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A Manual for Hog Raisers

W. J. Loeffel

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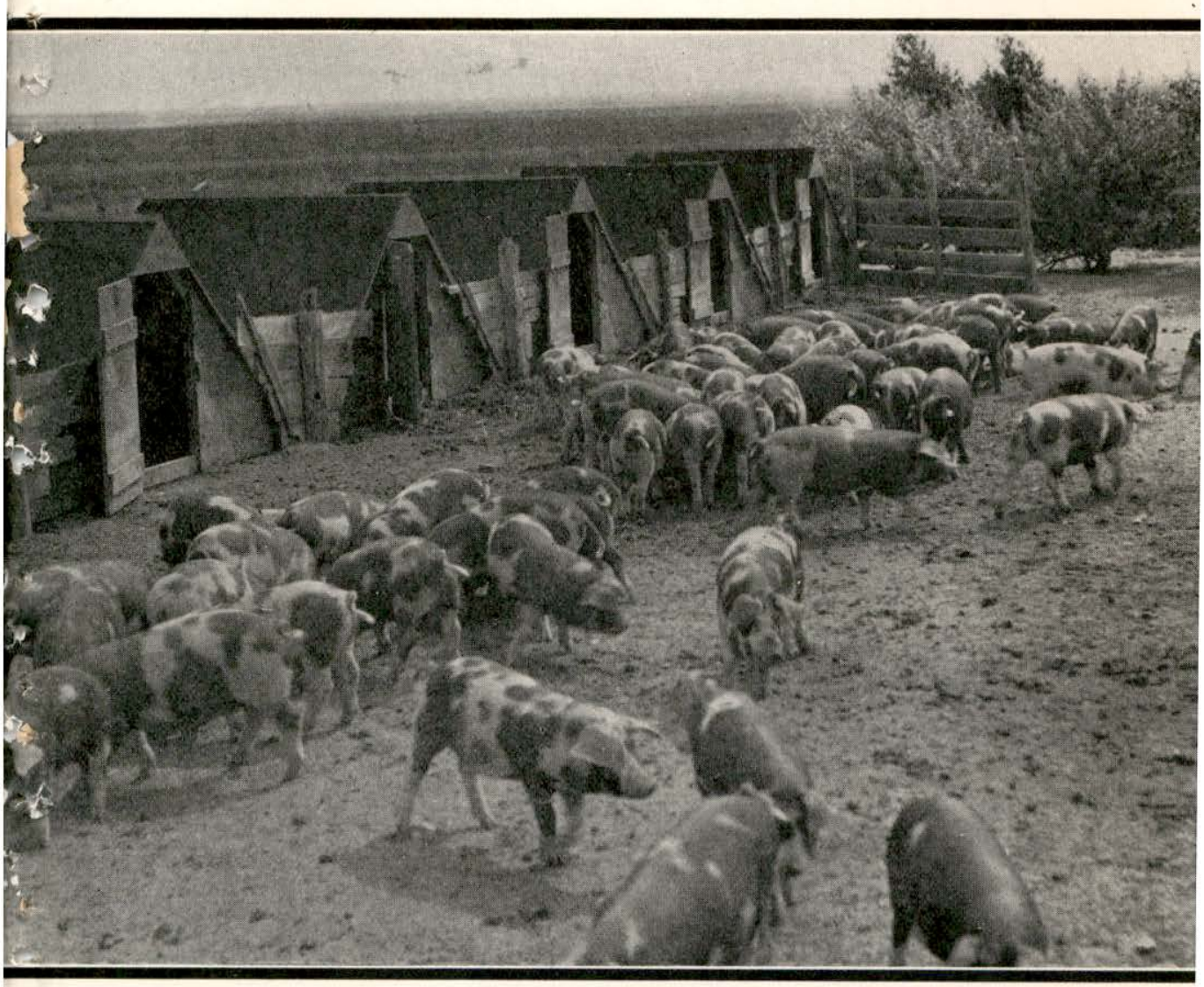

THE UNIVERSITY OF NEBRASKA COLLEGE OF AGRICULTURE
EXPERIMENT STATION, LINCOLN NEBRASKA
W. W. BURR, DIRECTOR

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FOREWORD

In the preparation of this circular, the writer has drawn freely upon the published and unpublished work of the Nebraska Experiment Station and from its substations, particularly that at North Platte. Among investigators in Nebraska who have contributed substantially in this field, E. A. Burnett and W. P. Snyder deserve to be mentioned. Where any field was not adequately covered, the work of other stations was used.

An effort has been made to present the substance of the various experiments in simple form, without tedious details and data so far as possible.

To some, the treatment given the various feeds may be disappointing. There may appear to be contradictions. To all this the writer can say that in the various tests a wide range of conditions existed which may easily explain apparent discrepancies. Some tests were conducted in dry lot, some on forage of various kinds. Pigs differed in initial and final weights. Tests varied in duration. In some cases, feeds were limited in amounts, and in other cases self-feeding was practiced.

The feeding standard and the feed analyses used in this circular were secured from the excellent work "Feeds and Feeding," by Henry and Morrison.

A Manual For Hog Raisers

WM. J. LOEFFEL [1]

Hogs are one of Nebraska's principal sources of agricultural income. According to the Nebraska and the United States Department of Agriculture, the average Nebraska farm income for the nine years from 1926 to 1935 was:

	Value	Per Cent of Total Income
Hogs	$90,209,500	30.6
Beef cattle	68,043,200	23.0
Sheep	3,942,600	1.4
Dairy products	25,205,900	8.5
Poultry products	17,698,000	6.0
Horses, mules, wool and other livestock products	4,832,000	1.6
Crops sold	85,315,400	28.9
	$295,247,300	100.0

The income from hogs fluctuates with the price of hogs and that of other commodities. The average for the ten years as indicated above is 30.6 per cent.

The popularity of the pig is doubtless due largely to his efficiency as a meat producer. He uses less feed to make a given gain than either the steer or the sheep. On being slaughtered, the pig dresses out a higher percentage of meat than either of the other two meat animals. Since pork is generally fatter than beef or lamb, it has a higher energy value.

The hog is generally adaptable. It is difficult to imagine a farm situation into which he will not fit efficiently. Hogs may be handled in small units or large ones, a condition which is not always true of other meat-producing animals. Much of the popularity of the pig is due to his adaptability to the wide range of conditions found on American farms.

In modern business, two well accepted principles are "quick turnover" and "mass production". The brood sow exemplifies both of these. The gestation period of the sow is 112 to 115 days, which is materially less than that of any other meat-producing animal. The Nebraska Pig Crop Contest has demonstrated the possibility of producing marketable pigs weighing in excess of 200 pounds at six months of age. The sow produces not single individuals, but litters of five to eight or more. When necessary, two litters can be produced in one year.

While these qualities are estimable ones in the brood sow, they also are undesirable ones from the standpoint that they accentuate periods of overproduction, with attendant low prices. These periods occur at rather regular intervals.

Pork lends itself to curing processes and, as cured meat and lard, occupies an important place in the world's commerce. Processing aids in obtaining an orderly distribution throughout the year.

The close relationship which exists between hog production and corn production is well recognized. The United States Department of Agricul-

[1] The author wishes to acknowledge aid in the preparation of this circular from Dr. L. Van Es and Dr. C. W. Ackerson, of the Nebraska College of Agriculture, and A. D. Weber, Paul McDill, M. B. Posson, and O. O. Waggener, formerly connected with the same college.

ture Yearbook for 1921 states, "The hog is the largest direct consumer of corn. It is estimated that 40 per cent of the total crop is fed to swine on farms."

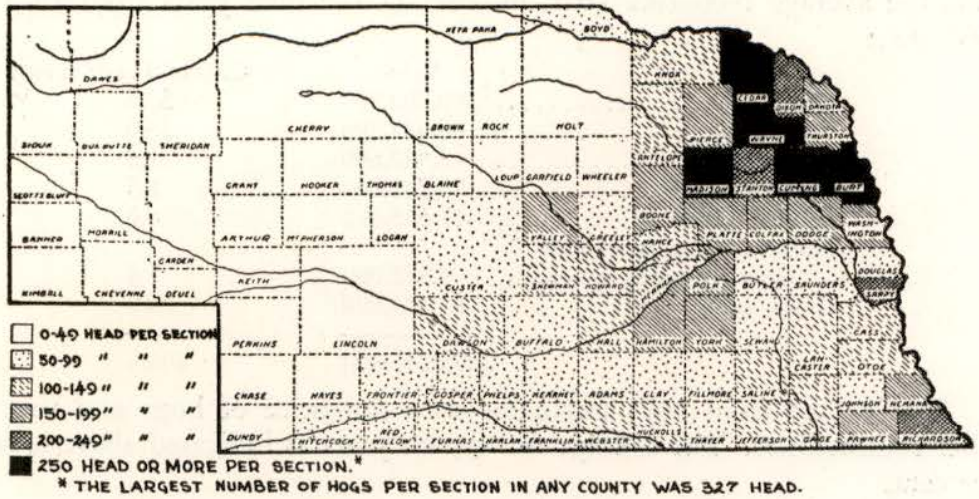


FIG. 1.—The number of hogs per section of Nebraska farm land on January 1, 1928, by counties. (From Hedges and Elliott.)

Figure 1 shows the distribution of hogs in Nebraska. The major portion of Nebraska's pig crop is produced in the northeastern portion of the state. In the region north of the Platte river and east of the line forming the west border of Antelope, Boone, and Nance counties, the greatest concentration of hogs is found. Second in pork production is the southeastern portion of the state. In the northwestern part of the state, the hog industry is assuming an important place.

Figure 2 shows the corn production of Nebraska. The close correlation between hog population and corn production is easily discernible.

Extensive studies were made to determine the cost of producing hogs on corn belt farms by the U. S. Dept. of Agriculture (U. S. Dept. Agriculture Yearbook for 1922) and the Illinois Experiment Station (Ill. Exp. Sta. Bul. 390). The distribution of production costs were as follows:

	U. S. D. A. *Per cent*	Illinois *Per cent*
Feed and pasture	64.3	84.2
Man labor	7.9	4.2
Horse labor	..	0.5
Lots and equipment	3.3	2.9
Depreciation on breeding herd	4.6	0.8
Veterinary	3.5	1.6
Overhead	2.6	3.4
Taxes and incidentals	..	0.1
Interest on breeding herd	..	0.8
Interest on equipment	6.3	1.5
Marketing costs	4.9	..
Miscellaneous	2.6	..
	100.0	100.0

The relative importance of these items may vary from year to year with changing conditions and feed prices. However, the pre-eminent position of the feed cost, being twice as great as all other charges combined, challenges the attention of every thinking hog man who strives for economical production. The possibilities for economies in production are certainly greater here than in any of the other items. This justifies our consideration of feeds and feeding as one of the primary factors in pork production.

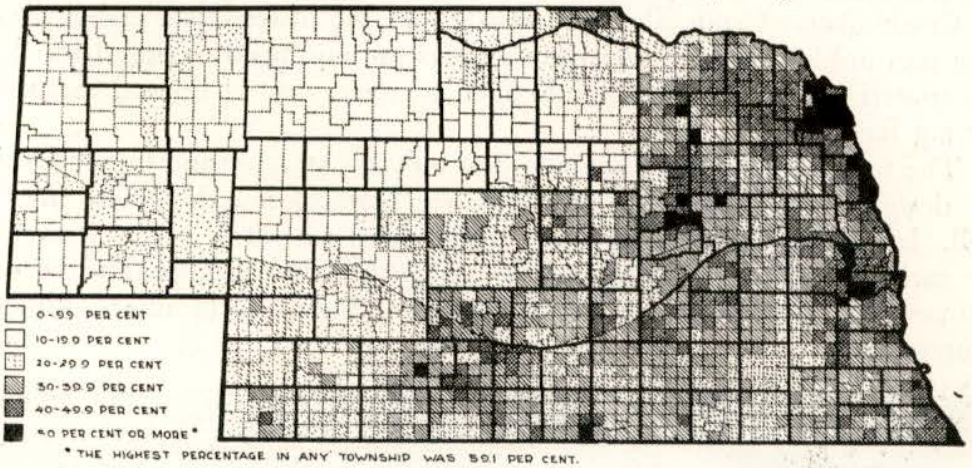


FIG. 2.—The percentage of Nebraska farm land in corn in 1927, by townships. (From Hedges and Elliott.)

CORN-HOG RATIO

The corn-hog ratio is the relationship between the price of corn per bushel and the price of hogs per hundred pounds. Putting it another way, it is the number of bushels of corn which 100 pounds of hogs will buy. The long-time average corn-hog ratio is 1:11½. This is considered by many to approximate cost of production although some believe a 1:10 ratio may be profitable under certain conditions. A ratio wider than 1:11 tends to expand pork production for under these conditions it is more profitable to feed corn than to sell it. A "narrow" ratio tends to reduce production. Unfortunately, the full effect of any given ratio is not apparent until some six months later.

NUTRITIVE NEEDS OF THE PIG

The nutritive requirements of swine are relatively simple. They consist of a need for a certain amount of energy-producing material, an adequate supply of protein of good quality, and a sufficiency of mineral substances together with certain vitamins which are recognized as essential for the growth and well-being of animals.

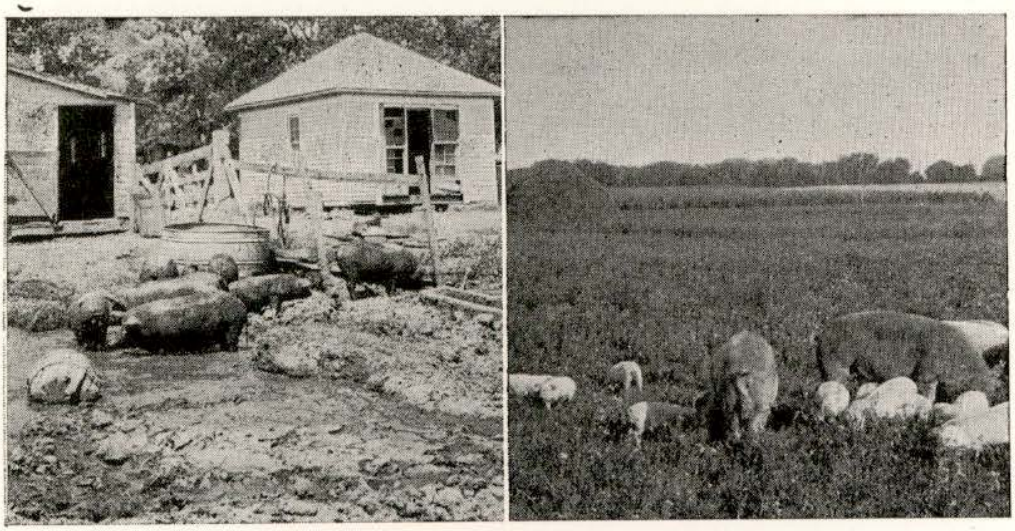
Energy.—Energy is essential for the life processes of the animal. After these requirements are supplied, surplus energy may be stored as body fat to be drawn upon by the animal in time of need. The chief energy-producing materials used by animals are the carbohydrates and fats. Of the carbohydrates, the so-called nitrogen-free extract, namely, starches and

sugars, are most valuable. These substances are abundant in the cereal grains.

Fats from feed may be used as a source of energy or may be stored as body fat. Fat is a more concentrated nutrient than sugar or starch. In fact, a pound of fat will produce 2.25 times as much energy as a pound of sugar or starch. Too much fat in a ration is undesirable, for it makes the ration less palatable, and tends to depress its digestibility.

Crude fiber.—Crude fiber, the woody material of feed, is a carbohydrate. The pig, unlike the steer and the sheep, is not equipped to digest much of this material. Feeds high in crude fiber, therefore, are of limited usefulness for pig feeding.

The term carbohydrates includes not only the starches and sugars (which are designated technically as nitrogen-free extract) but the crude fiber as well. In many feed analyses, the nitrogen-free extract is given as well as the carbohydrates. This duplication causes the total to appear to be over 100 per cent, which causes much confusion to those not familiar with such matters.



FIGS. 3 and 4.—Filth breeds disease. Clean pastures aid in preventing it.

Protein.—Protein is the material used by the body for certain vital functions as well as for the growth of organs, muscles, bones, and connective tissue. It is especially necessary in the ration of a young, growing animal. It is one of the more costly nutrients; therefore we should be careful to supply no great excess. Surplus protein does no harm to the animal, but on account of its relatively high cost it is supplied only in amounts calculated to produce the most economical gains. Aside from young animals, pregnant sows and sows suckling litters are particularly in need of ample protein. In addition to its nutritive qualities, protein has a marked stimulating effect upon the appetite as well as upon digestion.

The lack of protein is perhaps the limiting factor of growth in pig rations in the corn belt more than any other single factor. A mechanic might have enough engine parts to build ten engines, yet if he has bolts

enough to put together only five, he can make only five engines. In other words, the bolts become the limiting factor in engine building. There are many pigs with inherent ability to gain 1.35 pounds a day that gain only 0.75 pound because of a lack of suitable protein in the ration offered.

