or apparent finish of those fed on a more restricted allowance. Boiled potatoes may be used to replace not more than 50 percent of the grain ration. From 350 to 450 pounds of boiled potatoes are required to equal in feeding value 100 pounds of standard cereal grains. The importance of balancing a potato ration with adequate protein and minerals must be stressed. A heavy potato ration may be fed to bred sows in the early stages of gestation, but as pregnancy advances it should be gradually reduced and entirely eliminated prior to and immediately after farrowing.

Other root crops are of little importance in swine feeding in this country. These crops are succulent and probably are most valuable for brood sows and fall pigs during the winter months when pasture crops are not available. They usually contain 80 to 90 percent of water and do not have much actual feeding value. Under favorable conditions it requires 5 to 10 pounds of roots to equal the feeding value of 1 pound of grain. Best results are obtained when the roots are cut in small pieces and fed raw.

FEEDS THAT CAUSE SOFT PORK

One of the most important factors in determining the quality of pork products is firmness (469, 471). The products of soft and oily carcasses frequently suffer a severe cut in price. While no reliable average figures are available, it is estimated that soft hogs may be docked 10 to 25 percent of the market price.

There are a number of factors that have an influence on firmness, the chief of which is feed. The quantity and characteristics of the fat in the various feeds greatly influence the firmness of the body fat of
the hog. Hogs fed on large amounts of feeds of plant origin that are high in oil usually produce soft carcasses.

Feeds that produce soft pork can usually be grown cheaply. The hog producer should consider how he can use them to best advantage. When they are used for young growing pigs, a sufficiently long subsequent period on feeds that produce a hardening effect on the carcass may improve the quality of the product enough to make it acceptable on the market. Generally speaking, it requires three to four times as much gain on hardening feeds as was produced on the softening ration to make a satisfactory product.

The feeds most commonly used that produce soft pork are peanuts, soybeans, and mast (acorns and nuts on which pigs graze in wooded areas). Mention has been made of rice bran and rice polish. Corn-germ meal is another mill byproduct that must be classed as a softening feed.

Like soybeans, peanuts contain a much higher percentage of protein than the cereal grains. Because of their relatively high oil content together with a fair proportion of starches, they are both properly classed as fattening feeds. On a quantitative basis these feeds would not be expected to require additional protein or carbohydrate. Unfortunately, exclusive feeding of either is marked by the production of soft pork and by only moderately good rates of growth, owing to the rather poor quality of the protein as well as deficiencies in minerals and vitamins. While pigs make good gains on peanuts alone, especially when grazed, the addition of small amounts of animal protein such as tankage or fish meal fed in the dry lot has been found to increase the rate and economy of gains. The addition of a mineral mixture and of legume hay or meal as a source of carotene is also advisable, especially in lengthy feeding periods.

Soybeans, because of their widespread adaptability to different soils and climatic conditions, are a popular hog feed. They can be used to best advantage when they form part of the protein supplement rather than the basal part of the ration. Under ordinary conditions when soybeans used in this way do not form more than 10 percent of the ration of pigs starting at 100 pounds weight, carcasses of good quality will be produced. The addition of tankage to a soybean ration improves its quality. The soybean is low in calcium and phosphorus and a mineral mixture of these elements should be fed with a soybean ration for best results.

In some sections of the country, acorns, usually fed by mast grazing, assume considerable importance in feeding hogs and help to cheapen production. The pork produced is usually soft and of poor quality. For best results hogs should be finished on a grain ration following mast feeding.

BREWERY AND DISTILLERY BYPRODUCTS

Wet brewers' grains, a distillery byproduct, may be fed to fattening hogs when such concentrates as grain are supplied in addition, but the feed is too watery to be used alone. Usually about 4 pounds of wet brewers' grains are equivalent in feeding value to 1 pound of the dried. The composition and feeding value of wet brewers' grains vary widely, depending on the kind of grain predominating; rye is of considerably
less value than corn. Because of their low nutritive value these feeds are not economical unless the haul is short or unless they can be purchased at less than one-fourth the price of grain.

Distillery slop may be used in the ration for fattening hogs or for brood sows if it is fed in addition to a liberal grain ration and supplemented with such proteins as fish meal or tankage. From 1 to 1½ gallons per 100 pounds live weight daily is considered a good allowance.

