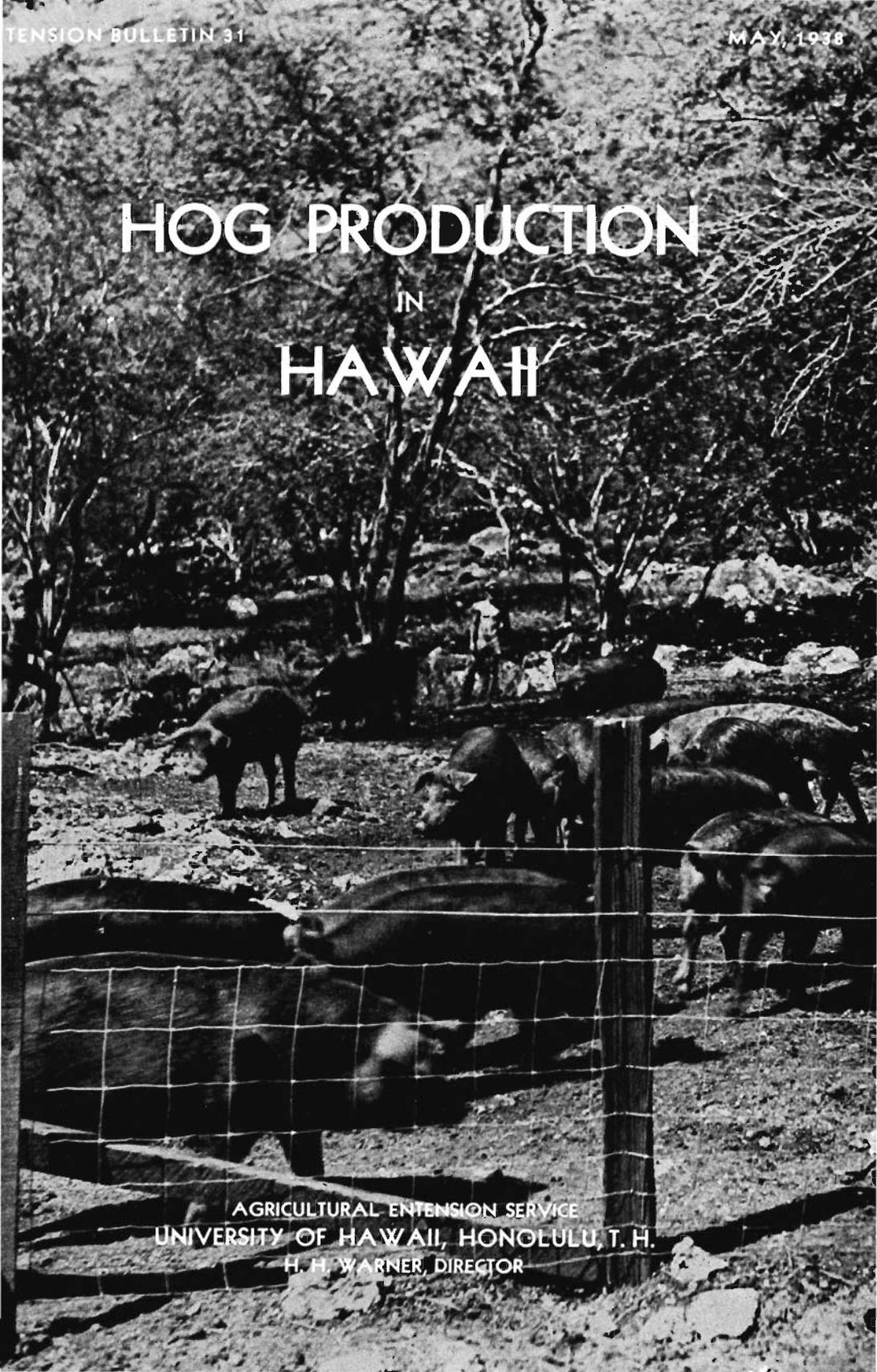


HOG PRODUCTION IN HAWAII



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HOG PRODUCTION IN HAWAII

BY

PAUL A. GANTT*

Extension Animal Husbandman

The hog is the most efficient of all our farm animals in his ability to convert feed into meat. While he cannot make profitable gains on a ration consisting entirely of grasses or other forages, he can utilize many products which otherwise would be wasted, such as garbage, cull fruits, and vegetables, and cheap feeds, such as pineapple bran and molasses. It would seem that more hogs could be profitably grown as a side line in our rural communities by making use of various by-products for a good part of their feed. It is a fact that at the present time many of our rural districts are not raising enough pork to supply their own needs. About half of the pork consumed in the islands is imported.