In the past we have been inclined to look upon protein without regard to quality. Today we recognize that some proteins are more nutritious than others. As a general rule proteins of animal origin are regarded as having a higher feeding value than vegetable proteins.

According to our present belief, proteins are built up of amino acids, which are sometimes designated as building stones. About 20 amino acids are recognized today. The amino acids are frequently compared to the letters of the alphabet, and the proteins to words. Certain amino acids are essential for life. A protein which lacks these acids is said to be incomplete and would, therefore, have a lower feeding value than a complete protein. Zein, the principal protein of corn, is a typical incomplete protein.

Mineral matter.—Mineral matter plays an important role in animal nutrition. It regulates many of the life processes aside from furnishing structural material for the growth of tissues. Bones and teeth, for example, are composed mainly of mineral matter, chiefly lime salts. Those animals

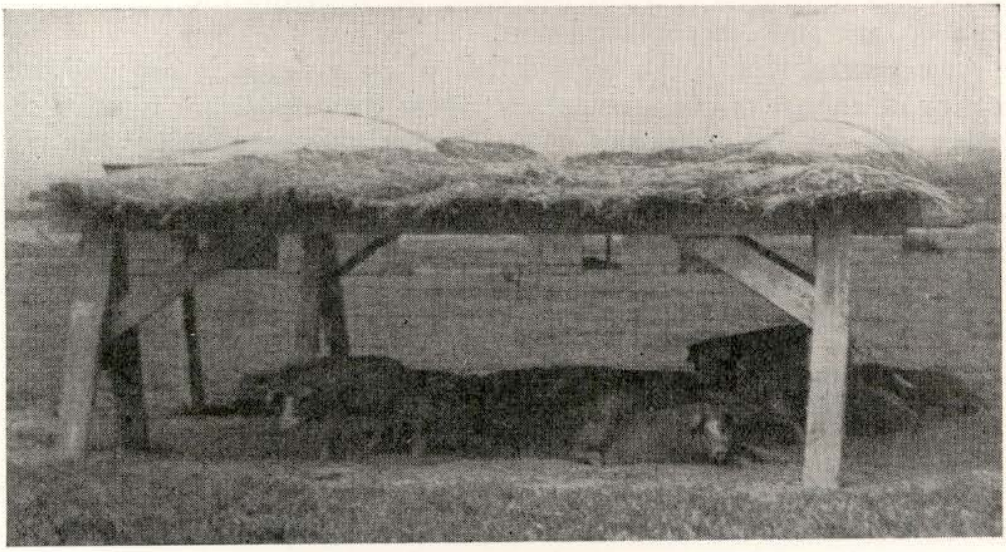


Fig. 5.—Shade is necessary in summer.

which have a high protein requirement, such as growing animals, pregnant sows, and those suckling litters, also have a need for abundant mineral matter.

Of the common domestic animals, perhaps none suffers so frequently from lack of mineral matter as the pig. Pigs are fed largely, and in some cases exclusively, upon rations of cereal grains which are relatively low in mineral matter, particularly in calcium or lime. The skeleton of the pig supports a greater weight in proportion to its size than that of any other of the domestic animals. Pigs are practically all marketed before they are

mature; therefore, their bones lack the strength that comes with maturity. As a result, a larger percentage of crippled hogs is received at the central markets than of all other kinds of stock combined. What stockman has not seen a sow "go down in the back" after suckling a large litter, or a paralyzed pig dragging himself from place to place? All of these are usually manifestations of lack of mineral matter in the ration.

A deficiency of hog rations in mineral matter is usually confined to a lack of lime or phosphorus. Common salt also may be lacking at times although it is well recognized that a pig does not require as much of this substance as the steer, sheep, or horse.

In certain localities the lack of iodine in the soil and water may cause goiter. This generally manifests itself in the form of the "hairless pig" trouble, which causes heavy mortality. This condition is not prevalent in Nebraska and where it does occur may be controlled by the feeding of minute quantities of iodides (usually potassium) during the gestation period.

While the cereal grains are admittedly low in mineral salts, nature, fortunately, has provided a number of feeds which contain an abundance of mineral matter. These feeds are the dairy by-products, skimmilk and buttermilk, and the packing house by-products such as tankage. Legume forages and roughages also aid materially in supplying the pig's requirements of lime and other mineral salts.

As a general rule, it can be said that where a ration is balanced with proteins of animal origin, particularly where these feeds are used in connection with legume pasture or in conjunction with legume hay, the pig's mineral needs are adequately supplied. Where such protein feeds are not used, minerals may be supplied economically by the use of steamed bone meal or ground limestone.

An inexpensive mineral mixture which may be kept before all farm animals may be made up as follows:

Steamed bone meal 2 parts
Ground limestone 2 parts
Salt 1 part

The vitamins.—Much has been said and written regarding the importance of the vitamins in nutrition. Every year brings forth new information concerning these substances, which play such an important part in animal nutrition and health. Today the chemical composition of several of the vitamins is known. The lack of vitamins in the diet results in the so-called "deficiency diseases." Certain vitamins are essential for certain species of animals. Other vitamins do not appear essential or perhaps certain species may be able to synthesize specific vitamins.

Vitamin A is needed by all species, the greatest need being during growth. However, it is also needed in considerable quantities during reproduction and lactation. It is even needed for the maintenance of mature animals. Its principal function is to keep the mucous membranes of the body in healthy condition in order to resist bacterial infection. Rations de-

ficient in vitamin A cause eye lesions known as xerophthalmia and also increased susceptibility to pneumonia.

In the case of pigs a deficiency of vitamin A in the ration results in nervous disturbances, including stiffness, lack of coordination, spasms, and paralysis.

Vitamin A is a colorless substance formed from a yellow pigment, carotene, widely distributed in green plants. Yellow corn is the only grain which contains appreciable quantities of vitamin A. Oxidation quickly destroys this vitamin, especially in hay which has been bleached or weathered in curing.

Vitamin D, the antirachitic vitamin, prevents the bone and joint disease known as rickets. It is essential for all species. Animals which are growing or producing milk have special need for it. This vitamin is necessary to permit the assimilation of the calcium and phosphorus of the feed. An adequate supply of these two minerals is also needed to prevent rickets. Vitamin D is abundant in sun-cured roughages and in certain fish oils, particularly the better grades of cod liver oil.

The short-wave-length rays have the same effect as vitamin D. During those seasons of the year when pigs are out in the direct sunshine, they are able to synthesize their own vitamin D. In cloudy weather or for pigs confined indoors some source of vitamin D is essential. It should be pointed out that when sunshine passes through ordinary window glass, the short-wave-length rays (ultra violet) are screened out.

Rickets in pigs is characterized by deformities of the bones and joints, stiff, stilted movement and general unthriftiness. Pigs which are being liberally fed are particularly susceptible to rickets.

Vitamin E, which is necessary for reproduction and lactation in certain species, is apparently not needed by the domestic animals or else they receive adequate amounts of it in the common rations. It is present in the oil of the germs of the common grains, in the green leaves of plants and in good-quality roughage.

Vitamin C prevents scurvy. This vitamin is needed only by man, the monkey, and the guinea pig. The common pig apparently has no need for it or perhaps he can manufacture his own.

Vitamin B or B_1 prevents polyneuritis in pigeons, chickens, rats and human beings. There is no evidence to show that it is needed by other animals. This vitamin is contained in abundance in the seed coats of grains and in yeast. Green forage and good quality roughage are fair sources of this vitamin.

Vitamin G (B_2) or riboflavin is especially important in poultry rations. There either is enough of this substance in the rations of farm animals or it is not required by them.

From time to time other vitamins have been proposed. Doubtless much additional information will be forthcoming in future years.

Water.—With water making up more than half the weight of the body, its importance can well be appreciated. In fact it is well recognized that an animal can survive longer without feed than without water.

Sunshine.—The germicidal value of sunshine is well recognized. Its importance in nutrition has been suggested under the discussion of Vitamin D.

Ration.—The term ration is applied to the feed supplied an animal in twenty-four hours. Sometimes the term is loosely applied to a mixture of feeds designed for pigs.

A certain portion of every ration is used for "maintenance", that is, to warm the body and to provide energy for muscular activity, respiration, circulation, and other vital functions. This maintenance portion has been likened to the power required to turn a machine over. A tractor yields only about half as much power at the drawbar as at the belt, because the remainder of the energy is required to move the tractor itself. Maintenance yields no material product for profit. About one-half of the ration of the liberally fed pig is required for this purpose.

FIG. 6.—Pasture lowers production costs.

It is only that portion of the ration fed above the maintenance requirement which can be used for growth and fattening. For efficient production, therefore, it is desirable to feed as much as possible above maintenace. By way of illustration, the factory operating day and night can manufacture at a lower overhead cost per unit of product than the same factory running only eight hours a day. With pigs, large gains, heavy feed consumption, and efficient gains usually go hand in hand.

A balanced ration is one which provides sufficient carbohydrates, protein, and fats to nourish a given animal for one day without an excess of any nutrient. In order to know how to calculate a balanced ration, it is necessary to know the requirements of the animal under consideration. Various investigators have given much study to this matter. One of the more recent feeding standards was developed by Morrison. This standard is adapted from that published in *Feeds and Feeding* by Henry and Morrison.

As has been frequently pointed out, animal feeding is not only a science but an art as well. A feeding standard, like that given above, is designed

Adaptation of Morrison Feeding Standard for Pigs

Weight of fattening pigs	Dry matter	Digestible crude protein	Total digestible nutrients	Nutritive ratio
Pounds	*Pounds*	*Pounds*	*Pounds*	*1:*
30– 50	1.4—2.6	0.23—0.43	1.24—2.27	4.0—4.5
50–100	1.9—4.1	0.28—0.60	1.65—3.64	5.0—5.6
100–150	3.2—5.4	0.44—0.74	2.88—4.83	5.5—6.2
150–200	4.4—6.4	0.53—0.78	3.91—5.70	6.2—7.0
200–250	5.1—7.0	0.60—0.85	4.54—6.25	6.5—7.3
250–300	5.6—7.5	0.65—0.88	5.00—6.67	6.7—7.5
Brood sows with pigs	6.9—9.6	0.83—1.08	6.42—8.40	6.0—7.0

merely to serve as an approximate guide. Individual pigs may vary from the requirements set forth, and in such a case it will be necessary for the feeder to use his judgment in adjusting rations to the needs.

Variations from the feed requirements set forth may be due to the type of pig. A 150-pound pig may vary from a well-finished small-type pig to a long-legged, unfinished, rapidly growing, big type. It is obvious that the latter would require a higher percentage of growth-producing proteins and mineral matter. The pig on a limited feed needs a smaller percentage of protein than one being full fed. Pasture-fed pigs need less protein than similar pigs fed in dry lot because some protein is furnished by the forage crop. Last but not least is the matter of individual variation. Certain pigs are more efficient than others. Coupled with these variations are the differences in feed proteins, some being more complete and therefore more valuable than others. The apparent wide ranges which are given in the feeding standard are provided to meet these variations.

The feeding standard suggested gives the needs of pigs according to weight. A 50-pound pig, for example, would require about 2 pounds of dry matter. Dry matter is all that remains of a feed after the moisture is driven off. This same pig would require 0.3 to 0.4 pound of digestible crude protein daily and about 2 pounds of total digestible nutrients. The term "total digestible nutrients" represents the total of all digestible material, the fat having been multiplied by 2.25 on account of its greater energy value.

Nutritive ratio.—The nutritive ratio is a simple and effective method of expressing the relation between the digestible protein and the digestible energy-producing material or nonproteins. Thus the nutritive ratio of 1:4.5 indicates that for every unit by weight of digestible crude protein there would be 4.5 units of nonproteins, the fats again being credited for their higher energy value.

The nutritive ratio can be computed for any ration by adding the nutrients contained in the various feeds. The digestible crude protein is subtracted from the total digestible nutrients. The remainder is divided by the digestible crude protein. The resultant figure is the second term of the proportion indicating the nutritive ratio.

Computing rations.—To compute rations, it is necessary to know the amount of digestible nutrients contained in the various feeds. Such figures

are presented in an appendix table in this circular. This table is adapted from those given by Henry and Morrison in *Feeds and Feeding*. The method commonly used in calculating a ration has been designated as the "cut and try" method. Suppose we have some 75-pound pigs and want to feed shelled corn and tankage. According to the table in the appendix, the two feeds contain:

Feed	Total dry matter in 100 pounds	Digestible nutrients in 100 pounds				
		Crude protein	Carbo-hydrates	Fat	Total	Nutritive ratio
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*1:*
Dent corn [1]	83.5	7.0	63.3	4.3	80.0	10.4
Tankage [2]	92.1	56.2	...	7.2	72.4	0.3

[1] Grade No. 3. [2] Sixty per cent protein.

It is necessary for us to decide arbitrarily upon a ration. For example let us use 3 pounds of corn and 0.25 pound of tankage. For our calculations we shall concern ourselves with dry matter, digestible crude protein, and total digestible nutrients only. By calculation, we learn that our ration contains the following:

Ration No. 1

Feed	Dry matter	Digestible crude protein	Total digestible nutrients
	Pounds	*Pounds*	*Pounds*
3 pounds corn	2.51	0.21	2.40
0.25 pound tankage	0.23	0.14	0.18
Total	2.74	0.35	2.58

Since the 75-pound pig is midway between 50 and 100 pounds, let us assume that his requirements are midway between the two extremes set by Morrison. The 75-pound pig then should have 3 pounds of dry matter, 0.44 pound of digestible crude protein, and 2.65 pounds of total digestible nutrients. Ration No. 1 when compared with this standard will be found deficient in dry matter and lacking in protein and total digestible material.

Let us make a second trial ration in which we increase the tankage to 0.40 pound.

Ration No. 2

Feed	Dry matter	Digestible crude protein	Total digestible nutrients
	Pounds	*Pounds*	*Pounds*
3 pounds corn	2.51	0.21	2.40
0.40 pound tankage	0.37	0.22	0.29
Total	2.88	0.43	2.69

The second ration coincides as closely with the standard as can be expected under practical conditions. To calculate the nutritive ratio of ration No. 2, we subtract the digestible protein (0.43) from the total digestible nutrients (2.69), leaving 2.26. This is divided by the amount of digestible

crude protein (0.43), giving 5.2. In other words, we have in this ration 5.2 pounds or parts by weight of energy-producing material (carbohydrates and fats) to every pound or part by weight of digestible crude protein.

Comparatively little use is made of feeding standards in the practical formulation of rations, except in checking up on rations to see how closely they are meeting accepted nutrient requirements.

Evvard (1929), in Iowa Experiment Station Research Bulletin 118, set forth a new pig-feeding standard which recommended substantially higher protein allowances than preceding standards. With this in mind, it is probably a good plan to calculate protein allowances in the upper range provided by Morrison. The engineer has long since learned the importance of the "factor of safety." In construction he always builds a little stronger than is needed to support the greatest load anticipated. Since the protein requirements of pigs are not completely understood and since proteins differ in feeding value, it would seem the part of wisdom to apply the "factor of safety" to the protein allowance in the hog ration. Surplus protein can do no harm, except to increase the cost, and we recognize that it does stimulate the appetite and digestion.

In considering the feeding standard it is well to point out that it does not concern itself with mineral matter nor vitamins. The physiological effect of the feed, whether laxative or costive, also must be recognized by the feeder. One of the very important factors is that of palatability. With the force-feeding methods in common use today, it is essential that rations be palatable.

Where pigs are self-fed free choice, the feeding standard may be dismissed from consideration, except from the standpoint of checking up on the feed intake of the pigs. Self-feeding free choice permits the pig to adjust its ration to its needs and experiments show that in many cases the pig can do so strikingly well. Where certain feeds are either especially palatable or unpalatable or where free choice self-feeding is not allowed, the pig cannot adjust his ration to his needs.

The daily feed intake of a pig will vary from 2.5 to 5 per cent of the pig's weight, light pigs taking a higher percentage than heavy. Fifty-pound pigs may consume 2.5 pounds or more of feed a day when on full feed. On the basis of 100 pounds of live weight, this would approximate 5 per cent. On the other hand, 250-pound pigs will eat about 7 pounds of feed a day, or, on a percentage basis, about 2.75 per cent of their live weight. Pigs on forage require less concentrated feed, since certain of their feed requirements are supplied by the green feed.

NEBRASKA HOG FEEDS

Feeds are roughly classified into the roughages or bulky feeds and the concentrates. The limited digestive capacity of the pig makes it necessary to practically eliminate the roughages from consideration, with the exception of alfalfa hay and forage crops. The concentrates may be further divided into those relatively low and high in protein. The low-protein

feeds are composed chiefly of the cereal grains which can be grown cheaply and abundantly on Nebraska farms. The high-protein feeds are largely commercial by-products. As a rule, such feeds are used in order to utilize the cereal grains efficiently.