PROTEIN FEEDS

Protein feeds are necessary to maintain and build body tissue. Because hogs grow at a more rapid rate than other farm animals in relation to their weight, their feed requirements change rapidly. In a comparatively short time there is a change from the high protein requirement of growth to a lower protein requirement during the fattening period after growth has been attained. Because of the low protein content of farm-grown grains used in swine feeding, the protein supply in the ration needs to be considered carefully.

The deficiency of grains in protein is corrected by adding protein-rich feeds such as milk and milk byproducts, tankage, fish meal, or linseed, cottonseed, soybean, or alfalfa meal to the cereal part of the ration. Home-grown protein feeds are usually not so abundant as carbohydrate feeds and it is often necessary to purchase them. Although they are higher in price than carbohydrate feeds, the cash outlay usually yields greater returns in increased rate of gain and better utilization of feed per unit of gain.

Skim milk is a valuable protein supplement for hogs when fed in connection with corn or other feeds of like nature. It should be fed in limited quantities for the most economical returns. Soon after pigs are weaned, not more than 4 or 5 parts of skim milk to 1 part of corn should be fed, and the proportion of skim milk should be reduced to about 1 or 1½ parts to 1 part of corn when the pigs weigh 150 pounds or more. Under these conditions, it can generally be figured that 100 pounds of skim milk is worth about half the price of a bushel of corn. The feeding value of buttermilk is similar to that of skim milk for pigs. Skim milk or buttermilk from cows that have not been tested and found to be free from tuberculosis should be pasteurized before being fed to pigs to prevent transmitting this disease.

Whey from cheese factories when fed to hogs has been found to be worth about half as much per 100 pounds as skim milk, or about the price of a peck of corn. Best results are usually obtained when whey is fed as a protein supplement to a corn or barley ration in combination with such feeds as linseed meal, cottonseed meal, or middlings.

Digester tankages, a byproduct of the packing industry used in hog feeding, are usually classified according to the percentage of protein they contain, which may range from 35 percent in the lower grade to 60 in the higher. Tankage is a good protein supplement to any of the cereal grains in balancing the ration. It is also high in mineral content and helps to supply the mineral deficiencies of the cereal grains. The grade of tankage is determined on the basis of the economy with which it furnishes a unit of protein. The fat in the tankage should be figured as equal in value to an equivalent amount of corn.

Fish meal is a byproduct of the fisheries industry. It is manu-
factured on both the Atlantic and Pacific coasts and has a wide dis-
tributioa as a high-grade protein supplement in competition with
tankage. Fish meal came into prominence as a protein supplement
in this country about 1920. Its composition is somewhat similar to
that of tankage but it is in addition a source of vitamins A and D.
In summarizing a number of tests conducted at various State agricul-
tural experiment stations comparing the value of fish meal with
tankage as a protein supplement to the corn ration, Morrison (819)
found fish meal to be superior for fattening hogs in dry lot. The
difference was not so great for pigs on pasture as for pigs in the dry
lot. The method of manufacture of fish meal is a determining factor
in its nutritive value, the vacuum-dried product generally having a
higher nutritive value than the flame-dried product made from the
same raw material. Price will no doubt be the main factor in deciding
which of the kinds of fish meal to use.

Shrimp meal, sometimes referred to as shrimp bran, is a good protein
supplement produced in limited quantities. It consists of the dried
heads and hulls of shrimp, a byproduct of the shrimp industry. The
meal contains approximately 40 to 45 percent of protein. Experi-
ments at the Louisiana Agricultural Experiment Station (149) show
it to be equal or superior to tankage as a protein supplement, whether
fed with or without other supplements. It is also cheaper in price per
ton than tankage.

Cottonseed meal, a byproduct of the cotton industry, is a cheap
source of protein when fed in limited quantities. It is deficient in
calcium and vitamin A, but experiments at the Texas Agricultural
Experiment Station (458) indicate that it may be fed in amounts up
to 9 percent of the ration with little danger. Like linseed meal it can
be used to best advantage mixed with tankage or fish meal. The
addition of good-quality ground alfalfa hay to a cottonseed-meal
ration supplies calcium and vitamin A and improves the quality of the
ration.

Fifty pounds of tankage, shrimp bran, or fish meal, 25 pounds of
cottonseed meal, and 25 pounds of ground alfalfa hay make an efficient
protein mixture. Good results are obtained when the grains and
protein supplement are placed in separate compartments of a self-
feeder and the hogs are allowed free access to the feeds at all times.