HOUSING AND BOARD OF HEALTH REGULATIONS

Probably 95 percent of the hogs raised in Hawaii are kept in confinement and most of them are raised in close proximity to cities and villages. Hence the Board of Health has laid down requirements which affect the hog grower. The first requirement concerns sanitary practices, including the maintaining of clean, sanitary premises, and the avoidance of noxious odors. Adequate disposal of wastes must, therefore, be planned very carefully. The other requirement is that of rat control. Supervision is particularly strict in the plague areas, and all buildings in which feed is either stored or fed are required to be rat-proof. These buildings can be made rat-proof by having tight walls, metal covered self-closing doors, and rat guards made of sheet iron extending 6 inches from the wall at a height of about 3 feet above the ground. The building code specifies that wherever concrete floors are built, an impervious wall, preferably of concrete, extend below the floor into the ground to a depth of 2 feet all around the edge of the floor in order to prevent the rats from burrowing and making their nests underneath the floor. This ruling applies to all floors built at a height

* The author wishes to acknowledge the suggestions and assistance given him by Professor L. A. Henke and Dr. S. H. Work of the Animal Husbandry staff of the University of Hawaii in the preparation of this bulletin.

of less than 20 inches above the ground. The Board of Health has model plans which comply with these requirements. These are on file for examination in the offices of all county extension agents.

Where only a few hogs are to be kept in rural areas the portable A-type of individual house is usually the most economical. Plans for this house may be obtained from your county agent.

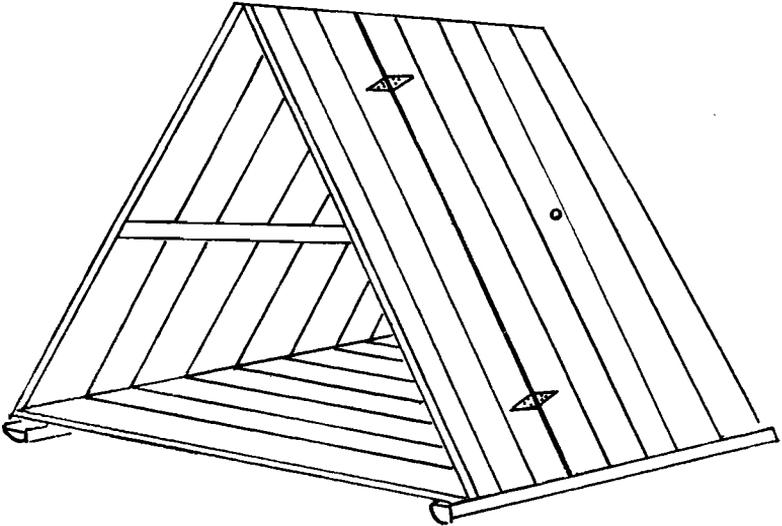


FIG. 1. A-TYPE HOG HOUSE

In general, well drained areas in the drier sections of the islands are to be preferred for hog raising.

TYPES AND BREEDS OF SWINE

Two types of hogs are raised in the territory: the meat or lard type, represented chiefly by the Duroc Jersey, Berkshire, Poland China, Hampshire, and Chester White breeds, and the bacon type, represented here by the Tamworth breed. The differences between these two types are gradually growing less and perhaps the distinction between them should be dropped.

Apparently the differences in rates of gains of the various breeds are not great and more variation is to be found between animals of poor and good types within a breed than between the breeds themselves. The chief considerations, then, are to

choose animals of good individuality and reproductive ability from any of the breeds which are popular in the territory. It is usually unwise to choose a breed other than those listed above because of the difficulty of securing stock of other breeds and because local butchers may be prejudiced against breeds new to the territory. There is an opportunity for one or two breeders on each of the larger islands to raise purebred hogs of good quality for sale as breeding stock.

CROSSBREEDING

Much attention has been given to experimental work with crossbreds during the last decade. Crossbreeding has been found to produce offspring with what is known as 'hybrid vigor.' These first cross hybrids, resulting from mating one breed with another, such as Tamworths with Berkshires, usually make faster and more economical gains in weight than purebred swine.

It was previously thought that crossbred females should not be kept for breeding purposes, but it was later found that the crossbred sow produced larger and stronger litters than her purebred dam. By changing the breed of boar used with each generation, and through continuous use of purebred boars of good type, it is possible to maintain a herd of good market type and still make full use of hybrid vigor.

When boars of two breeds are used on crossbred sows and alternated each generation, the process is called criss-crossing. When three breeds of boars were used in rotation on succeeding generations of crossbred sows, even better results were obtained at the Minnesota station, where much work has been done along this line.