Corn.—Corn is Nebraska's principal crop, occupying one-half of the state's cultivated acreage and representing almost one-half of the value of all crops. The yield in bushels far exceeds that of all other grain crops combined.

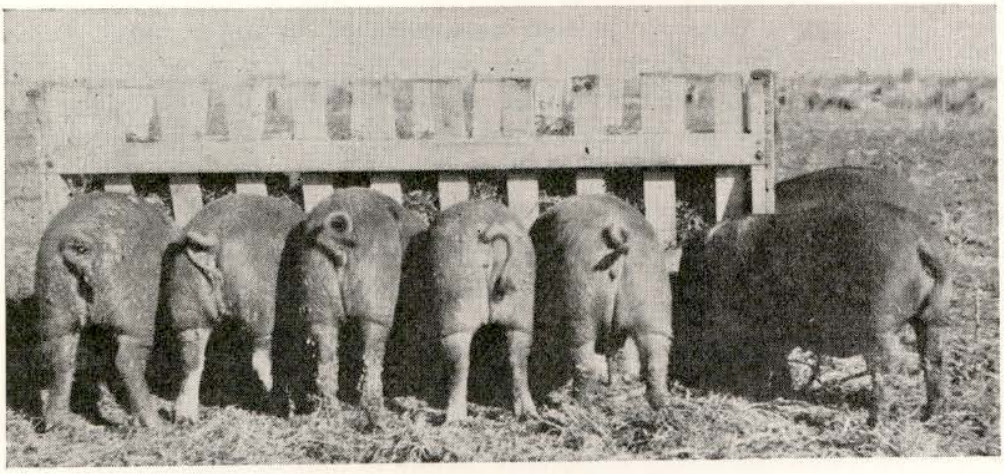


FIG. 7.—Alfalfa hay can be fed in racks in winter.

Corn is the single feed around which most rations are built. It is particularly palatable and very nutritious, being especially rich in carbohydrates and fats, the energy-producing materials. The outstanding deficiency of corn lies in its lack of protein and in the rather low value of most of the protein contained. The efficient use of corn requires the addition of a high-protein supplement to offset this deficiency. Corn is also low in mineral content, particularly lime. The results of feeding trials, substantiated by many breeders, show that corn can be used in the breeding-hog ration if used with discretion and intelligently supplemented.

Yellow corn is richer in vitamin A, the growth-promoting substance, and therefore superior for growing pigs in dry lot, than white. For pasture feeding or where the supplementary feed contains vitamin-rich feeds like alfalfa hay, white and yellow corn appear to be equal in feeding value.

Within the weight limits commonly followed in commercial pork production, there appears to be no advantage in grinding or soaking corn, except in the case of old corn which is very dry and hard. Where corn is fed in a mixture with other feeds, it is usually necessary to grind it in order to secure a uniform mixture.

Wheat.—Wheat is generally too high in price to feed to hogs. Through various combinations of circumstances such as high-priced corn and cheap wheat, its use for hog feed may become desirable at times. Wheat too low in grade for milling purposes, may frequently be fed advantageously. Like corn, wheat is low in protein and mineral matter, although not to so

marked a degree as corn. However, for efficient utilization, wheat should be fed with a high-protein supplement.

Because wheat kernels are small and hard it is generally recommended that it be coarsely ground. Wheat appears to be more palatable than corn. According to experimental results, pigs receiving wheat in place of corn make larger and more economical gains. Ground wheat appears to vary in feeding value from equality with corn, pound for pound, to 8 per cent greater efficiency than corn.

Oats.—In Nebraska, oats rank next to corn and wheat in importance. The decreasing horse population of the country has been an important factor in diverting this feed to hogs.

Oats contain the largest percentage of crude protein of the common cereal crops. The protein of oats is also higher in feeding value than that of other grains. The ash or mineral content of oats is higher than that of most grains. Oats contain about 11 per cent of fiber which, of course, is objectionable from the standpoint of hog fattening. Because of their high protein and ash content, oats are especially desirable in the rations of growing or breeding hogs. The fiber content serves as a filler to satisfy the appetite, yet prevents the animal from becoming excessively fat.

A number of tests indicate that the usefulness of oats in the fattening ration is limited. Whenever they comprise more than one-fourth of the ration, they retard the rate of gain. In the tests reviewed, whole oats ranged from 67 to 88 per cent as valuable as corn per unit of weight. In other words, 100 pounds of whole oats was the equivalent of from 67 to 88 pounds of shelled corn.

This wide variation in feeding value can be explained only by variations in the size of pigs used, the length of the feeding period, and the test weight of the oats fed. Oats vary widely in test weight per bushel, depending upon the climatic and soil conditions under which they were produced. Light oats are "chaffy", that is, they contain a high percentage of fiber, which makes them less desirable for hog feed. Not only are differences found in oats produced in different states, but also with oats produced in different sections of the same state. Within the same region, the oats produced one year may differ materially in composition and therefore in feeding value from those produced in other years.

Several stations agree that it is desirable to grind oats, particularly for fattening hogs. The limited amount of work done with hulled oats has been unfavorable to the use of this feed because of its high cost.

Barley.—The introduction of the new "smooth" varieties of barley, together with the more general use of the combine, has been an important factor in greatly increasing barley production in Nebraska.

Barley is higher in protein and crude fiber, but lower in fat than corn. While barley comes a little nearer being "balanced" than corn, the addition of a high-protein supplement to a barley ration is generally necessary for economical gains.

Barley, like oats, fluctuates in test weight per bushel. Doubtless some of the apparent discrepancies in feeding value are due to this fact. Plump,

well-filled, heavy barley is obviously more nutritious than light-weight grain.

As a rule, pigs fed barley consume slightly more feed than similar pigs fed corn. Ground barley, when fed with a high-protein supplement, has proved to be worth 83 to 88 per cent as much as shelled corn. By this it is meant that 100 pounds of ground barley were equal to from 83 to 88 pounds of shelled corn. A few northern and western stations have reported higher values for barley. It is quite possible that under their conditions, barley was superior to that produced in eastern Nebraska and the corn somewhat inferior, causing the two feeds to approach equality more nearly.

Whether or not to grind barley must be determined by the price of

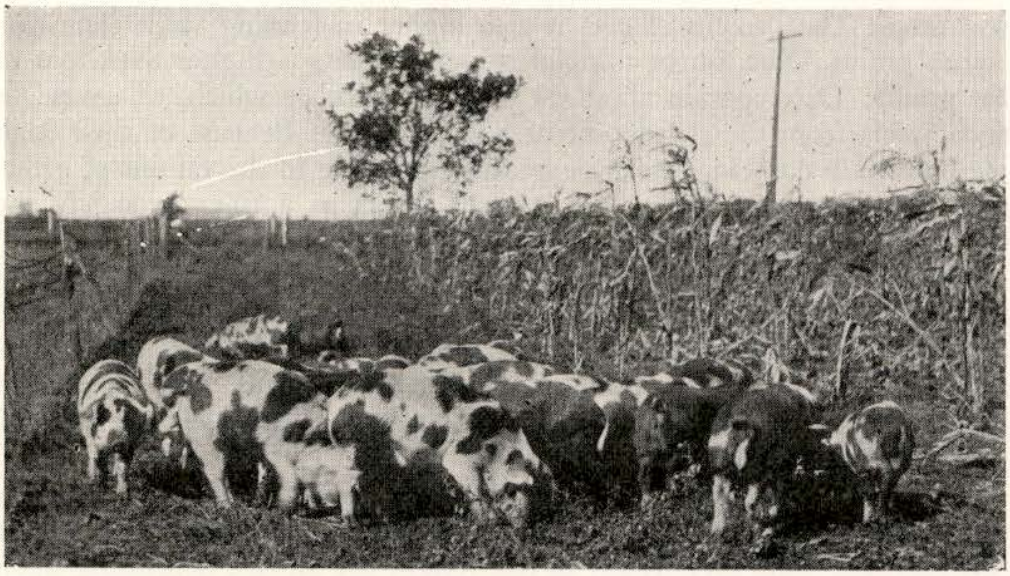


FIG. 8.—Pigs save huskers' wages.

barley and the cost of grinding. In Nebraska tests, whole barley proved 80 per cent as valuable as corn, whereas ground barley was 84 per cent as efficient. The work of several stations indicates that soaking whole barley is a poor substitute for grinding. Soaking ground barley has slightly increased its efficiency, although not enough to cover the cost of additional labor.

Some attention has been directed recently to a fungus scab (*Gibberella saubinetti,* Mont., Sacc.), which affects barley, wheat, rye, and oats. During recent years this disease has caused heavy losses through reduced yields in the eastern corn belt. Scabby barley, slightly pink in color, was said to be causing sickness and death among pigs to which it was fed. Numerous feeding tests were carried on by eastern corn-belt experiment stations as well as by the United States Department of Agriculture and it appears that barley which is very scabby is so unpalatable to pigs that they will not eat it. Studies thus far indicate that scabby barley should be fed to sheep or cattle rather than to pigs. Scab requires humid conditions to develop and

for this reason probably will not prove a serious handicap to barley production and feeding in Nebraska.

Rye.—Of the cereal grains grown in Nebraska, rye is the least important. Frequently the farmer producing rye in a limited way is forced to feed it as the only means of marketing his crop. Rye resembles wheat closely in composition. Because of its small kernels and hardness, rye should be ground for hog feed. Like other grains, it lacks protein, hence should be fed with a high-protein supplement.

Rye lacks palatability and therefore should be fed with some other palatable grain. The Minnesota Station, which probably has done more work with rye than any other station, has never succeeded in finishing a lot

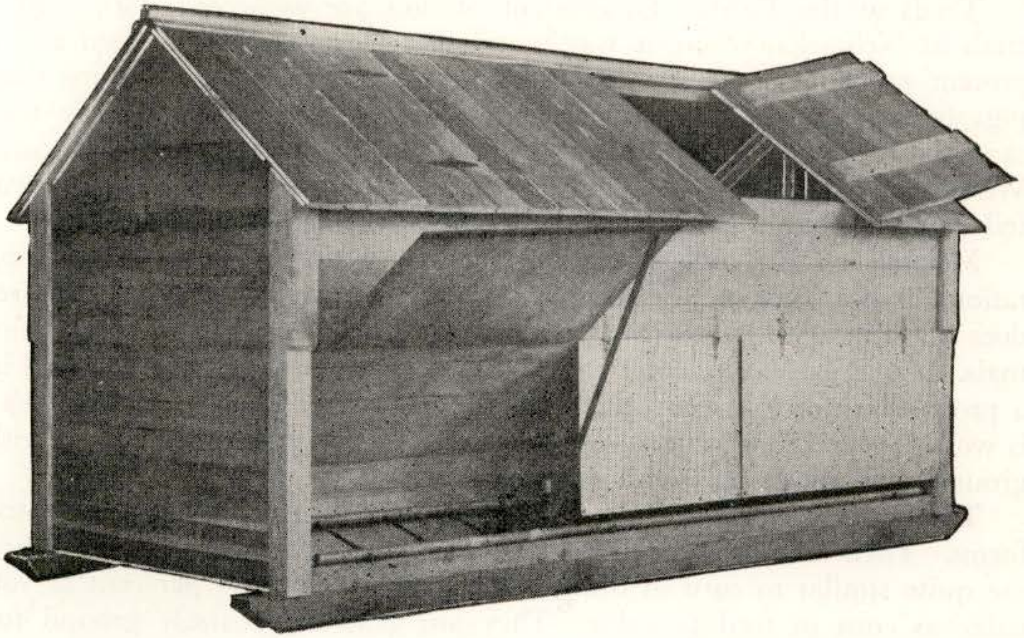


Fig. 9.—The Nebraska "pig cafeteria". Plans can be obtained from the Agricultural College Extension Service.

of pigs on rye, tankage, and mineral in dry lot. Where pigs were fed rye as the only grain, they began to scour and lose weight after 90 to 120 days of feeding. The only satisfactory ration where rye comprised the only grain was that of ground rye and buttermilk, equal parts. Better results are secured with rye on pasture than in dry lot.

The fungus ergot is frequently found growing on rye. Rye badly affected with ergot should never be fed to pregnant sows because of the likelihood of causing abortion. When it becomes necessary or desirable to feed rye, it should be ground and fed with a high-protein supplement. Better results may be expected if it is mixed with a more palatable grain.

Proso or hog millet.—Some interest has been manifested by western-Nebraska hog men in the recent Colorado trials with proso, hog millet, or hershey, as it is variously called. Two tests were carried on in which corn was compared with ground millet. A protein feed was fed in each case. In one trial the millet-fed pigs gained more rapidly than the corn-

fed, although a second trial revealed little difference in rate of gain. In one trial ground millet proved equal to corn in feeding value and in the other trial 95 per cent as valuable as corn. It should be pointed out that these values are both higher than those determined by the South Dakota Station.

Hominy feed.—Hominy feed or meal is a by-product of corn milling by the dry method. This feed consists of corn bran together with the germs and some of the starchy materials. In some instances the oil may have been extracted from the germs. Ordinarily this feed is absorbed by commercial feed mixers, although during periods of corn shortage it is of interest to feeders as a corn substitute.

Trials at the Purdue Experiment Station are in accord with similar trials at Nebraska, where it was found that pigs fed hominy feed and a protein supplement ate less feed and made materially smaller gains than pigs fed corn and a supplement. On a replacement basis, hominy feed ranged from 95 to 100 per cent as valuable per unit of weight as corn. Where hominy feed replaced only a part of the corn, that is, where it was fed with corn, more satisfactory results were obtained.

Molasses.—Cane molasses is used in only a very limited way in hog rations. It is a constituent of some commercially-mixed hog feeds. Molasses does not appear to be nearly as palatable to pigs as to other domestic animals. It may be fed in slop or in mixtures of ground feeds. When fed in a proportion not to exceed 10 to 30 per cent of the ration, cane molasses is worth about 75 per cent as much as corn. Cane molasses is best fed with ground oats, alfalfa meal and similar feeds.

The grain sorghums.—These feeds include the kafirs, milos, and related forms. Their drouth resistance makes them of particular interest. They are quite similar to corn in composition and are 90 to 95 per cent as valuable as corn in feeding value. They are generally coarsely ground for hog feeding, although where self-fed, grinding does not appear to be so necessary. Since these grains, like corn, are deficient in protein, a good protein supplement should be fed in conjunction with them.

Potatoes.—During periods of low prices, potatoes may frequently be fed to livestock advantageously. Low-grade or cull potatoes are commonly used for this purpose.

As a general rule, potatoes give best results when cooked. According to some of the early experiments, cooking increases their feeding value for pigs 50 per cent, although more recent trials show an even higher value for cooking. Cooked potatoes are one-fourth as valuable per unit of weight as shelled corn for hog feed. Because of their bulk, due to the high water content, potatoes should not form the entire ration for fattening hogs. Some grain should be fed with potatoes. The Oregon Station secured best results where one pound of grain was fed to every four pounds of potatoes. Potatoes, like the cereal grains, are deficient in proteins; consequently such feeds as tankage, dairy by-products, or alfalfa forage or hay should be included in the ration to supply the protein needs.

HIGH-PROTEIN FEEDS

The protein-rich feeds for the most part are by-products from the manufacture of human food. Thus, we have packing-house, dairy, mill, oil-mill, and starch-factory by-products, all of which occupy places of more or less importance in hog feeding.

THE PACKING-HOUSE BY-PRODUCTS

Tankage.—Tankage is made from meat products not suitable for human food. This material is cooked by steam under pressure, the grease is removed, and the residue dried and ground and is variously known as meat meal, tankage, or digester tankage. The better grades contain 60 per cent crude protein. Tankage generally contains considerable bone, which is available to the pig as bone-forming material.

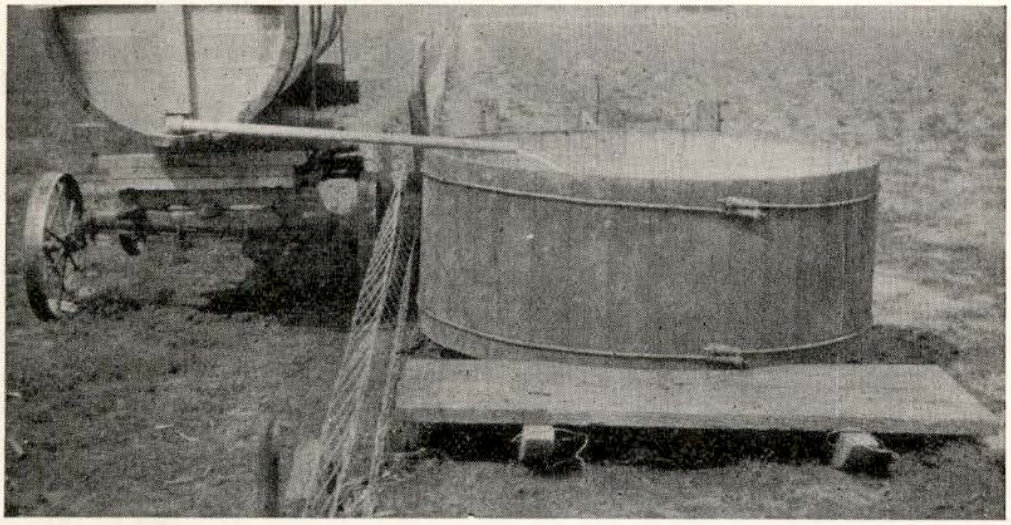


Fig. 10.—Hog waterers attached to the bottom of a barrel or stock tank solve the watering problem on pasture.