Peanut meal, a byproduct of the peanut industry, is a good protein
of plant origin. Because it is lacking in vitamins A and D and is low
in calcium, these elements should be supplied in the ration through
other feeds. Good results have been obtained in fattening hogs on
pasture when peanut meal has been fed in the proportion of approxi-
mately 5 parts of corn and 1 part of peanut meal, supplemented with a
good mineral mixture. For younger pigs it is advisable to combine
peanut meal with tankage or fish meal to furnish protein of good
quality. When peanut meal makes up half of the protein supplement
for pigs on a corn ration in dry-lot feeding, the gains are usually
slower and less economical than when either soybean or cottonseed
meal is used.

Soybean meal (oil extracted), containing 35 to 42 percent of digest-
able protein, is an excellent protein supplement to the usual grains
for growing and fattening hogs. It may be used as the sole protein
supplement for hogs weighing 100 pounds or over, or it may be fed in combination with tankage or fish meal. Soybean meal is low in calcium and phosphorus, and a mineral mixture containing both of these elements should be available to hogs at all times. If home-grown soybeans can be exchanged for soybean meal at or near the same price per ton it is well worth the trade because the latter can be used more extensively in the ration.

Alfalfa meal made by grinding alfalfa hay is fairly rich in protein and minerals and is a good source of vitamins A and D. On account of its bulk it should not be fed as the sole protein supplement to fattening pigs, but it may be combined with other more concentrated proteins. Alfalfa-leaf meal has a higher protein and a lower crude-fiber content and is usually higher in price than alfalfa meal. In comparing the two from the standpoint of economy, the vitamin and mineral content should be considered in relation to the need of the hogs for these nutritive essentials. Alfalfa meal or ground alfalfa hay can be fed efficiently at a level of 5 to 10 percent of the total ration, or even 15 to 20 percent when the ration is balanced otherwise. As a home-grown protein supplement, the use of alfalfa meal may reduce the amount of high-priced protein feeds that must be purchased.

A number of suggested protein supplements composed of feeds of both animal and plant origin are shown in table 2. These supplements provide for the use of home-grown protein products, either wholly or in part. They may be fed in a definite proportion with the grain ration or mixed and fed in a self-feeder, giving the hogs free choice.

**Table 2.—Suggested formulas for protein mixtures**

<table>
<thead>
<tr>
<th>Formula No.</th>
<th>Tankage</th>
<th>Linseed meal</th>
<th>Alfalfa meal</th>
<th>Cottonseed meal</th>
<th>Soybean meal</th>
<th>Ground soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>25</td>
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<td>25</td>
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</tr>
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<td>3</td>
<td>25</td>
<td>25</td>
<td>25</td>
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<td>5</td>
<td>30</td>
<td>35</td>
<td>35</td>
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</tr>
<tr>
<td>6</td>
<td>25</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

1. Either fish meal or shrimp meal may be substituted for tankage in the above mixtures. Skim milk or buttermilk may be used instead of tankage. When used as the only protein supplement, 2 pounds of milk may be used to 1 pound of grain.

**SELECTING THE RATION**

Besides establishing fundamental facts about the nutritive requirements of swine, experimental work conducted by the agricultural experiment stations during the past 50 years has answered many practical questions about the selection of rations.

Not all the feed eaten by the hog is digested or utilized. The proportion utilized varies partly according to the kind of feed. To get a high degree of utilization, it is necessary for the most part to depend on specific combinations of feeds. Because of this fact, tables of feed analyses with coefficients of digestibility, biological values of proteins, and other expressions of nutritive value lack the degree of exactness of figures for the nutritive value of a specific ration used under specified conditions.
Results of experimental work indicate that as the percentage of fiber in the ration for fattening hogs is increased beyond a certain point, the rate of gain of the pig tends to decrease, while the amount of feed required to produce a unit of gain increases. A ration for good growth and fattening usually does not contain over 5 percent of fiber, although as much as 7 or 8 percent is sometimes fed without materially affecting the rate of gain.

The question of how much protein to feed is usually difficult to answer. Since proteins have varying biological values as building material for animal tissues, it may be best to supply an excess in the ration if the price of protein feeds is not too high in relation to other feeds. Generally speaking, the ration for pigs weighing 35 to 100 pounds should contain approximately 18 to 20 percent of protein; for hogs weighing 100 to 150 pounds, approximately 15 percent; and for hogs weighing 150 to 225 pounds, approximately 12 percent.