It should, however, be remembered that even in crossbreeding, the purebred sire is still the basis for improvement of the breeding stock. Grade or scrub boars should never be used.

PARENT
STOCK

CROSSBRED

1ST CRISS-
CROSS

2ND CRISS-
CROSS

4TH
GENERATION

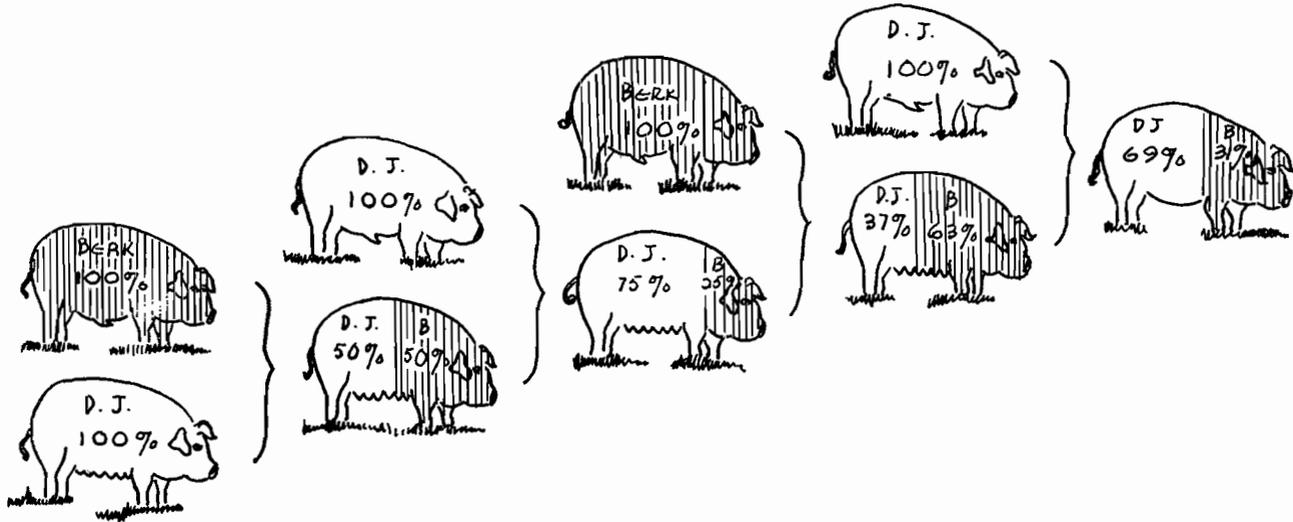


FIG. 2. CRISS-CROSS BREEDING ILLUSTRATED USING DUROC JERSEY AND BERKSHIRE PUREBRED BOARS.

CARE AND MANAGEMENT OF THE HERD

HANDLING THE BREEDING ANIMALS

It is commonly said that "the boar is half the herd," so he should be entitled to good care. He should be given a large pen in order that he will have room to exercise and should have a run where he can be on the ground at least part of the time. Ordinarily he can be given the same ration fed to dry sows, but in periods of heavy use he should be fed the growing ration. He should never be allowed to get too fat. Young boars can be used to breed about two sows each week after they are 8 months old. An older boar, if kept in good condition, may be mated with several sows each week where breeding is done by hand. An old boar can be made safer by removing his tusks with a bolt clipper or heavy hoof trimmers. Another way to remove tusks is to place a heavy bar behind them and knock them off with a cold chisel and hammer. The boar can be effectively restrained by snubbing him with a noose of $\frac{1}{2}$ -inch rope placed over his upper jaw and snout just behind his tusks, and tying him short to a stout post. This is an excellent method of holding older hogs, for they will pull back and cannot get away. Old boars can even be castrated in this position if a box is placed under them so that they cannot sit down.

Gilts are usually ready for breeding at 8 months of age but should not be bred if they weigh much less than 200 pounds. Sows should ordinarily be bred the first time they come in heat after weaning their litters, although in the case of a small litter they may be bred while the pigs are still suckling. The gestation or "carrying period" of a sow is approximately 3 months, 3 weeks, and 3 days, or, more accurately, about 113 days.

Although seasonal breeding is commonly practiced elsewhere, the evenness of the seasons in Hawaii makes it possible to carry on breeding operations throughout the entire year. With the exception of hog farms located in wet, cold locations, year-round breeding is probably the best system, for it provides a continuous market supply, distributes the work evenly, and permits more efficient use of housing facilities.