Tankage stimulates the appetite. For example, pigs fed corn and tankage consume more feed than those fed corn alone. As a rule, pigs receiving tankage make larger gains than those getting nothing but corn. One of the chief advantages from the use of tankage is the saving of grain effected in producing a given gain. In a series of Nebraska tests on alfalfa pasture using 60-pound pigs, a pound of tankage saved or replaced 4 pounds of corn. In other words, whenever a pound of tankage costs less than 4 pounds of corn, 100 pounds of gain can be produced more cheaply with tankage than without it. With young pigs, tankage has a higher replacement value than with heavier hogs. In dry lot, tankage is more valuable than under pasture conditions.

Tankage may be self-fed free choice with the grain. Where this method of feeding is followed, pigs generally take the proper allowance of tankage. In the early stages of the feeding period, pigs which are protein

starved frequently overeat as far as the tankage is concerned. This, of course, does no harm except to increase the expense. Over a feeding period of any length, pigs consume on the average one part of tankage to 10 of corn. However, in the early stages of fattening, pigs may eat one part of tankage to seven or eight of corn, while later, one part of tankage will be consumed with 12 or 15 parts of corn. The feeder then who hand-feeds tankage at the rate of one to 10 parts of grain is likely to cut his pigs short on protein early in the feeding period and provide a surplus later when the need is not so great.

Corn and tankage are two feeds so nearly equal in palatability that the pig may be permitted to balance his own ration. Where a less palatable grain is used or a supplement more palatable than tankage is fed, the consumption of supplement would be increased so that self-feeding free choice would be neither economical nor desirable. It can safely be said that the supplement should never be self-fed unless the grain is self-fed.

A more desirable practice where hand-feeding is to be resorted to is to feed one-fourth to one-half of a pound of tankage per head daily. The changing amounts of corn taken and the increasing live weight tend to adjust the tankage allowance to body needs.

Meat and bone meal.—Many packers are now using the dry melting method to reduce material inedible as human food instead of the tanking process just described. The resultant product is known as meat and bone meal or "odorless tankage". This product usually contains 50 per cent protein, and also 20 per cent bone, which assures adequate mineral constituents.

The Nebraska Station carried on some of the earliest work with this supplement. Meat and bone meal proved to be more palatable than tankage and stimulated the consumption of both grains and supplement. Probably because of increased feed intake, the gains were larger than where tankage was fed. In practically all cases less feed was required to produce 100 pounds of gain in the lots receiving meat and bone meal. It appears then that meat and bone meal that contains 50 per cent protein is fully equal to 60 per cent protein tankage.

The by-product from dry melting, because of its freedom from unpleasant odors, is eagerly sought after by commercial feed mixers; therefore, the amount of this by-product reaching the hands of feeders has been small. The price of meat and bone meal is about the same as that of tankage.

Fish meal.—While not, strictly speaking, one of the packing-house by-products, fish meal, because of its composition and feeding value, may be classed along with them. Fish meal may result from the manufacture of fish oil. This type of fish meal is commonly known as menhaden because it is made from a small herring by that name. Menhaden fish meal contains about 55 per cent crude protein. The recent development of trade in frozen boneless fish fillets has resulted in large accumulations of refuse material at the packing points. This material when processed results in white or lean fish meal which may run upwards of 60 per cent protein.

Numerous feeding tests have demonstrated that fish meal not only is equal to tankage as a protein supplement, but may actually excel it. Larger gains from less feed have generally resulted where fish meal has been fed.

The amount of fish meal sold to Nebraska feeders at this time is negligible, although it is being used to some extent in commercial feed mixtures. It is not amiss to point out here that fish meal made from sea fish is rich in iodine. Its use, therefore, in regions where hairlessness of pigs is prevalent should serve a double purpose, that of supplying protein and iodine.

Blood meal.—Blood meal, another packing-house by-product, contains upwards of 80 per cent crude protein, which is higher than that of any other feed. It is quite unpalatable, and is distinctly lower in feeding value than the other packing-house by-products. Its lack of palatability, low feeding value, and high price make it a feed of little importance in hog rations. Blood meal is sometimes used in feed mixtures to bolster up the protein content. It is a valuable corrective, being effective in controlling scours caused by digestive disturbances. A few handfuls of blood meal fed to a suckling sow are usually effective in stopping scours in her litter.

Bone meal.—Bone meal from some standpoints can hardly be classed in the same category as the preceding feeds. It is a mineral supplement, rich in calcium or lime and phosphates, which are esential constituents for bone formation.

Two types of bone meal are available, the steamed bone meal from which all protein has been removed by cooking, and the raw bone meal. Raw bone meal contains about 48 per cent of bone phosphate of lime, while steamed bone meal contains 65 per cent. For the person desiring to purchase calcium and phosphorus, the steamed bone meal is preferable.

THE DAIRY BY-PRODUCTS

Whole milk is the food designed by nature for young mammals. It contains all of the constituents needed for growth except possibly iron. The value of the butterfat generally precludes the use of whole milk for pig feed except under unusual circumstances.

Skimmilk.—Skimmilk is undoubtedly the best "farm grown" protein supplement for pig feeding. It supplies an abundance of protein of excellent quality, together with ample quantities of minerals for growth and development. Skimmilk is deficient in the fat-soluble vitamins and care should be exercised to secure a supply through one of the other feeds used.

The money value of skimmilk naturally varies with the price of other feeds, the price of hogs, and the amount of milk fed. It is more valuable for young pigs than for pigs in the last stages of fattening. Purebred breeders can afford to pay more for skimmilk than market hog men. An old rule, generally given, is, that for supplementing corn, 100 pounds of skimmilk is worth one-half the price of corn per bushel. This rule probably errs on the side of conservatism. Under most conditions the man who can buy skimmilk within the limits set by this rule is undervaluing rather than overvaluing the milk. From the standpoint of providing protein, two gallons of milk are equivalent to one pound of tankage.

Where the problem is to dispose of skimmilk, market hogs may be allowed all they can drink, although unlimited skimmilk makes pigs paunchy, which is, of course, undesirable. Where the skimmilk has considerable money value, it can be fed most efficiently at the rate of one-half gallon to one gallon per head daily for pigs in dry lot. Less milk need be fed on pasture.

Souring does not materially change the feeding value of skimmilk. Milk should be fed consistently sweet or sour. There is reason to believe that sour milk is quite valuable in controlling certain intestinal disturbances of pigs. On account of their high water content, skimmilk and buttermilk should not be diluted.

The chief difficulties with milk are its perishability and bulk. The pig feeder should assure himself that the milk is from disease-free cattle or else that it has been pasteurized. Milk is an excellent medium for the growth of bacteria and may sometimes be responsible for spreading disease.

Buttermilk.—Some Nebraska hog feeders are so situated that they can secure creamery buttermilk for a nominal price. Buttermilk may be considered equal in feeding value to skimmilk and interchangeable with it in the hog ration.

Semisolid buttermilk.—Some creameries preserve surplus buttermilk by condensing it. The water is evaporated and the milk condensed to about one-seventh of its volume. The resultant pasty substance is called condensed or semisolid buttermilk, a product containing about 13 per cent crude protein. It may be kept for long periods without deterioration. It is mixed with water for feeding.

A number of experiment stations, including the Nebraska Station, have conducted feeding tests to compare semisolid buttermilk with tankage as a supplement for corn. Where semisolid buttermilk comprised the sole protein supplement, it was found to be approximately one-third as valuable, pound for pound, as tankage. In pasture tests, semisolid buttermilk proved only one-fourth as valuable as tankage. Pigs receiving semisolid buttermilk without exception gained more rapidly than those receiving tankage as a supplement.

At the Nebraska Station several tests were carried on in which pigs were self-fed corn and tankage, and in addition a small daily allowance (0.4 pound) of semisolid buttermilk was hand-fed. The rate of gain was increased over that secured with corn and tankage and a much higher return was made for the semisolid buttermilk fed. Some investigators claim that where only limited amounts of semisolid buttermilk are used its replacement value is two-thirds that of tankage.

Semisolid buttermilk is an excellent feed. It is palatable and stimulates gains. For most efficiency, it should be used as an appetizer, relying upon some cheaper source of protein to supply the major portion of that constituent. Semisolid buttermilk is particularly desirable for young pigs. It contains considerable lactic acid, which is of value in controlling the kind of organisms which inhabit the digestive tract.

Dried milk.—Dried buttermilk and skimmilk are prepared by various processes. Because of the demand for these products for human use, the price has been high. Only limited amounts have been available to hog feeders. They contain about 35 per cent crude protein.

The Minnesota Station has carried on several tests comparing dried buttermilk with tankage as a supplement to corn and red dog flour. In these tests the pigs receiving the milk gained more rapidly. Dried buttermilk proved almost equal to tankage on rape pasture.

Whey.—With the increasing number of cheese factories in Nebraska, it is quite likely that whey will become increasingly important as a hog feed. The Nebraska Station and other stations have shown that whey is about one-half as valuable as skimmilk as a protein supplement to corn. Whey runs so low in protein that for young animals some additional high-protein feed such as tankage should be provided.

MILLING BY-PRODUCTS

Bran and shorts are the principal by-products of Nebraska flour mills, although in some instances other by-products may be produced. However, for practical consideration we may limit our discussion to these feeds.

Bran.—Bran is so bulky, because of its crude fiber content, as to practically eliminate it from the list of feeds suitable for either fattening or rapidly growing pigs. If bran is to be used in hog rations, its place should be in the rations of pregnant and suckling sows. Bran contains considerable protein and some mineral matter and is laxative in action. It should be said, however, that bran is low in lime or calcium. Wherever wheat by-products make up any considerable portion of the ration, other feeds rich in minerals should be included in order that the calcium needs of the pigs may be supplied.

Shorts.—Inside the bran coat are several layers which are removed in milling. Immediately beneath the bran, the brown middlings or shorts are secured. Brown shorts contain some of the finer bran particles, which give the feed its characteristic color. The bran particles increase the fiber content and lower the feeding value of the brown shorts as compared with the gray shorts or middlings, which are the more floury particles beneath the layer of brown shorts. Large mills frequently make both white and brown shorts and in addition a low-grade feeding flour known as red dog. Most country mills, however, do not find a sufficient demand for the various by-products, so mix them all together and sell the product as standard wheat shorts.

Shorts or middlings rank among the most commonly used pig feeds. As a portion of the feed of suckling and weanling pigs, shorts are held in high esteem. Investigators are well agreed that the use of shorts to balance the corn ration is not desirable nor economical, except perhaps on good legume pasture.

The addition of shorts to a corn-and-tankage ration results in increased gains, with a saving of both corn and tankage. On the basis of replace-

ment value, shorts may be considered slightly less valuable than corn, pound for pound.

THE OIL MEALS

Linseed meal.—Linseed meal of good quality contains approximately 30 per cent protein. It is quite palatable, rather laxative in nature, and produces a glossy coat on the animals to which it is fed.

As a sole protein supplement fed to pigs in dry lot, linseed meal has proved rather disappointing. Pigs receiving linseed meal have made smaller gains and required more feed per weight unit of gain than similar pigs receiving tankage as a protein supplement. On legume pasture and fed to heavier pigs, linseed meal has appeared to better advantage as a corn supplement.

Where linseed meal has been fed in conjunction with tankage, the feed consumption and the rate of gain have been increased. It appears that the chief benefits of adding linseed meal to tankage have been to increase feed consumption and rate of gain, rather than to reduce the amount of feed needed for a given gain.

Cottonseed meal.—Cottonseed meal has long been looked upon as a questionable feed for hogs. Fatalities were reported in early hog-feeding trials, which were attributed to a poisonous alkaloid, "gossypol". Recent feeding trials at numerous experiment stations have indicated, however, that where cottonseed meal is intelligently fed it may be used in the hog ration without bad results. The cottonseed meal here referred to is choice-grade meal, containing 41 to 43 per cent protein.

Work at the North Platte (Nebraska) Substation, and other stations, indicates that the usefulness of cottonseed meal as the sole protein supplement with corn is quite limited. Pigs fed cottonseed meal and corn do not gain so rapidly as similar pigs fed corn and tankage. More feed is required per unit of gain than where tankage is fed.

The Texas Station recommends that cottonseed meal should not exceed 9 per cent of the ration, although this percentage has been exceeded without bad results in Nebraska tests. Until the effect of cottonseed meal is better understood, the Texas recommendations should be followed. Nine per cent of meal does not permit a pig to meet his protein requirements adequately; therefore, some other high-protein supplement should be fed along with the cottonseed meal.

Numerous tests at the North Platte Substation and the Nebraska Station have indicated that combinations of cottonseed meal and tankage are superior to straight tankage for balancing a corn ration. These combinations have proved more desirable under dry-lot conditions than on pasture. A mixture of cottonseed meal and tankage, equal parts, has proved as satisfactory as any combination used in the Nebraska tests.

There are indications that where cottonseed meal comprises any considerable portion of the ration, mineral deficiencies may be encountered. Some reports of good results from the supplying of steamed bone meal or ground limestone with rations containing cottonseed meal are available.

Cottonseed meal is very palatable to pigs. In every case where cottonseed meal has been fed at the Nebraska stations a considerable increase in feed consumption has been noted.

Soybean oil meal.—Tests conducted by eastern corn-belt stations indicate that soy-bean oil meal is one of the most valuable tankage substitutes available. Where this feed has been supplemented with ground limestone, steamed bone meal, or other lime supplements, it has frequently proved almost equal to tankage. It varies somewhat in palatability and feeding value, depending upon the method of manufacture.

Soybean oil meal is more palatable and a more valuable protein supplement than ground soybeans. Ground soybeans have the disadvantage of producing "soft pork" when fed to pigs. Soybean oil meal is not open to this objection.

Corn-oil cake meal.—Corn-oil cake meal, or germ oil meal as it is sometimes called, is the remainder of the corn germs after the oil has been pressed out. Since the proteins of this feed would have the same limitations as those of corn, corn-oil cake meal should hardly be used to balance up a corn ration. It is generally used in commercial mixed feeds or combined with other protein supplements such as tankage.

In three tests at the Nebraska Station, the addition of corn-oil cake meal to a corn-and-tankage ration reduced the daily gain and increased the feed required per unit of gain. The corn-oil cake meal constituted half the protein supplement and proved in these trials to be less than half as valuable as tankage as a protein supplement.

MISCELLANEOUS FEEDS

Gluten meal.—Corn-belt hog feeders are frequently urged to use protein supplements originating in the corn belt. One of the feeds frequently suggested is gluten meal, a by-product from starch manufacture. This feed contains 35 per cent or more of crude protein. Coming from corn, it naturally has the same limitations in protein quality as corn. It is not surprising, therefore, that at the Kansas Station gluten meal and corn made an unsatisfactory showing for dry-lot feeding. Gluten meal appeared unpalatable and pigs receiving it gained less than half as rapidly as similar pigs fed tankage as a supplement. Slightly more than half as much corn and tankage were required to produce 100 pounds of gain as was necessary where the gluten meal was fed. On alfalfa pasture, where bone meal or tankage was fed in addition, gluten meal closely approximated tankage in feeding value for 63-pound pigs.

Alfalfa hay and meal.—The more leafy cuttings of alfalfa hay are very valuable for hog feed, particularly if of a good green color. Alfalfa hay provides an abundance of mineral matter, especially lime, and with this contains about as much protein as bran. It supplies vitamins essential for health and growth.

Alfalfa hay may be considered a maintenance ration for mature hogs. By this is meant that they will neither gain nor lose in weight. The prin-

cipal use of alfalfa hay is as a source of protein and minerals with a grain ration. Many pigs are fattened on corn and alfalfa hay. Averaging seven trials at the Nebraska Station, 100-pound pigs fed corn and alfalfa for 90 days gained 1.12 pounds daily as compared with 1.58 pounds for pigs fed corn and tankage. One hundred pounds of alfalfa hay replaced 67 pounds of tankage. With the alfalfa hay, 106 pounds more corn was required than with tankage. Therefore, 100 pounds of alfalfa hay would be worth the cost of 67 pounds of tankage minus the cost of 106 pounds of corn. Hay is frequently fed along with other supplements and is an effective means of reducing the consumption of the more costly purchased feeds.

Alfalfa meal, if of good quality, is an excellent constituent of hog feeds. Meal made from low-grade stemmy hay is of little value for hogs. Aside from its nutritive qualities, it is frequently used as a filler in mixtures in order to prevent excessive consumption of the feed.