The choice of the feeds to be used in the ration will depend on what is available locally and comparative costs. There is no certain method of determining the feeds that will give best results without a definite comparison, which is not always practicable. Usually the feed that costs least per unit of protein is the one to use. For example, if 100 pounds of 60-percent-protein tankage costs $3 and 100 pounds of soybean meal containing 40 percent of protein costs $1.75, then a unit of protein in tankage would cost $3 divided by 60, or 5 cents a pound, while a unit of protein in soybean meal would cost $1.75 divided by 40, or 4.38 cents a pound. In this case the unit of protein is cheaper in soybean meal without regard to digestibility or biological value. These two factors vary with different combinations of feeds fed under different conditions. For example, the Wisconsin Agricultural Experiment Station found that the trinity mixture, composed of 50 parts of tankage, 25 parts of linseed meal, and 25 parts of alfalfa meal, by weight, when fed under certain conditions produced more economical gains than tankage fed as a sole supplement.

The need for minerals and vitamins can usually be met in a well-balanced ration through a judicious use of protein feeds and forage without recourse to special supplements. The cereal grains are low in minerals and contain less calcium than is needed for rapid growth. Protein supplements such as tankage, fish meal, and skim milk are relatively high in calcium and ordinarily furnish enough of this element. Phosphorus is usually found in adequate amounts in grains and protein supplements. Pastures likewise furnish minerals and vitamins to help correct the deficiencies of those elements lacking in the grain ration. When hogs are fed in dry lot there is more likelihood of a shortage of minerals and vitamins. In this case a mineral mixture may be kept available in small boxes or self-feeders to which the hogs have access at all times, or minerals may be fed in the grain ration at the rate of 1 pound of mineral mixture to each 100 pounds of feed mixture. The vitamins present in green pasture, legume hays, and yellow corn are generally considered sufficient to meet the requirements.

The tables in the article Composition of the Principal Feedstuffs Used for Livestock (p. 1065) should be consulted for data on general composition, including calcium and phosphorus, and for the digestible
nutrients of the more common hog feeds as an aid in the selection of
the more unusual feed combinations for compounding rations.

METHODS OF FEEDING

A number of different methods may be used in feeding hogs, in-
cluding hand feeding, self-feeding, limited feeding, and hogging-down
crops. It is not possible to say that any one system is the most
practical under all conditions. In fact, the hog feeder may employ
two or more methods. A brief description of the various methods
will be given, but it will be for the individual to decide which best
fits into his production program.

Years ago the hand-feeding system was used almost exclusively
except as pigs were permitted to graze in the woods and fields. The

![Figure 2.—Suckling pigs with access to a self-feeder containing supplementary feeds.](image)

results obtained by this method depend largely on the ability of the
feeder to determine the amount to feed. Regularity is important, as
the pigs become accustomed to the time of feeding—usually twice
daily, morning and evening, although some feeders may give a noon-
day meal—and any great variation may tend to upset the digestive
system. The feed is usually dry or in slop form and is mixed in definite
proportions so that the hog has no choice, but must accept the
mixture as a whole.

Since about 1920, self-feeding has come into prominence as an
economical method. The hog is one animal that will not overeat
when given unlimited access to large quantities of feed. The results
of many experiments comparing hand feeding with self-feeding for
growing and fattening hogs generally favor the latter method. Various
aspects of rationing by the self-feeder method have been discussed by Evvard (351). Different feeds are generally placed in separate compartments of the feeder and the pig is allowed to balance its own ration (fig. 2). Generally speaking, the pig selects different feeds in the proportions that meet its needs for growth and development. The efficacy of the system is discussed in the article Nutritive Requirements of Swine in connection with the daily intake of total feed and protein by record-of-performance pigs (p. 714). Self-fed pigs eat smaller amounts at a time but eat many times during each 24 hours. The fact that they eat smaller amounts at a feeding may lead to less waste in the assimilation of food and account for the more economical use of feed. A self-fed pig also seems to be more satisfied, seldom grunting or squealing, whereas the pig that is hand fed is usually squealing for feed at various intervals between feedings. Aside from the fact that self-fed pigs usually gain rapidly, the saving in labor under this system is a point especially in its favor.

If it is desired to feed a certain combination of grain and protein supplements, the feeds may be mixed in definite proportions and the dry feed placed in the self-feeder where the hog will have an opportunity to eat the amount it desires at any time. Though many combinations of feeds may be used, a few are suggested in table 3 for different classes of hogs, fed by either the hand-feeding or the self-feeding method, on a full grain allowance.