CARE OF PREGNANT SOW

The period of approximately 16 weeks that a pregnant sow carries her litter, is too often the most neglected time of her life. She is often bred when she is thin and run down, immediately

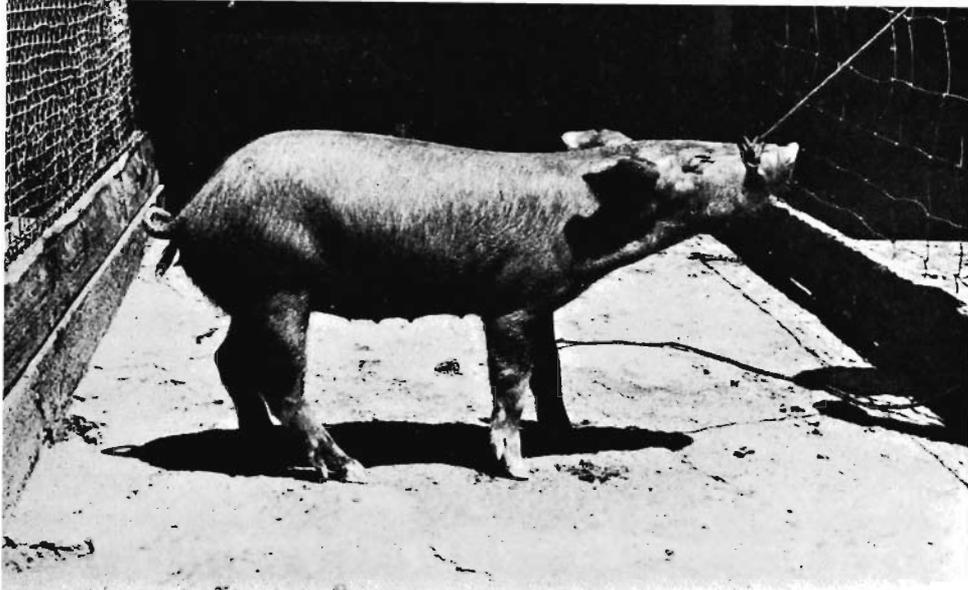


FIG. 3. METHOD OF SNUBBING A HOG.

after having weaned her previous litter. The gestation period should, therefore, be a time of building up for both the sow and the litter she is carrying. A sow needs exercise at this time more than at any other. If more sows were provided with runs where they would be forced to exercise during pregnancy, they would not have so many weak pigs at farrowing time.

A common mistake in Hawaii is to cook all the green feed. Cooking honohono or other greens to feed with the slop is satisfactory, but hogs of all ages should be given fresh greens daily in addition.

A sow that farrows while she is in a thin, half-starved condition cannot be expected to give birth to a good normal litter and to nurse it satisfactorily. Neither can a fat, lazy sow be expected to do well. She is apt to prove to be both a pig killer and a poor mother. A sow will normally gain from 75 to 100 pounds while she is carrying her litter. As the embryo litter makes about 75 percent of its growth during the last 6 weeks of the gestation period, it is especially important that the sow be given a balanced diet at this time. This can usually be obtained by adding a little fish meal to increase the protein content of the ration.

CARE OF THE SOW AT FARROWING TIME

About a week before farrowing time, the pen in which the sow is to have her litter should be scrubbed thoroughly with a

solution made of one can of lye added to about 20 gallons of boiling water. This will disinfect the pen and kill any worm eggs which may be present. The sow should be washed with soap and water, special care being taken to be sure that her udder is cleaned well. Then she should be moved into her farrowing quarters. This will give her time to get acquainted with her pen so that she will not be nervous at farrowing time. The pen should be at least 7 feet wide and 7 feet long and equipped with guard-rails or fenders to prevent her lying on the small pigs. These can be made of 2 x 4's or iron pipe placed 8 or 9 inches from the floor and wall on three sides of the pen.

Her ration should be decreased to about half of what it has been, and bran or succulent feeds should be added to ensure that her bowels are kept in a laxative condition. Exercise at this time is too commonly overlooked. Where the pen is small the sow should be driven up and down the feed alley once or twice a day previous to farrowing. When it is observed that her time is only a day or two off, bedding of some kind should be provided if she is being kept on a cement floor. A coarse straw should not be used at this time, for it increases the danger of the baby pigs becoming entangled and crushed while they are still young and weak. Rice hulls or unsifted dried bagasse are both fairly satisfactory if used rather sparingly. In cooler sections of the islands, particularly during the rainy season, a board platform which can be lifted up when the pen is washed makes a warmer bed for the sow and litter than a cement floor.