In a rather exhaustive series of studies at the North Platte Substation it has been found that under ordinary conditions, alfalfa hay may be fed most profitably in a rack. Unless some specific purpose is contemplated such as mixing with other feed, grinding is unnecessary. Soaking and stewing fall into the same category.

Protein supplementary mixtures.—Perhaps the reader has been impressed in the foregoing discussion with the frequency of the statement that where a given supplement was combined with tankage or some other feed, a higher feeding value was obtained. Investigators have long noticed this fact and for some years have given study to protein supplementary mixtures.

Many proteins, particularly those of vegetable origin, are incomplete; that is, they lack certain essential amino acids or building stones. By bringing together proteins from different sources there is a likelihood that deficiencies of one feed are offset by surpluses from another. As a result, mixtures have frequently proved more efficient than single supplements.

One of the earliest and best of the simple mixtures is the "trinity" mixture developed by the Wisconsin Station. This mixture is commonly used throughout the hog-producing section. As originally suggested, this mixture was composed of two parts tankage, one part linseed meal, and one part alfalfa meal. The Nebraska Station has proposed the modification of substituting cottonseed meal for linseed meal. Equal parts of cottonseed meal and tankage have proved very satisfactory in Nebraska tests. For other simple mixtures see Nebraska Bulletin 243, *Pork Production at the North Platte Substation.*

In some instances very elaborate formulae have been suggested, many of them too complex for home mixing. Some mixtures are very palatable, probably due to the variety contained. It must be admitted that the chief value of some mixtures appears to be to stimulate the appetite and increase the rate of gain, rather than to make more efficient gains. Of course, rapidity of gain is important when many pigs go to market weighing over 200 pounds at six months of age.

Hog growers who mix their own feeds are sometimes inclined to "cut corners" in their efforts to reduce the costs of their feed mixtures. Frequently the more valuable constituents are left out, particularly if they happen to be the more costly ingredients. The home mixer, before making a substitution in a feed formula, should assure himself that the feeding value of his mixture is being maintained.

Commercial pig feeds.—Practically all cereal grains are deficient in protein and the hog raiser is interested in securing his protein where he can purchase it most economically. Conditions vary so much that it is impossible to say that any one feed is more desirable than another under all conditions. So far as is known, the protein supplementary feeds manufactured by reliable manufacturers are satisfactory. Experimental work with those brands used at the Experiment Station has indicated slightly larger gains where the mixed feeds were used than where corn and tankage were fed. With price conditions prevailing at the time the experiments were carried on, it was found that cheaper gains could be produced with corn and tankage than with the mixed feeds.

There is nothing about the mixing of feeds that is beyond the capability of the intelligent feeder or farmer. Many feeders, however, feel that they do not have the time or equipment to prepare their mixtures and, as a result, are willing to pay commercial mixers for their services. Commercial mixers have distinct advantages over home mixers in that they can buy large quantities, taking advantage of market situations and, above all, have means of controlling the quality of the by-products entering their feeds and the quality of the feed produced. The farmer, on the other hand, usually buys his by-products in small quantities, paying comparatively high prices for them, and the higher local freight charges. The farmer has no opportunity to analyze the feeds which he uses in compounding a feed. The commercial feed mixer has many advantages in his favor so long as he does not charge an excessive price for mixing and merchandising.

It would seem that the most valuable place for mixed feeds would be in the production of purebred pigs, or for the specialized feeder who produces pigs for the early market. In these instances, maximum gains and timeliness of marketing frequently bring sufficiently greater returns so that increased production cost may be of secondary consideration.

EVALUATING FEEDS

In deciding between two protein supplements, the feeder should rely upon feeding values as determined by feeding tests where such information is available. For such comparisons some feed must be used as a standard. It this discussion, tankage has been so used because of its uniformity and ready availability.

The progressive hog feeder will have many occasions to refer to results of hog-feeding tests conducted at various agricultural experiment stations. Many find difficulty in interpreting these results and therefore the following data are presented for discussion. They represent a 110-day trial

on alfalfa pasture in which Lot 1 was self-fed corn and tankage, while Lot 2 received corn only.

Item	Lot 1	Lot 2
Average daily ration, pounds per head:		
Shelled corn	4.86	3.43
Tankage	0.39	...
Average initial weight *(pounds)*	61.83	61.50
Average final weight *(pounds)*	209.89	141.58
Average gain *(pounds)*	148.06	80.08
Average daily gain *(pounds)*	1.35	0.73
Feed required per 100 pounds of gain:		
Shelled corn	361.00	471.00
Tankage	29.00	....

Financial data, such as costs and profit or loss, are influenced by market conditions; hence they are likely to fluctuate widely. Knowing the amount of feed required to produce 100 pounds of gain, a man can compute the cost for any price conditions.

In the data presented, it will be noted that the consumption of 0.39 pound of tankage increased the daily corn consumption 1.5 pounds. In producing 100 pounds of gain, 29 pounds of tankage saved the difference between 471 and 361 pounds of corn, or 110 pounds. Twenty-nine pounds of tankage was equivalent to 110 pounds of corn or one pound of tankage was worth almost 4 pounds of corn. Whenever one pound of tankage can be purchased for less than the cost of 4 pounds of corn, gains can be produced more cheaply with corn and tankage than with corn alone. This is spoken of as the replacement value and is of interest to everyone seeking economical production. The replacement value does not take into consideration the rapidity of gain, which may be materially greater with one ration than with another. In the trial cited, the pigs fed tankage weighed 210 pounds after 110 days' feeding and could have been marketed, while the pigs receiving no tankage weighed only 142 pounds and needed further feeding. Under most conditions, the 210-pound pig would be worth more per hundred pounds than the 142-pound pig, although the replacement value gives tankage no credit for this advantage.

Replacement values may be calculated for any experimental lots in which there is only one variable. One of the lots must represent the exact method of feeding contemplated. The replacement value calculated for tankage here is only applicable where pigs are fed free choice on alfalfa pasture. If the amount of tankage were limited, or if it were fed in dry lot, substantially different replacement values might be found.

Where experimental tests are not available on a particular feed, the digestible nutrients may be used as an index of feeding value. Where a protein supplement is under consideration, the cost per pound of digestible protein may be made the basis of comparison. Such a comparison is based upon the presumption that all proteins are equal in value, which, as has been pointed out, is not true. In the case where a grain feed or a complete

ration is contemplated, the total digestible nutrients may be used as a guide to feeding value.

In the case of commercial mixed feeds, digestible nutrients cannot be determined without knowing the kind and amount of the various constituents. With feeds of unknown composition, the chemical analysis (that is, the percentage of crude protein, nitrogen-free extract, and the fat) must be relied upon although this is less reliable even than the digestible nutrients. Such feeds may be compared in composition with feeds of known feeding value such as shorts, linseed meal, or tankage.

A FEW GENERAL CONSIDERATIONS

It is not intended that the list of feeds here given be complete. There are many other excellent pig feeds which, in localities, may overshadow in importance those enumerated. The object is to discuss here only those feeds which are most important under Nebraska conditions generally.

Of the protein supplements, those of "animal" origin, such as milk and tankage, are considered more efficient than those more directly of vegetable origin. A study of various protein supplements indicates that those of lower protein quality are more efficient on pasture than in dry lot. Perhaps the pasture supplies something which is lacking in the supplement. It is admitted, of course, that the need for a protein supplement is not so great on forage, particularly on legume forage, as in dry lot because of the high-protein content of the legume.

It appears that in feeding a protein supplement, the law of diminishing returns is operative. The first unit of protein is more valuable than any succeeding increment. The first ounce of protein fed to a pig is more valuable than the second, the second is more valuable than the third, and so on. Finally, if we fed a pig on nothing but protein, the last unit or ounce of protein would be no more valuable than a similar weight of carbohydrates. Where protein supplements are fed in limited amounts, they generally show larger returns per unit than where fed in unlimited quantities.

Few feeders realize that by feeding a protein supplement they may increase the fertility of their soil, provided reasonable care is taken of the manure. Protein supplements are rich in nitrogen and phosphorus, of which 75 to 90 per cent is excreted by the animal as manure.

EFFECT OF FEED UPON PORK QUALITY

Numerous investigations have shown that a relation exists between the feed supplied to an animal and the quality of meat produced. It is well recognized that feeds affect the character of fat; certain feeds, notably peanuts, soybeans, and rice-polish produce soft or even oily pork. The majority of feeds used in Nebraska produce firm pork of good quality. The effect of specific feeds upon the palatability of pork is not as yet sufficiently well understood to permit generalization at this time. Investigations now under way should give more light on this subject.

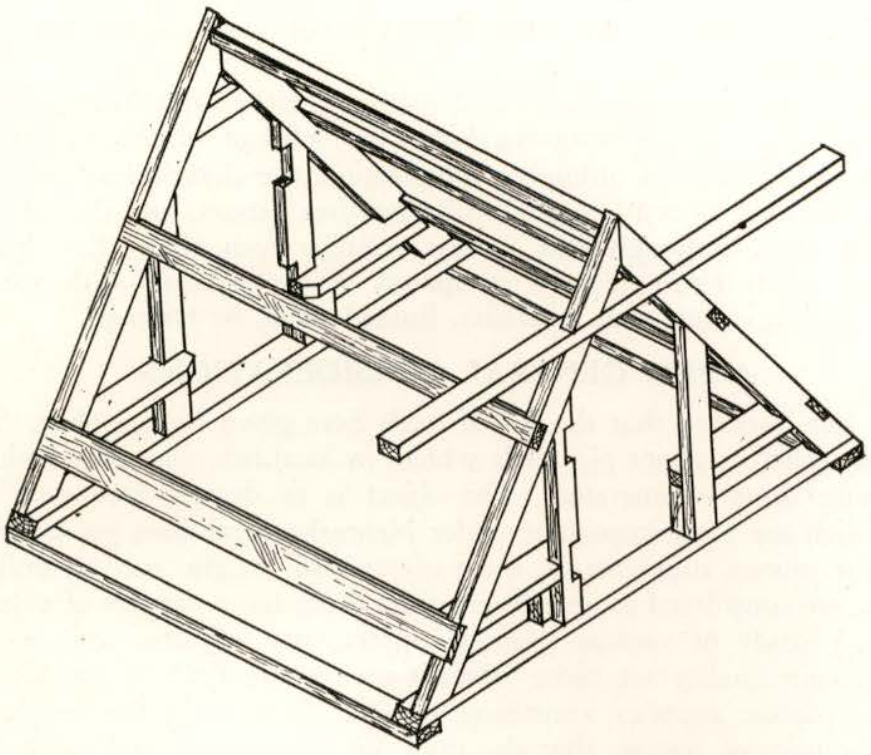


FIG. 11.—Frame of the Nebraska blizzard beater with store front.

Lumber

Skids	2—2″x4″x6′ (Creosoted material preferred)	Ridge rafter..	1—2″x4″x6′	Store front header	1—2″x4″x7′
Sills	2—2″x4″x7′	Nailing girts.	2—2″x4″x6′	Guard rail...	4—2″x6″x2′
Rafters ..	4—2″x4″x6′		2—1″x6″x6′	Guard rail support cleats	4—2″x6″x8″
		Door frames .	4—2″x4″x3′	Ventilators ..	1—1″x8″x8′
		Door headers.	2—2″x4″x1′	Door braces..	4—1″x6″x2′

Hardware

Ridge roll.....	1 piece galvanized iron ridge roll 6′ 6″ long
Hinges	2 pair 5″ heavy strap hinges with 16—3/16″x1¼″ flat head stove bolts } with 1 heavy 16—3/16″x2¼″ flat head stove bolts } washer each
Hasps	2—6″ wrought steel hasps with staples
Hooks and eyes.....	2—4″ steel hooks and eyes
Nails	2½ lbs. 16d common, 2½ lbs. 8d common, 2½ lbs. 6d common

The frame may be covered with 4″ flooring, 6″ flooring, or 12″ barn boards and metal bats. Flooring is preferable since hogs rub the bats loose. If flooring is used, the joints should be leaded as the boards are nailed in place. Four-inch flooring is found in all lumber yards and is usually better quality than the 6″ material.

If 4″ flooring is used:
- 48 pieces 6′ long—sides
- 26 pieces 4′ long—front end
- 13 pieces 4′ long—back end

If 6″ flooring is used:
- 30 pieces 6′ long—sides
- 16 pieces 4′ long—front end
- 8 pieces 4′ long—back end

If barn boards and metal bats are used for covering:
- 12—12″ barn boards 6′ long—white pine
- 11—12″ barn boards 4′ long—white pine
- 10—6′ galvanized bats
- 8—4′ galvanized bats
- 1 lb. ¾″ or 1″ galvanized nails for bats

FORAGE AND PASTURE CROPS

Pasture crops play an important part in modern pork production. Perhaps the most important function of pasture is the reduction in the amount of concentrated feed required to produce a given gain. Secondly might be mentioned the saving of labor. Pasturing eliminates the labor of harvesting the crop and generally simplifies the labor of caring for the animals pastured. As a rule, pigs on pasture are in better health due to the exercise provided and the protective accessory substances, proteins and minerals, contained in the forage.

With as great a range of rainfall and growing conditions as exists in Nebraska, it can readily be seen that it is difficult to make definite forage recommendations which would be applicable over the state. In fact, because of seasonal variation, recommendations for one year are not necessarily applicable the following year.

Where adapted, the legumes are preferable to the non-legumes. They are soil improvers, more permanent, and richer in protein and mineral matter than the grasses. As a general rule, the legumes furnish a longer grazing season. The cost of seed is generally a larger item with the legumes, but considering their greater permanency, this item can be discounted to some extent. Permanent pastures have their drawbacks in that they are frequently used too long, becoming an excellent medium for the spread of disease and parasites. There is no question but that the frequent plowing of hog lots for annual crops is an excellent means of holding disease and parasites in check. Pigs on pasture receive more exposure to sunshine, which adds to their well-being. Pasture has a stimulating effect upon the milk flow of the nursing sow.

Alfalfa.—Where it can be grown, alfalfa is Nebraska's outstanding forage crop. Mature hogs may be maintained on good alfalfa pasture without loss of weight. Young pigs should receive some concentrated feed on pasture. Where the pigs are merely to be grown out for future finishing, the 2.5 per cent grain ration or 2.5 pounds of grain per 100 pounds of live weight is very satisfactory. For 50- to 60-pound pigs, this constitutes about a half ration. Under this system of limited feeding, maximum use is made of forage and concentrated feed. Limited feeding calls for a greater area of pasture, and also results in slower gains. At Lincoln 20 full-fed pigs have been pastured per acre. Where the 2.5 per cent grain ration was fed, only half as many pigs could be pastured per acre. One successful Nebraska hog man suggested that 500 pounds of pigs might be grazed per acre of alfalfa. This does not pasture the alfalfa to capacity and permits the regular cuttings of hay to be made.

In alfalfa pasture tests at Lincoln, it appeared desirable to feed a protein supplement (tankage) to 61-pound pigs where a full feed of grain was fed. The amount of tankage consumed was only a fourth of a pound a day, although the pigs had free access to it. Similar pigs in dry lot ate 0.6 pound of tankage a day. Tankage-fed pigs on alfalfa gained twice as rapidly as similar pigs fed corn only. Every pound of tankage saved 4.5

pounds of corn. The pigs which had received tankage weighed 210 pounds after 115 days' feeding, while those receiving no tankage weighed only 140 pounds. Where no tankage was fed, the pigs rooted the alfalfa very badly, apparently in search of something lacking in their ration. Where the pigs were fed tankage the alfalfa remained in good condition.

At the North Platte Station similar comparisons did not show so much advantage for tankage. It is difficult to account for the difference between the two groups of tests unless the soil and climate conditions produce differences in the nutritive value of the forage crop.

Clover.—Red clover, particularly in eastern Nebraska, is commonly considered to be more or less interchangeable with alfalfa. No experiments have been conducted under Nebraska conditions to compare clover and alfalfa. Clover and alfalfa are so similar in comparison that one may safely conclude that the two forages are practically of equal value.

FIG. 12.—Banked up for early farrowing.

Sweet clover.—Several tests have been conducted with first-year sweet clover (both yellow and white) at the Nebraska Station. In these tests just as large and as economical gains have been secured as on alfalfa pasture. Sweet clover must be given an opportunity to get started in the spring and therefore provides a shorter grazing season than alfalfa.

The white-blossom clover comes on earlier than the yellow-blossom and makes a more woody growth. No work has been attempted with second-year sweet clover. Because of its rank growth, second-year sweet clover is not as desirable a hog forage as the first year's growth. Furthermore, second-year sweet clover dies down and provides little or no forage after midsummer. See Nebraska Agricultural Extension Circular 134.