**Table 3.—Suggested feed combinations for various classes of hogs**

<table>
<thead>
<tr>
<th>Class of hogs</th>
<th>Corn</th>
<th>Barley</th>
<th>Wheat</th>
<th>Oats</th>
<th>Rye</th>
<th>Grain sorghum</th>
<th>Tankage or fish meal</th>
<th>Cottonseed meal</th>
<th>Linseed meal</th>
<th>Alfalfa meal</th>
<th>Soybeans</th>
<th>Soybean meal</th>
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</thead>
<tbody>
<tr>
<td>Growing—weaning to 100 pounds (dry lot)</td>
<td>80</td>
<td>85</td>
<td>90</td>
<td>20</td>
<td></td>
<td>85</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Growing—weaning to 100 pounds (on pasture)</td>
<td>65</td>
<td>65</td>
<td>40</td>
<td>25</td>
<td>25</td>
<td>30</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Fattening hogs over 100 pounds (dry lot)</td>
<td>45</td>
<td>45</td>
<td>45</td>
<td>45</td>
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<td>45</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Fattening hogs over 100 pounds (on pasture)</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>62</td>
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<td>62</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Brood sows and boars.</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td></td>
<td>92</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td></td>
</tr>
</tbody>
</table>

1 Shrimp meal may be substituted for tankage or fish meal in the above mixtures. Skim milk or buttermilk may be substituted for tankage or fish meal. Approximately 11 pounds of skim milk or buttermilk will replace 1 pound of tankage.

2 Linseed meal, soybeans, or cottonseed meal may be used interchangeably.
Limited feeding, in which less than a full daily ration is fed, may be employed when the seasonal feed supply is limited until a new crop is available. Pigs may also be limited in feed when it is desirable to hold them for a certain market. In the case of feeder pigs, the limiting of grain on pasture leads to a greater utilization of forage crops and aids in economical production.

Experiments were conducted by the Department on the effect of limiting the feed allowance to approximately three-quarters and one-half of full feed to pigs starting at 65 pounds in weight and fed to a weight of 200 pounds. The quantity of feed required to produce a unit of gain was generally smaller than on full feeding, although the rate of gain was slower. Pigs on limited feed have less opportunity to store fat, and the meat tends to have a higher proportion of lean than that of full-fed pigs. From the practical standpoint the feeder must decide whether the increased labor necessary under this system might more than offset the saving of feed. Better results are usually obtained when the pig is well grown to a weight of approximately 65 to 75 pounds before the period of restricted feeding begins.

The method of hogging down crops is practiced quite generally in many sections. Corn is the principal crop used and the hogs are usually turned into the field when the corn is in the dent stage. This method saves the labor of harvesting the crop and also has the advantage of scattering the manure over the land (fig. 3). Hogs should not be given too large an area to work over at a time or there may be an excessive waste of grain. A self-feeder containing a protein supplement may be placed in the field, or the supplement may be hand-fed daily to help balance the ration. Usually a short period of feeding
in dry lot is required to finish the hogs before they are marketed. The practice of hogging down small grains is not generally followed, although such crops as rye, barley, and oats are sometimes harvested in this manner. There is usually a larger waste because of the small size of the seeds. Supplemental protein and mineral feeds should be given when small grains are hogged down. In the South, peanuts, sweetpotatoes, and other root and tuber crops are frequently harvested by hogging down.

**PASTURES**

Pasture crops are important in the economical production of hogs. They not only reduce the cost of needed protein, minerals, and vitamins but are a big factor in controlling parasitic infestation if a system of pasture-lot rotation is used. Pigs cannot be grown and fattened economically on forage crops alone, but these crops are an important adjunct to a good grain ration (fig. 4). The saving in the number of pounds of grain required to produce 100 pounds of gain when pigs are on pasture varies considerably. It is estimated that on the average good-quality pasture saves approximately 15 percent of the grain concentrate per unit of gain and speeds up the rate of gain in comparison with hogs fed in dry lot.

Permanent pastures do not give the most economical returns unless they are supplemented by temporary pastures. A combination of the two is a valuable asset. When properly planned they can supplement each other and furnish good-quality grazing at practically all seasons of the year.

The plants used most extensively for permanent hog pastures are alfalfa, red clover, alsike, white clover, bluegrass, orchard grass,

![Figure 4.—Pigs on pasture being fed a limited supplementary grain ration on a feeding platform.](image-url)
lespedeza, and carpet grass. The most common temporary-pasture plants are rape, rye, oats, wheat, soybeans, cowpeas, and field peas. Seeding for temporary pastures should be timed to furnish grazing for short intervals when permanent pastures are in a dormant or resting state. When given a period of rest after close grazing, temporary pastures may make sufficient regrowth to furnish a second grazing period before the field is plowed for the next crop. The rate of seeding for temporary pastures is usually much heavier than for a grain crop.

Legume crops such as alfalfa, the clovers, and rape usually yield the greatest returns in pork production. As a general rule pigs grazed on a good legume pasture when on full feed require approximately half as much concentrated protein supplement as pigs in dry lot. If the amount of grain on pasture is limited, the pigs will consume a greater quantity of forage and possibly require only 30 to 40 percent as much concentrated protein supplement as hogs in dry lot. As the hog grows it will be able to consume greater amounts of forage, thus progressively decreasing the amount of protein supplements needed.

Since there are so many different factors to consider in planning a pasture crop-rotation system for hogs it is best to consult the State agricultural experiment station as to the pasture crops best adapted to a particular region, the time and rate of seeding, and the stage of growth at which the crop should be pastured.

FEEDING FOR SPECIAL CONDITIONS

SUCKLING PIGS

The suckling pig during the first 2 or 3 weeks obtains all its nutrients from the mother’s milk. When the pig is approximately 3 weeks of age it will begin to take additional feed. Feeds of a protein nature such as skim milk or tankage, if made available in a creep, will give the needed stimulus to faster growth and produce a larger pig at weaning time.

GROWING AND FATTENING PIGS

It may be more profitable at times and under certain conditions to limit the feed of growing pigs to prevent fattening before the fattening period begins. When full feeding is practiced, pigs should be fed liberally on a well-balanced ration. Following weaning, the young pig should receive a ration that supplies a large amount of protein. Protein needs cannot be met by any other nutrient, and if sufficient protein is not present in the ration, the needs will be supplied from the tissues of the body and growth will be retarded. The pig is able to retain and build into muscle tissue a large part of the protein taken from the feed. As it grows older the percentage of protein stored in the body decreases. After growth has stopped and the muscles and organs have reached their full development, little protein is stored. It is important, therefore, that the ration of the young growing animal furnish the proper nutrients to utilize to the fullest extent this early efficiency in transforming food into body tissue. Pasture and forage crops play an important part in producing cheap gains on growing pigs.

After the pig attains its growth, the demands for fat production,
which are supplied largely by carbohydrates, are most important. Concentrates must be supplied, since the hogs cannot consume enough pasture or cured forage to fatten them. Fattening pigs on full feed require approximately 5 pounds of feed daily per 100 pounds of live weight up to 100 pounds in weight. From 100 pounds to a finished weight of 225 pounds, pigs on full feed require about 4 pounds of feed daily for each 100 pounds of live weight. On the average about 400 pounds of feed are required to produce 100 pounds of gain from weaning age to approximately 200 pounds weight. About 360 pounds of this is corn and 40 pounds tankage, fish meal, or the equivalent. On this basis, pigs weighing 35 pounds at weaning and gaining 165 pounds would require 594 pounds of corn and 66 pounds of protein supplement, or a total of 660 pounds of feed from weaning to a market weight of 200 pounds. An additional 100 pounds of feed per pig raised should be added to feed the sow and litter during the suckling period.

Hogs fattened in dry lot require a protein supplement for most efficient results. When hogs are fattened with access to a good pasture, the addition of a protein supplement increases the rate and economy of gains.

THE BREEDING HERD

Pigs that are to be developed for the breeding herd should be fed to get the maximum growth and development without becoming too fat. Both gilts and boar pigs should be fed a ration in which protein makes up at least 12 to 14 percent of the total feed in order to make the maximum development. The pigs should have access to good pasture in summer and to good-quality alfalfa hay or alfalfa meal in winter. Pigs on good pasture may be fed approximately a 3-percent grain ration (3 pounds of feed per 100 pounds live weight daily). Gilts of large type may even be self-fed with the fattening hogs until they reach a weight of approximately 200 pounds without becoming too fat for breeding.