Fall rye.—Rye seeded in the fall produces earlier spring pasture than any other forage crop. For the early litter, rye pasture is unexcelled. Under Nebraska conditions, June 1 marks the final limit of usefulness for rye pasture, for it heads out and becomes unpalatable. Heavy grazing prolongs

its usefulness. When rye becomes unpalatable, it may be permitted to mature as a grain crop or it may be plowed under and the land put into sudan grass or corn to hog down.

Sudan grass.—One of the most satisfactory of the annual pasture crops is sudan grass. It is strictly a hot-weather crop and should not be seeded until warm weather is assured. It is available for grazing at Lincoln about the last of June and may be pastured until the latter part of September, when killing frosts usually occur. It is admitted that the grazing season of sudan grass is short, but where it has had sufficient moisture to become established, there is perhaps no crop which has a greater carrying capacity.

In several tests conducted at Lincoln, pigs on sudan grass made as large and as economical gains as pigs on alfalfa. In tests conducted at North Platte, alfalfa excelled sudan grass. In the tests at Lincoln the desirability of feeding corn and tankage on sudan grass was strikingly demonstrated. The tankage-fed pigs averaged 210 pounds, while pigs receiving corn alone weighed only 140 pounds.

When moisture conditions are favorable, sudan grass may be used to follow fall rye, thereby furnishing a succession of forage. Unless chinch bugs are a serious factor, sudan grass does well where used in this manner. Heavy grazing promotes abundant tender leaf growth and improves the quality of sudan grass for hog feed. In some instances, clipping must be resorted to to keep it in the best condition for pigs.

Oats and barley.—Where rye and sudan grass are used as succession crops, an interval of a few weeks occurs when no forage is available. At the Nebraska Station a plan has been followed of seeding half the hog lots to a mixture of oats and barley. This generally is available about the time the rye becomes unpalatable and carries the pigs until the sudan grass is ready. After the usefulness of this pasture is over, it may be plowed and permitted to lie fallow until fall rains make possible the seeding of fall rye. A two-year rotation is thus provided which furnishes a maximum of forage and permits the frequent stirring of the soil, a desirable hygienic practice. By having half the lots in rye and the other half in oats and barley, a continuous succession of forage is produced. As an alternative to the production of sudan grass, early-maturing varieties of corn may be planted to hog down.

Bluegrass.—No experimental work has been carried on at the Nebraska Station with bluegrass pasture, although this grass is commonly used, particularly in eastern Nebraska. Work at other stations reveals that this grass is lower in value than alfalfa or clover. However, the hog feeder should bear in mind that any kind of pasture is better than no pasture at all.

Rape.—Dwarf Essex rape is a popular hog forage crop in the eastern corn belt. In the eastern part of Nebraska, rape is used to some extent, although it does not enjoy as great a popularity as some of the other crops discussed. The hot, dry weather of midsummer frequently retards the growth of rape to the extent that it becomes unpalatable.

While rape has a longer pasture season than some of the other annual pasture crops, it does not have the midsummer carrying capacity of sudan

grass or alfalfa. In northeastern Nebraska rape is sometimes planted in corn, particularly where the corn is to be hogged down.

Soybeans.—Soybeans are adapted to the extreme eastern counties of Nebraska where they are used to a limited extent as a forage crop for hogs. Soybeans are sometimes planted in corn to be hogged down, with the thought that the pigs are provided with a home-grown protein supplement along with the corn. Under eastern corn-belt conditions, this system is frequently productive of good results. With the more limited rainfall of Nebraska, this practice hardly seems desirable since the growth of beans will usually reduce the yield of corn proportionately. It is generally recommended under Nebraska conditions to grow the beans in separate blocks from the corn, thereby giving both crops better opportunities.

For hogging off, the light-colored, early-maturing varieties of beans should be used. Pigs should be given access to the beans before they are fully ripe in order to secure the maximum benefits from them.

Hogging down corn.—The practice of hogging down corn has received much attention in the last ten or fifteen years. The Nebraska Station has done very little investigational work on this problem. If we accept the evidence of the many tests conducted at other stations, hogging down corn is an economical method of fattening pigs. As a rule, pigs make more efficient use of corn in the field than if the same corn were husked and fed in dry lot, to say nothing of saving the labor of husking the corn.

It should be said that the success of hogging down corn will depend largely upon the weight of pigs used, the season, the character of the soil, and possibly other factors. Well-grown pigs in average flesh weighing about 125 pounds are best adapted to hogging down corn. Fleshy pigs should never be turned in the corn field.

The practice is generally more successful during seasons when the weather is reasonably dry. Rainy weather and muddy corn fields reduce returns through loss of grain and in some cases cause pneumonia in the pigs.

Pigs do best if they are accustomed to corn-field conditions by being turned first into a small patch of sweet or squaw corn or one of the early-maturing varieties which ripen before the field corn is ready. A considerable saving of feed is generally effected by turning the pigs into such a portion of the field as they are likely to clean up in 10 to 14 days. Woven wire and steel posts offer a simple means of restricting the range of the pigs.

Pigs in the corn field should be observed closely. The last few bushels of corn disappear surprisingly fast. It is not a good plan to expect pigs to clean up the corn field too closely. After the fattening hogs are removed, brood sows or stock pigs will glean any grain overlooked by the fattening pigs.

Pigs in the corn field should be regarded as being upon a full feed of corn and therefore they need some protein supplement. This need may be sharply reduced, however, if the pigs can be given access to an adjacent alfalfa or clover field while they are in the corn.

After hogs have been fed in the corn field, it is a good practice to full feed them in dry lot for a week or two. Very economical gains are generally made where a good ration is fed for a short time.

The hogging down of small grain is regarded as an unsatisfactory practice unless it becomes a matter of salvaging a crop that has been damaged by hail or wind.

MINERAL MIXTURES

A certain amount of mineral matter is necessary for hogs to develop and grow normally. The two minerals most needed by animals are calcium or lime and phosphorus, which are used to build up bone, muscle, nerves, and milk. Unfortunately, these elements are lacking in grain. Hogs are fed largely upon grain feeds and all of the cereal grains and practically all of the grain by-products are deficient in ash or mineral matter. There are feeds, however, which are rich in these bone-building substances, provided the soil itself is not deficient in either lime or phosphorus. Chief among these may be mentioned the legume pastures and hays. Milk and tankage also contain ample amounts of these bone-building substances. Where hogs have access to alfalfa or clover pasture, or where they are being fed milk or tankage, the probability is that they are receiving sufficient mineral matter. The feeding of a good quality of leafy alfalfa hay to hogs during the winter is an excellent practice for this reason. Experiments have shown that sows fed grains and alfalfa hay farrow larger litters of larger and stronger pigs than sows fed grain alone.

Where hogs are confined to a dry lot, or where they are limited to a strictly grain ration, there may be a need for a mineral mixture to supply mineral matter. In supplying a mineral mixture, however, we must recognize that mineral matter in an inorganic form, such as ground limestone, is less valuable than organic mineral matter such as exists in the legumes, milk, or tankage.

Too many farmers feel that a mineral mixture acts as a "tonic" to stimulate growth or fattening. This is not the case unless the lack of mineral matter is the limiting factor in the ration and hogs are actually suffering for it. Neither should a mineral mixture be regarded as a "cure-all" for all real and imagined ailments of hogs. Frequently a visit from a competent veterinarian will be more helpful.

Where there is a deficiency of calcium and phosphorus in the ration, bone meal, which may be purchased from the packing houses, will probably come as near meeting the needs as any other substance. Air-slacked lime, marble dust, ground limestone, or ground oyster shell may be used to correct a deficiency of lime in a ration. The United States Department of Agriculture recommends feeding a mixture made up of one bushel of wood or cob ashes, 5 pounds of salt, and 8 pounds of air-slacked lime. Another mixture which is frequently suggested is 40 pounds of steamed bone meal, 40 pounds of ground limestone, and 20 pounds of salt. If mixtures such as these are kept before hogs where wind and rain cannot get

at them, they will probably meet the needs of a pig for mineral matter, at least as well as many of the more costly mixtures upon the market.

Much has been said concerning the value of certain mixtures as worm expellers or worm preventives. As a matter of fact, if a mineral mixture contained enough of a drug sufficiently powerful to expel worms, it would be a dangerous and unnecessary feed to use constantly.

Salt is usually found in all mixtures. While hogs do not need as much salt as some of the other domestic animals, nevertheless a certain amount should be fed. Block salt may be conveniently fed to hogs. If hogs are unaccustomed to salt, it is dangerous to give them all the salt they will eat. There are many cases on record where too much salt has caused death.

Charcoal and slack coal are not digestible and are therefore entirely without value to a hog.

Lye is very irritating to the intestines and may cause death if fed in quantities. As a worm expeller it is worthless.

Copperas or iron sulfate is often fed in a mixture as a vermifuge but as such is useless.

Sal soda and sodium bicarbonate are purgatives. Physicians recognize that the constant use of a physic is a bad practice. There is no more excuse for constantly doping a hog than a man. If hogs become constipated, the ration should be corrected by including green feed, bran, or linseed meal, or by allowing more water and more exercise. In individual cases, it may be necessary to resort to drugs, but they should not be included in a mixture to be kept before hogs at all times.

Sulfur is another of the ingredients generally found in a mineral mixture. Sulfur is not soluble nor is there any digestive juice to make it soluble in the digestive tract. Hence it is of no value in a mineral mixture.

Potassium iodide is sometimes recommended to be fed in limited quantities in a mixture, since it prevents goiter or hairlessness, a serious problem in some states. This condition is not common in Nebraska so this drug need not be fed unless specific conditions warrant.

Mineral matter with the exception of salt can best be supplied by pasture, especially legumes, and feeds like legume hays, milk, and tankage. Where there is a possible lack of bone-building substances, the use of bone meal, crushed limestone, air-slacked lime, or other forms of lime may be desirable.

SELF-FEEDERS

To none of the domestic animals is the practice of self-feeding as well adapted as to pigs. With a stomach of limited size, the pig eats small amounts of feed at a time but will eat frequently if given the opportunity. Where pigs are permitted access to a self-feeder some will be found eating at all hours of the day and night.

Summarizing a large number of tests carried on at the Nebraska and other stations, we find that self-fed pigs consume more feed than similar pigs hand-fed the same rations. Pigs on a self-feeder make larger gains than pigs fed by hand. There appears to be some disagreement as to the

economy of gain. In many cases the pigs self-fed required less feed than those fed by hand. However, there have been enough instances where the opposite was true to demonstrate that intelligent hand-feeding is just as efficient as self-feeding. One of the chief values of the self-feeder is the saving in labor effected. This is a factor only where the self-feeder is of sufficient size to hold several days' supply of feed.

The principal value of the self-feeder lies in the fattening of pigs, where it may be used in dry lot or on pasture. Where pigs are merely to be grown out, the self-feeder is not well adapted since self-fed pigs are inclined to fatten rather than to grow. Self-fed pigs on pasture do not make extensive or efficient use of pasture, since the self-feeder encourages the use of concentrates rather than the maximum use of forages. Where it is desired to use the self-feeder for growing pigs, it is necessary to incorporate considerable fiber into the ration by means of alfalfa meal, bran, oats, or similar feeds.

The self-feeder may be used for sucking pigs. In some instances it is used in a creep to which only the pigs have access, while in other instances sows and litters alike are given free access to the mixed feed after two or three weeeks of working the sow up to a full feed by hand. The United States Department of Agriculture (Farmer's Bulletin 1504) reports very favorably on the self-feeding of brood sows and litters.

Two methods of using the self-feeder are available. First, there is the method of mixing a ration, combining various constituents in definite proportions. This method is used most extensively in feeding young pigs or breeding stock. By this plan the animal is forced to consume a definite percentage of protein or fiber, which is useful to prevent pigs from becoming too fat. The more common use of the self-feeder is for the free-choice or "cafeteria" plan, whereby the carbohydrate feed is fed separately from the protein feed, the pig being permitted to take what he desires. This method is used primarily for fattening hogs where maximum gains are the object.

Where both feeds are reasonably palatable, pigs show an uncanny ability to adjust the protein intake to their requirements. Thus with corn and tankage, pigs will consume a greater proportion of tankage in the early stages of fattening and later will reduce their tankage intake as their protein needs become reduced. For this reason pigs fed free choice generally make more efficient gains than those fed a definite percentage of tankage during the entire feeding period. There are sufficient data available to indicate that where intelligent feed adjustments are made to approximate the needs such as are set forth in the standard on page 10, hand-fed pigs will gain as efficiently as pigs self-fed.

Where either the grain feed or supplement is particularly palatable, the pig does not adjust his protein intake to his needs. Certain mixtures, particularly those containing cottonseed meal, are exceptionally palatable and in those cases pigs may consume more protein than they require.

SELF-WATERING

In a rather extensive series of tests at the North Platte Substation, self-watering increased the rate of gain and reduced the feed required to produce a given gain. The Minnesota Station found that self-watered pigs drank 27 per cent more water than similar pigs hand-watered. No differences were noted in either rate or economy of gain. If these results have no other significance, they should at least force us to a realization of the importance of an abundant and regular supply of water for hogs of all kinds.

GRINDING, SOAKING, OR COOKING THE FEED

Much attention has been directed within the past few years to the subject of grinding. Claims of larger and more economical gains are frequently made by those who manufacture grinding equipment. The literature on this subject is not so extensive as might be desired, yet is of sufficient volume to permit reasonably accurate conclusions. Within the weight limits that pigs are usually fed, that is, up to 225 to 250 pounds the grinding of corn is not advantageous. Above those weights, grinding appears to be more justifiable. Grinding of small grains such as wheat, barley, and rye, is generally desirable particularly where the grain is hand-fed.

Very finely ground feeds are less palatable than feeds coarsely ground. Where a mixture of various feeds is to be made, it is generally necessary to grind them all to a uniform fineness in order that a uniform mixture may be secured. Because ground feeds become rancid, they should be fed freshly ground.

Soaking feed appears to be an unsatisfactory substitute for grinding. By slop feeding, animals may sometimes be induced to consume a little more feed. Unless some special object is at hand, slop feeding does not pay for the additional labor required.

In the past cooking was highly regarded as a method of preparing feeds. Today it is recognized that most feeds are actually lowered in feeding value by cooking, with the exception of potatoes.

HANDLING THE HERD

Selection of a breed.—It is not the intent to enter into an extensive discusion here as to the relative merits of various breeds nor to discuss the desirability of purebreds as compared with grade hogs. There is considerable evidence to indicate that greater differences exist between individuals of a breed than between breeds. This should impress upon the beginner the need of securing the best individuals within his means. The word "best" should not be construed as meaning the most expensive.

The vast majority of hogs must find as their ultimate purpose, the "pork barrel." Most farmers are primarily interested in market hog production. The hog business should form a regular part of the farm business.

A definite number of sows should be maintained subject only to such slight fluctuation as may seem warranted by crop or economic conditions.

There is a field for a limited number of progressive and intelligent breeders to produce purebred stock for "seed" purposes. In addition to a knowledge of animal types and intelligent feeding, the purebred business requires ability and salesmanship. There is no established market for purebred breeding stock, and the producer is dependent upon his own resources and ingenuity to dispose of them above market prices.

It should be emphasized that the rapid rate of reproduction makes it possible for the hog producer to purchase one registered sow and from her offspring to establish a purebred herd in a short time. It would seem the part of wisdom to use nothing but purebred boars. In this way any outstanding individual might be disposed of for breeding purposes and the bulk of the pigs sold on the market.

In selecting animals for the breeding herd, not only should conformation be taken into consideration, but also prolificacy, rate of gain, and feeding quality. Such a system of selecting breeding animals is in operation in Denmark and Great Britain. A start in this direction has been made in the United States by means of the record-of-performance plan that is being developed by the United States Department of Agriculture and the experiment stations of several states.

Equipment.—The equipment for swine production need not be expensive or extensive. Hog housing systems have been of two general types, the centralized house and the colony or portable house. For the large part, the advantages of one type are the disadvantages of the other. The central house is convenient and impressive with a low upkeep cost. Since it is fixed in location, the immediate premises become so contaminated with parasite eggs and disease germs that the production of healthy pigs becomes almost an impossibility. Well-built centralized houses with concrete floors may be cleaned and scalded so that pigs may be farrowed there to be moved out to clean premises. However, the marked tendency at the present time is towards the use of the colony house whereby pigs are produced on pastures on which there have been no pigs for at least two previous years. For details of disease prevention, see Nebraska Circular 39, *Swine Sanitation,* by Van Es.

Portable houses are efficient (Fig. 11). They may be increased to meet the expanding production of the small operator. Since they are movable, they are adapted to the renter. It is not to be denied that these houses are less convenient and that caring for pigs is more laborious, particularly during inclement weather. The upkeep cost on portable houses is greater proportionately than for a central house.

Care of the bred sow.—To a large degree the success or failure of any year's pig crop is dependent upon the treatment given the brood sow. Proper feed is one of the primary considerations. Evvard, at the Iowa Station, has found that the addition of a protein supplement such as alfalfa hay or tankage to a corn ration increased the size of the litter, the average birth weight of the pigs, and also the percentage of strong pigs.

The unborn litter is growing rapidly; therefore a balanced ration is necessary for the bred sow. In the case of a gilt, the need for protein becomes doubly important, since it is needed not only for the growth of the litter but also for the growth of the gilt as well.

In Nebraska, corn is generally the cheapest source of energy for the hog ration and, where it is intelligently supplemented, may be used with good results. No definite rules can be given as to the amount of corn to feed to a brood sow. This will depend upon the age of the sow and the amount of flesh she is carrying. Young sows must be fed more liberally than mature ones and sows suckled down thin require more feed than sows in good flesh. A good rule is to have the sow increasing in weight during the gestation period but not excessively fat at farrowing time.

When pasture is available, bred sows should have access to it. Legume pasture like alfalfa is particularly valuable in providing protein, minerals, vitamins, and exercise for the well-being of the brood sow. During the winter season, green leafy alfalfa hay is valuable for the same reason. Alfalfa hay may be provided in a rack, or the hay may be coarsely ground or chopped in an ensilage cutter and mixed with grain and fed in a self-feeder. At the North Platte Station, satisfactory growth was secured with bred gilts on a mixture of 1,000 pounds of chopped alfalfa, 1,000 pounds of ground corn, 500 pounds of shorts, and 100 pounds of tankage. The alfalfa hay was cut with a silage cutter.

As a general rule, it is a good plan to feed a small quantity of high-protein concentrate even where alfalfa hay is fed. Milk, tankage, or any good protein supplement may be used. From one-third to one-half of a pound of tankage may be fed daily or an equivalent amount of protein in the form of some other supplement.

Equally as important as the matter of proper feeding is that of exercise. Particularly in cold weather, sows are inclined to remain close to their quarters, calling the ingenuity of the herdsman into play to force them to move about. Some give the sows the run of a corn field after the corn has been picked. Others feed at a distance from the sleeping quarters when weather permits. Sows that have had ample exercise during the gestation period generally have less difficulty at farrowing and produce larger, stronger pigs.

The gestation period.—The gestation period of the sow is 112 to 115 days, or, an easy way to remember it, 3 months, 3 weeks, and 3 days. Some individual variations will occur. It is better to underestimate the gestation period in order to be certain that proper preparations are made. One hundred and twelve days, if anything, errs on the side of safety.

Care before farrowing.—Three or four days prior to farrowing the sow should be isolated from the herd. She should be thoroughly scrubbed to remove the dust and dirt from the body. This dirt from the old hog lots frequently contains enough parasite eggs and disease germs to doom a large percentage of the unborn litter. The sow should then be placed in a pen which has been thoroughly scalded with lye water or taken to a

clean portable house on ground where there have been no pigs for at least two years. The sow must be kept in these quarters. To let her go back to the old hog lot for feed or exercise is to defeat the precautions taken thus far.

When a sow is confined to a small farrowing pen, she may become constipated, particularly if she has been accustomed to exercising freely. Therefore it is essential to restrict the amount of her ration. Laxative feeds such as alfalfa hay or meal, bran, and linseed meal are particularly helpful at this time. Too much bedding in the farrowing pen is a more common difficulty than too little. About a bushel of straw, preferably cut straw, is sufficient. When indications point to the likelihood of the sow farrowing within 24 hours, all feed should be withheld. The sow should be given ample quantities of water and in severe weather this should be warmed slightly.

At farrowing time.—Some feel that it is essential to attend a sow at farrowing time. Occasionally difficulties arise which can be overcome by intelligent assistance. Fortunately, in the vast majority of cases, everything goes normally if nature is permitted to run its course. Too many beginners are overly anxious to assist a sow and frequently do more harm than good. A nervous sow is often made more irritable by someone being around at farrowing time. It is always desirable, of course, to have sows gentle and accustomed to being handled. This obviously cannot all be accomplished in a day or two prior to farrowing. The sow farrowing in a portable house can be given little if any assistance due to lack of room.

A guard rail around the farrowing pen is an effective means of reducing the loss of young pigs by crushing. The guard rail may be constructed of 2x6s or 2x8s nailed on edge around the pen 7 or 8 inches above the floor.

In extremely cold weather or with a very nervous sow it is sometimes desirable to remove pigs as farrowed, placing them in a cloth-lined basket or box to prevent chilling until farrowing is completed. When it is very cold, a jug of hot water may be placed in the box or basket to provide warmth.

The newly-farrowed pig should be dried off. Breathing may sometimes be started in a pig apparently born dead by pumping his side with the hands. A chilled pig can frequently be revived by immersing him up to his nose in water as hot as can be tolerated by the elbow. Some advocate that the navel cord of newly-farrowed pigs be tied off with common string an inch from the body and the end cut off. The remaining end may be touched with a little tincture of iodine to prevent the possibility of infection.

Immediately after the farowing is a good time to clip off the "needle" or "wolf" teeth. Two of these teeth will be found in each corner of the mouth, making eight in all. A sidecutting jeweler's pliers is the most satisfactory instrument for this purpose. Care should be exercised not to break the skin of the gum, for this may provide an opening for the germs that cause bull nose or canker sore mouth to enter. If these teeth are not removed the pigs are likely to skin up each other's noses in fighting. These abrasions may furnish an opportunity for infection. Pigs whose teeth are not removed may worry a sow, particularly if the sow's udder is tender.

Farrowing time is the best time to mark the pigs. Some record should be kept even where grade hogs are produced if gilts are to be selected from the larger and more efficient litters. Marking usually consists of notching the ears with a special tool or by taking out half circles from the edge of the ear with a harness punch. The first litter may have one notch in the right ear, the second two in the right as follows:

1. VR	5. VRVL	9. VVVR
2. VVR	6. VVRVL	10. VVVRVL
3. VL	7. VRVVL	11. VVVRVVL
4. VVL	8. VVRVVL	12. VVVRVVVL

Another common method is to arbitrarily assign values to notches in different positions. By adding these values together a variety of numbers may be made, thus:

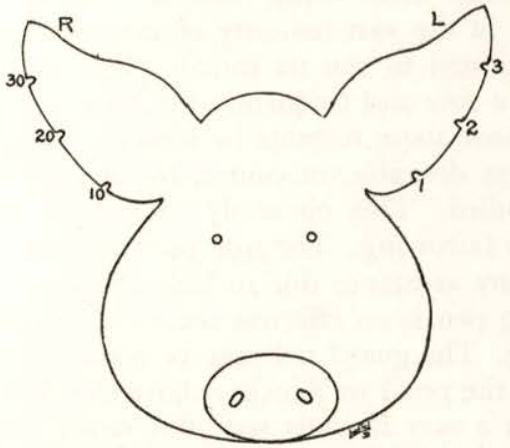


FIG. 13.—This system provides unlimited numbers.

Litter number:

1. Base of left ear
2. Middle of left ear
3. Top of left ear
4. Base and top of left ear
5. Middle and top of left ear
6. Base, middle, and top of left ear.

With the latter system extreme care must be observed that the position of the marks is accurate. By combining the digits with the tens in the other ear a large number of marks are possible. The marking system should be simple, and, particularly with purebreds, the key should also be in the hands of more than one individual. The incapacitation or accidental death of the owner has sacrificed more than one good purebred herd because no one knew the identity of the individual animals.

After the sow has farrowed, the pen has been cleaned, and fresh bedding supplied, the pigs should be returned to the sow for feeding. No feed need be given the sow for 24 hours after farrowing, although she should be provided with an abundance of drinking water. On the second day a light feed of bran or shorts may be fed. Gradually the "heavier" feeds should be introduced into the ration and the ration increased in amount. The milk flow of the sow is influenced by the amount of feed consumed. The flow of milk should be stimulated by increasing the feed as rapidly as the pigs can handle the milk. Too rapid stimulation of the milk flow usually results in indigestion in the pigs, followed by scours. Considerable variation will be found in sows as in dairy cows, some producing milk more rapidly than others. The condition of the pigs is undoubtedly the best index for feeding the sow. Provide all the feed the sow will consume without scouring the pigs. At the first appearance of scours, reduce the

sow's feed and in severe cases skip a feed entirely. A few handfuls of bloodmeal fed to a sow is usually effective in stopping scours in her litter.

Scours are usually caused by too much feed, spoiled feed, or a sudden change of feed. Another type of scours is due to bacteria, and correcting the ration will prove of little benefit.

Several investigators have recently called the attention of hog men to the possibility of anemia causing serious death losses in suckling pigs. The deficiency of iron in milk is well recognized. While the young pig is entirely dependent on his mother's milk, there is a likelihood of his getting insufficient iron. This trouble is more likely to occur when pigs are confined in concrete pens. To overcome this difficulty, pigs should be encouraged to eat as soon as possible after farrowing. Some have suggested that a piece of sod from uncontaminated ground will provide all necessary minerals to suckling pigs.

In most cases, about two weeks will be required to work a sow up to a full feed after farrowing. A ration successfully used at the Nebraska Agricultural College for young pigs and brood sows as well is:

Ground corn	200 pounds
Ground oats	200 pounds
Shorts	200 pounds
Tankage	20 pounds
Linseed meal	15 pounds
Steamed bone meal	6 pounds
Salt	3 pounds

When pasture is not available, sows receiving this ration should be fed leafy alfalfa hay of a good green color. Many other rations may be used for brood sows. The mixture need not be so complicated as the one just given. The essential thing in the brood sow's ration should be an ample supply of protein and mineral substance in order that she may produce milk efficiently. After the sow has been established on a full feed, self-feeding may be resorted to. (See U. S. D. A. Farmer's Bulletin 1504.)

Orphan pigs.—Occasionally the hog man will have a litter of orphan pigs on his hands as a result of the death of a sow or the failure of a sow to produce enough milk to suckle her litter. If a number of sows are bred to farrow at the same time, it is generally possible to "switch" pigs, dividing surplus pigs among the smaller litters. This practice is far more satisfactory than attempting to raise orphans by hand. Infinite patience and absolute cleanliness are necessary where orphan pigs are to be raised successfully.

The Iowa Experiment Station has carried on extensive experiments in raising orphan pigs. They offer the following suggestions:

That pigs be permitted to secure some of the colostrum or first milk if possible.

That flat pans be used and that bottles and nipples be dispensed with entirely. Pigs may be taught to drink with little effort. The pans can be cleaned and sterilized more readily than bottles and nipples.

That young pigs be fed five or six times daily during the first few weeks, after which three times daily are sufficient.

That orphans should not be overcrowded.

That a quart of whole milk to each pig is most satisfactory. Where whole milk is not available, skimmilk, buttermilk, or condensed buttermilk may be used. Modification of whole milk by adding cream or sugar proved undesirable.

That yellow shelled corn, tankage, and a salt mixture should be provided free choice. The addition of one raw egg daily for each pig proved beneficial.

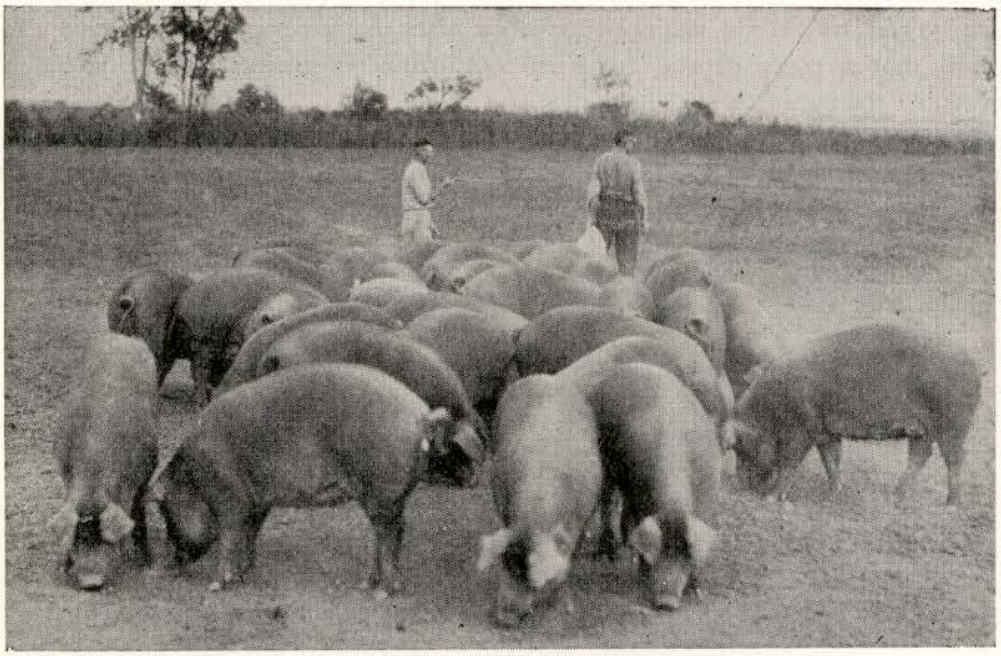


FIG. 14.—Good sows are necessary for efficient production.

Creep feeding.—During the suckling period, pigs make the most economical gains of their lives. It is well to take advantage of this growth impulse by providing pigs with some feed in addition to the mother's milk. At about two weeks of age, pigs will begin to eat. Young pigs will take shelled corn more readily than any other feed. Where the sow and litter are not to be self-fed, additional feed may be provided in a creep. Since the milk contains ample protein, the use of a highly carbonaceous feed like shelled corn is satisfactory. As the milk flow declines, a better balanced ration should be fed such as previously suggested for the sow, corn and tankage, or corn, shorts, and tankage.

Creep feeding increases pig gains. Sows do not lose so much flesh where the pigs are creep fed. Whether the sow is to be marketed after weaning her litter or whether she is to remain in the herd, the flesh lost must be replaced. As a rule it is cheaper to retain the flesh than to put it back by later feeding.

Creep-fed or self-fed pigs are heavier at weaning time. Since they are accustomed to eating grain, they may be weaned with less setback than pigs which have had no supplementary feeding. When necessary, such pigs may be weaned at a younger age.

When at all possible, suckling pigs should be kept on pasture, and the pasture should be "clean." Litters produced in central houses should be hauled, not driven, to clean pastures. Sows and litters driven through old hog lots might pick up enough infection to defeat the entire program.

Castration.—Pigs can be castrated with less danger and chance of setback during the suckling period than later on.

FIG. 15.—Scrubbing the sow before farrowing removes dust and dirt, which contain parasite eggs.

Weaning.—Pigs should not be weaned at less than seven weeks of age and if possible weaning should be deferred until later. Pigs weaned at eight to ten weeks of age generally "do" better.

At weaning time, the feed to the sow should be sharply reduced, thus reducing the milk flow. If the sows have been running to self-feeders, a hurdle built around them so as to exclude the sows but to admit the pigs accomplishes the same purpose. Such feeds as shelled corn or oats tend to dry up the sows. It is a better plan to move the sows from the pigs than to move the pigs to strange quarters. The pigs are accustomed to their lot and are less upset by weaning if no change is made. Sometimes it is necessary to return a sow to the pigs after a day in order that the udder may be milked out. If this is not done, the udder is apt to "cake" and a portion be lost. Weaning time is a critical time for a pig and therefore no radical changes in feeding should be made at this time.

Vaccination.—Hog cholera is one of the principal causes of loss to Nebraska hog men. Hog lot sanitation is of no avail in controlling this

disease, vaccination being the only preventive. A complete discussion of this disease will be found in U. S. D. A. Farmer's Bulletin 834.

Feeding after weaning.—After weaning time two methods of feeding are open to the producer. First, he may full feed or self-feed, hurrying the pigs to an early market; or second, he may grow them out on pasture with a light feed of grain with the expectation of fattening later upon new corn, hogging down corn, or putting them in the feed lot behind cattle. It is well recognized that hogs are marketed seasonally. Most pigs are farrowed in the spring, grown on grass, fattened in the fall, and are marketed the following winter. Market receipts of hogs decline until April first when the marketing of fall pigs increases receipts again until June first. Summer receipts are the lightest of the entire year. For the most part, the price curve is the opposite of the receipt curve. In other words, when hogs are plentiful, prices are low and vice versa.

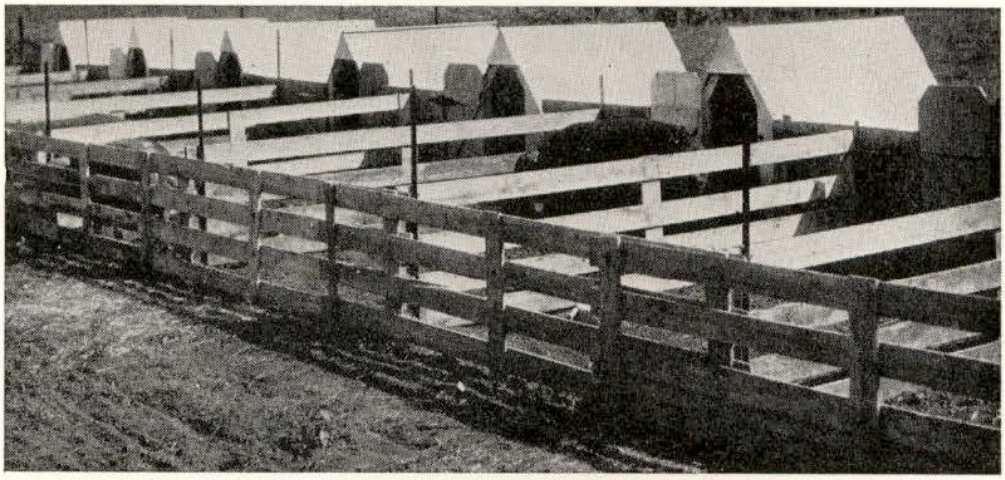


FIG. 16.—Portable equipment simplifies disease prevention.