The protein requirements of the boar may be considered the same as those of the sow of equal weight. The young growing boar during the period between breeding seasons needs protein for growth in addition to the requirements for maintenance. Just prior to and during the breeding season the protein part of the ration should be increased to provide for the increased activity during this period.

THE GESTATION PERIOD

The protein, vitamin, and mineral requirements for normal reproduction may be met cheaply if the sows are given access to fall wheat or rye pasture or any other kind of green pasture plus a mineral supplement. When green pasture is not available a rack supplied with green, leafy legume hay, such as alfalfa, soybean, or cowpea hay, will provide proteins, minerals, and vitamins of desirable quality.

Gilts are usually bred at 8 to 8½ months of age to farrow their first litter when 1 year old. During the gestation period, the gilt will usually make better use of her feed than at other times. A gilt carrying her first litter should be furnished with sufficient protein to meet the needs of maintenance and growth in addition to the needs of the growing embryos. For this reason gilts should receive a little more protein daily than old sows. The gilt ration should contain at least
12 to 15 percent of protein of good quality, including a protein of animal origin. A protein reserve should also be built up in the body to provide for the demands of the lactation period when the production of milk for the litter often requires more protein than the sow is able to digest from her daily ration.

The ration for the mature sow during the gestation period should contain at least 10 to 12 percent of protein to meet the needs for maintenance and body repair, the development of the growing embryos, and the lactation period. Since old sows need no protein for growth, they can be fed a larger amount of carbohydrate feeds, which in general are cheaper than the protein supplements.

A ration that contains corn, protein supplement, and a mineral mixture is suggested for the gestation period. The protein supplement may consist of 50 parts of tankage, 25 parts of linseed meal, and 25 parts of alfalfa-leaf meal. To 100 pounds of this mixture may be added 5 pounds of a mineral mixture composed of equal parts of ground limestone, steamed bone meal, and common salt. A sow should be fed to gain ½ to 1½ pounds a day during the gestation period, depending on her condition when bred. Gilts may be fed a ration composed of 7 parts of corn and 1 part of protein and mineral supplement, while old sows may be fed a ration of 8 parts of corn and 1 part of protein and mineral supplement. These mixtures may be fed at the rate of 1½ to 2 pounds daily per 100 pounds live weight, depending upon the condition of the sow. In addition sows should have access to good-quality legume hay in a rack if pasture is not available.

SOWS SUCKLING LITTERS

Sows suckling their litters need a liberal ration containing feeds rich in protein and minerals. If possible they should also have access to good pasture. If this is not available, the ration may contain 5 to 10 percent of good-quality alfalfa hay. Feeds that will furnish a heavy milk flow are desirable so the pigs will get a good start in life. At no time do pigs make as economical gains as when they suckle their dams. A sow on full feed following farrowing will need 3 to 5 pounds of feed daily per 100 pounds live weight, depending on the number of pigs in the litter.

PRESENT-DAY PROBLEMS IN SWINE FEEDING

Experiments in the past developed new methods of feeding, the use of new feeds, and efficient combinations of different feeds to produce economical returns, but present knowledge is limited on many problems of swine feeding. The chemistry of proteins is a field of research that has great possibilities. Information on the amounts of different amino acids in various feeds is fragmentary. More knowledge in this field may lead to entirely different feed combinations or levels of feeding from those used today.

Research in the field of mineral metabolism offers possibilities for refinement of present knowledge. Though past work has thrown much light on the part played by calcium, phosphorus, copper, iron, and iodine in metabolism, little is known of the interaction of such elements as magnesium, manganese, cobalt, and zinc.

Although studies on certain vitamins are well advanced in the case
of small laboratory animals, and to a lesser extent with human beings, their application to the hog is not so far advanced. However, within a comparatively short period pure chemical compounds of a number of vitamins, including riboflavin, nicotinic acid, thiamin, and ascorbic acid, have become available. This simplifies vitamin research by aiding in making up synthetic diets in which the effect of the presence or absence of a single nutrient can be determined.

The relation of nutrition to fertility and the size and vigor of the litter is a field that deserves special attention. What are the factors that affect milk secretion and influence the quality and quantity of milk from the standpoint of the growth and development of the young suckling pig? Although this problem has received much attention in the case of dairy cows, little is known about it in relation to the pig.

Investigation of the nutritive value of different pasture grasses in different stages of growth and the extent to which they may be used in developing the most efficient type of ration offers opportunity for improvement in swine feeding.