The marketing of hogs at certain seasons is due to definite seasonal crop production. Whenever production is carried on at other seasons than the normal, greater costs are encountered. The normal time for reproduction of hogs doubtless is the late spring season. Whenever it is moved up to the early spring months, greater mortality may be expected. Where pigs are full fed for the early fall market, which, incidentally, has been the highest market of the year, the feed for those pigs must have been carried over from the preceding crop season. As a result of storage expenses, shrinkage, and interest, the cost of this feed is normally higher than it would have been the preceding fall and winter. Where the practice of full feeding is followed, it is to be expected that production costs will run higher.

Where pigs are full fed, they cannot utilize pasture as efficiently as pigs which are carried on a lower grain allowance. Pigs that are getting only a limited amount of grain will eat more grass, and since pasture is ordinarily a low-priced feed, cheaper gains can be expected where this practice of feeding is followed.

It has been repeatedly demonstrated that thrifty pigs intelligently fed will weigh in excess of 200 pounds at six months of age. This means that early spring pigs full fed from birth should reach market soon after September first, and basing our opinion upon the past, this market is generally the high market of the year. It should be said, however, that many hog men are taking advantage of this situation and as a result the increased number of early-marketed pigs is having the effect of reducing the price and lowering the returns from this method of production. It is obvious that it would not be so desirable to full feed late pigs for the reason that they would compete with pigs produced on a limited grain ration and therefore lower production cost.

Pigs fed a light feed of grain during the summer season can be produced for a lower price than full fed pigs. They use pasture more efficiently. They are in a position to make efficient gains on cheap new corn in the fall. Of course, it is true that they generally sell for lower prices in the late fall or early winter.

Full feeding does have the advantage of quick turnover, thereby effectively reducing risk and interest charges. Full feeding enables one to dispose of his spring pig crop in time to make available the equipment and full attention of the operator for fall pig production.

Full feeding.—Where full feeding is to be practiced it is evident that a liberal allowance of a well-balanced, highly palatable ration must be fed. Self-feeding is generally to be recommended, practically speaking, from birth. Corn is most cases should form the major portion of the ration, although in its place such feeds as ground barley might be used. Only a limited amount of bulky feeds such as oats should be used, possibly not over 25 per cent of the grain ration. The use of a high-protein supplement of some sort is absolutely necessary for the rapid gains which are essential for early marketing. Milk, tankage, or a mixture of high-protein feeds may be confidently expected to make good returns. Protein supplementary mixtures will not show up as advantageously on pasture as in dry lot. Palatable forage crops occupy an exceedingly important place in rushing the full-fed pig to market.

Growing pigs.—Pasture and forage crops must play a leading part in producing the cheap gains generally expected with limited rations. It is not advisable to restrict the ration of the pig until well after the weaning period. After the pigs are weaned, a limited grain ration may be fed. Some feel that no grain at all should be fed on pasture during the growing period. Extensive tests at the Nebraska Station have indicated that some grain is essential for satisfactory growth on pasture. A 2.5 per cent grain ration, that is, 2.5 pounds of feed a day per 100 pounds of live weight, has proved very desirable. This generally constitutes about a half feed, and forces the pig to consume large quantities of forage.

Pigs grown by this method are in excellent condition to make rapid and economical gains on new corn in the fall. They may be put in the feed lot behind cattle, or they may be used to hog down corn.

Fattening hogs.—For fattening, the self-feeder assumes an important place. Corn again holds the center of the stage as the principal feed, although under certain price conditions the corn may be replaced with ground barley or ground wheat. Ground rye or hominy feed may be partially substituted for corn. Dry-lot feeding makes the use of a protein supplement imperative. Even for pasture feeding a protein supplement is justified from the standpoint of increased gains and efficient production. Under dry-lot conditions, the protein mixtures have shown up to best advantage, particularly from the standpoint of increasing the rate of gain. When pasture is not available, it is desirable to supply alfalfa hay in a rack.

Developing breeding hogs.—Pigs to be used for breeding purposes should be carried on a reasonably high plane of nutrition. Forage and balanced rations are important. The more extensive use of such bulky feeds as oats and shorts is desirable.

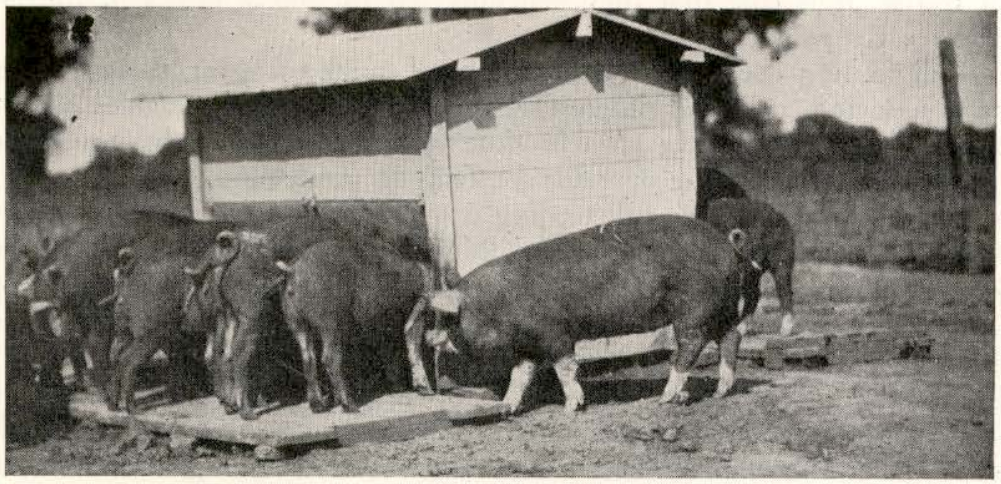


FIG. 17.—The self-feeder shortens the road to market.

Where pigs are of the big type, no serious objections can attach to the practice of permitting the gilts to run with the fattening hogs until they weigh 200 or 225 pounds. Gilts of the big type generally do not become too fat even where self-fed to those weights.

One or two litters?—Probably not more than one-fourth to one-fifth as many fall pigs are produced as spring pigs. It is true that fall pigs are produced at a season when conditions for growth are less favorable. Fall pigs do not have the abundant forage available for spring pigs. The weather is inclement. On the other hand, feed is generally more plentiful and lower in price during the winter months when fall pigs are being produced. Farm work is less pressing, and therefore the unfavorable weather may be largely offset by the farmer's giving his pigs better care than he can ordinarily give spring pigs. Perhaps the deciding factor is the fact that fall pigs generally bring a higher average price than spring pigs, for they reach market during a season of fairly limited hog marketing.

Work at the Minnesota Experiment Station agrees with the results at the Nebraska Substation (Bulletin 243) that fall pigs are just as efficient in

the utilization of their feed as spring pigs. Because of the lower price of grain feeds during the winter season, the grains are frequently lower in cost for the fall pigs. The mortality of fall pigs averages higher than for spring pigs. More equipment is necessary for the production of fall pigs.

If two litters of pigs are to be raised per year, the major part of the herd must be made up of mature sows, or fall gilts must be held over. It is asking too much to expect a yearling sow to produce two litters. Producing two litters a year from a mature sow reduces the birth cost of each pig; that is, for the same investment the production is twice as great. The saving, in fact, is not so great as it appears, for a sow producing two litters a year must be fed more liberally than when only one is produced. Where two litters are produced, spring litters must be farrowed a little earlier and fall pigs a little later than may appear to be desirable, and it is necessary to wean pigs younger.

Gilts vs. mature sows.—The North Platte Substation has carried on extensive tests comparing mature sows with gilts. By averaging four years' work in which approximately 20 gilts were compared annually with an equal number of sows, the following conclusions were reached.

Mature sows require less feed during the winter but more after farrowing than gilts. For this reason, the cost of wintering a mature sow is less than that of a gilt. Over a four-year period, the old sows farrowed about three more pigs per sow than gilts and raised a slightly larger number (6.55 as compared with 6.2). The pigs farrowed by old sows weighed more at birth (2.4 pounds against 2.31 pounds). Those produced by mature sows gained more rapidly, reaching the 50-pound average weight in 89 days as compared with 99 days for the pigs produced by gilts. The gilt, of course, grew in size and therefore increased in value while producing a litter and this was sufficient to offset the greater efficiency of the mature sow as a mother. As a result, the pigs from the gilts averaged slightly lower in cost at 50-pound average weight than pigs produced by old sows. The greater prolificacy of mature sows can probably be explained because they represent a selected group, the sows which were poor mothers having previously been culled out.

Age to breed.—Gilts are generally bred at about eight months of age, which means that they will farrow at about one year of age. It has been commonly believed that early breeding stunts an animal, but recent work at the Missouri Station indicates that lactation rather than reproduction retards growth. It is not to be denied that the gilts, to be suitable for breeding at eight months, must have been liberally fed and that this feeding policy must be continued after breeding.

The practice of "flushing" sows two weeks prior to breeding is a good one. A fresh succulent pasture and liberal feeding generally assure large litters. The sow should be gaining in weight at breeding time.

The herd boar.—Too frequently the herd boar is looked upon as a necessary evil. We have the old statement that the sire is half the herd, although as a usual thing he does not receive his proportionate share of

attention. He is often confined in a small pen or dark stall and fed in anything but an intelligent manner.

The boar, particularly if a young one, needs an abundant supply of protein and mineral matter in his ration. He should have green feed, sunshine, and exercise. If he becomes restless, a barrow or a bred sow placed in his pen is an effective means of quieting him. Confining the boar and limiting breeding to single services are to be recommended where this practice can be followed. A young boar should not be used more than once daily, although mature boars are sometimes used twice a day.

The weight at marketing.—The market has expressed in no uncertain terms its preference for the pig weighing 185 to 225 pounds provided it is well finished. A study of hog prices generally indicates that a pig actually depreciates in value after reaching 250 pounds in weight. The market demand for the lighter-weight pigs has been brought about by consumer preference for small pork cuts and also by the unfavorable price situation of lard. Pork producers have an effective means of reducing or expanding pork production by the lowering or increasing of the average weight of hogs marketed. Increases in live weight beyond a certain point represent increases in the production of lard rather than of meat.

A study of experimental feeding tests shows that young pigs require less feed per weight unit of gain than older ones. Henry and Morrison in *Feeds and Feeding* by a very extensive compilation of experimental data show that the average daily gain of pigs increases up to 300 pounds, after which it declines. However, careful study reveals that the gains of lighter pigs are actually larger in proportion to their live weight than those of the heavy pigs.

With the market frequently penalizing pigs weighing over 250 pounds and with numerous feeding tests indicating that gains become smaller and more costly, it would seem desirable to market pigs at weights below 250 pounds under most conditions. Frequently it is a problem of marketing corn. The points made are admitted, yet the marketing of corn through the pig is sufficiently profitable that the feeder prefers that channel rather than selling it on the market. Hog-marketing figures indicate that when corn is cheap in price hogs are marketed at heavier weights.

Measuring feeds.—The average feeder relies upon measurements rather than weight in estimating rations. For this reason, the following table giving weights per quart of various feeds will prove helpful:

Feed	Weight of one quart	Feed	Weight of one quart
	Pounds		*Pounds*
Alfalfa meal	0.6	Oats, ground	0.7
Barley, whole	1.5	Skimmilk	2.0
Barley, ground	1.1	Tankage	1.6
Corn, shelled	1.7	Wheat, whole	1.9
Corn, ground	1.5	Wheat, ground	1.7
Cottonseed meal	1.5	Wheat bran	0.5
Linseed meal	1.1	Wheat shorts	0.8
Oats, whole	1.0		

DOLLAR VALUE OF CORN SUBSTITUTES AS COMPARED WITH CORN AT VARIOUS PRICES

Find the nearest price of corn in the top row; then read down to get comparative values.

Price of Corn per bushel	**$0.42**	**$0.56**	**$0.70**	**$0.84**	**$0.98**	**$1.12**	**$1.26**
One bushel Wheat (ground)	.46	.62	.77	.93	1.08	1.24	1.39
One bushel Rye (ground)	.36	.48	.60	.71	.83	.95	1.07
One bushel Barley (ground)	.31	.41	.51	.61	.71	.82	.92
One bushel Oats (good quality, ground)	.17	.22	.28	.34	.39	.45	.50
100 lbs. Milo or Kafir	.68	.90	1.13	1.35	1.58	1.80	2.03
100 lbs. Cane Seed	.56	.75	.94	1.13	1.31	1.50	1.69
100 lbs. Shorts	.68	.85	1.06	1.28	1.49	1.70	1.91
100 lbs. Hominy Feed	.71	.95	1.19	1.43	1.66	1.90	2.14
100 lbs. Cane Molasses	.56	.75	.94	1.13	1.31	1.50	1.69

The above figures are based on experimental trials with growing fattening hogs. Where feeds are fed in a limited way in mixtures, higher values may sometimes be secured.

Where RYE is fed as the sole grain ration for prolonged periods, difficulties may be encountered. RYE is best fed in mixtures with other grains.

OATS should not make up more than one-fourth, by weight, of the grain ration of fattening pigs if maximum gains are desired.

CANE MOLASSES may be substituted for grain up to 20 per cent.

APPENDIX

The following table is reproduced from Henry and Morrison, *Feeds and Feeding.*

Digestible Nutrients in Feeding Stuffs

Feeding Stuff	Total dry matter in 100 pounds	Digestible nutrients in 100 pounds				Nutritive ratio
		Crude protein	Carbo-hydrates	Fat	Total	
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*1:*
Alfalfa leaves	93.4	17.3	35.9	3.0	60.0	2.5
Alfalfa meal	91.2	10.2	38.7	0.8	50.7	4.0
Barley, common	90.7	9.0	66.8	1.6	79.4	7.8
Buttermilk	9.4	3.4	4.9	0.1	8.4	1.5
Corn, dent, Grade 3	83.5	7.0	63.3	4.3	80.0	10.4
Corn, dent, well cured	89.5	7.5	67.8	4.6	85.7	10.4
Corn germ meal	91.1	16.5	42.6	10.4	82.5	4.0
Corn gluten feed	91.3	21.5	51.9	3.2	80.7	2.7
Corn gluten meal	90.9	30.2	43.9	4.4	84.0	1.8
Cottonseed meal, choice	92.5	37.0	21.8	8.6	78.2	1.1
Cowpea seed	88.4	19.4	54.5	1.1	76.4	2.9
Cow's milk	13.6	3.3	4.8	3.6	16.2	3.9
Dried blood	90.3	69.1		0.9	71.1	0.03
Emmer (spelt)	91.3	9.5	63.2	1.7	76.5	7.1
Fish meal	89.5	40.1	..	8.3	58.8	0.5
Hominy feed	89.9	7.0	61.2	7.3	84.6	11.1
Linseed meal, old process	90.9	30.2	32.6	6.7	77.9	1.6
Millet seed, hog	90.9	8.4	63.7	2.4	77.5	8.2
Molasses, cane, or blackstrap	74.3	1.0	58.5	..	59.5	58.5
Oat meal (rolled oats)	92.1	12.8	56.9	6.0	83.2	5.5
Oats	90.8	9.7	52.1	3.8	70.4	6.3
Red dog flour	88.9	14.8	56.5	3.5	79.2	4.4
Rye	90.6	9.9	68.4	1.2	81.0	7.2
Skimmilk, centrifugal	9.9	3.6	5.1	0.2	9.1	1.5
Soybean oil meal	89.5	39.7	34.7	4.5	84.5	1.1
Soybean seed	90.1	33.2	24.7	16.1	94.1	1.8
Tankage, guaranteed 60 per cent protein	92.1	56.2	...	7.2	72.4	0.3
Wheat, Minn., N. D., S. D., Nebr., Kans.	89.6	10.0	66.3	1.5	79.7	7.0
Wheat bran, winter	89.4	12.2	40.9	2.9	59.6	3.9
Wheat middlings, flour	89.3	15.7	52.8	4.3	78.2	4.0
Wheat middlings, standard (shorts)	89.5	13.4	46.2	4.3	69.3	4.2
Whey	6.6	0.8	4.7	0.3	6.2	6.8

9-30-10M
7-32-10M
9-36-5M
9-38-15M