Someone should be in attendance at the time the sow gives birth to see that all goes well. If the sow is restless, it is best to remove the pigs as they are born, wipe them off, and place them in a box where they will not chill and will be safe. Sows often move about considerably at this time and, if unattended,

FIG. 4. PIPE GUARD-RAIL OF PERMANENT TYPE.



frequently crush 2 or 3 pigs during the first few hours. Sometimes the little pigs become entangled in the fetal membranes and are unable to move, and occasionally the membranes may cover the nostrils of a pig, smothering it if assistance is not given. It takes 4 or 5 pigs to pay for the cost of keeping the sow, and profits are directly proportional to the number of pigs raised above that number. Thus the grower can often save himself from \$5 to \$15 worth of pigs by being present during farrowing, whether it occurs in the daytime or in the middle of the night.

CARE OF THE SOW AND LITTER

After all the pigs have arrived, they should be returned to the sow to nurse. If she is quite nervous or the litter is particularly valuable, it may pay to keep them away from her for 2 or 3 days until they are strong and able to care for themselves. During this period they should be given an opportunity to feed every 2 hours during the day and every 3 hours during the night. When the pigs are left with the sow, a lantern or light often helps during the first few nights.

The sow should be fed very sparingly the day she farrows. About one-fourth of the usual ration with all the green feed she will eat should be given her and this ration should be gradually increased thereafter until she is on full feed at about the tenth day. Many cases of scours are caused because the sow is overfed and her milk is too rich or too plentiful at the start. However, after the litter is well started the sow should be given plenty of feed, for milk production places a heavy drain upon her. From 2 to 4 pounds of dry feed for each 100 pounds liveweight of the sow is the proper amount, although the age and condition of the sow and the number of pigs she is suckling should be factors in fixing the amount of her ration. Should the sow be constipated, this condition should be corrected promptly, because it is likely to cause the production of abnormal milk and thus throw the litter off-feed. This may be corrected by the addition of $\frac{1}{2}$ pint mineral oil or $\frac{1}{4}$ pint castor oil to her feed, or by the administration of a small handful of Epsom salts. To dose a sow with salts, snub her to a post and then slowly feed her the salts dissolved in about a pint of warm water through a hose from a fountain syringe. Great care should be taken not to raise her head too high nor to let the salts flow while she is squealing, otherwise she may choke. A little red earth or a piece of sod should be placed in a corner of the pen every few days for the benefit of both the pigs and the sow, for earth contains iron, a mineral which is somewhat deficient in milk.

EARMARKING

Some system of marking is essential to any successful breeding program. It is highly desirable that commercial growers mark their pigs while they are young in order that they can keep accurate records. These will assist in checking the rate of growth of the young stock and aid in the selection of the most successful sows. Various methods of earmarking have been tried but the most successful as well as the most economical is that of notching. Notching can be done with a special punch made for the purpose, with ordinary shears, or with a sharp pocket knife. If a knife is used, the ear to be notched should be laid across a block of wood, and two cuts should be made for each notch, the blade being drawn from the apex of the notch to the edge of the ear. Various systems of notching are in use. However, the one illustrated below is one of the simplest and is the one in use at the University Farm.

Numbers for individual hogs are made by combining the notches to add up to the total desired. The pig illustrated would be No. 44. Pig No. 45 would have one more notch cut on the lower side of the right ear while pig No. 10 would carry only one notch and that on the lower side of the left ear. Holes may be punched in the ears to represent hundreds if desired.

CREEP FEEDING

During the latter part of the second week a creep of some kind should be provided where the little pigs can have dry grain and water before them at all times. A simple creep can be made by partitioning off a part of the pen in such a way that only the small pigs can enter. Extra grain given to the litter at this time

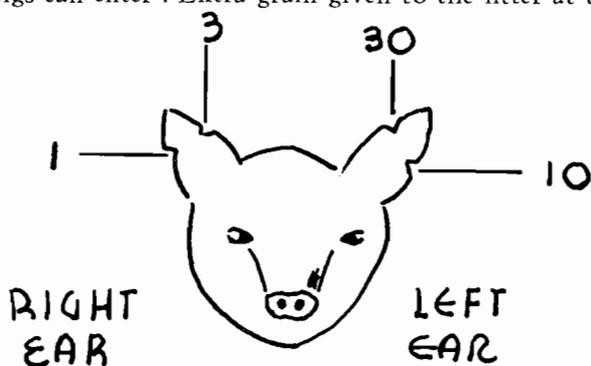


FIG. 5. EARMARKING.



FIG. 6. A SATISFACTORY TYPE OF EAR-MARKER.

will pay for itself many times over, as it will increase the growth of the pigs and make them much stronger at weaning time. They should be given a good quality feed containing very little pineapple bran or molasses before weaning. A mixture such as the following may be used:

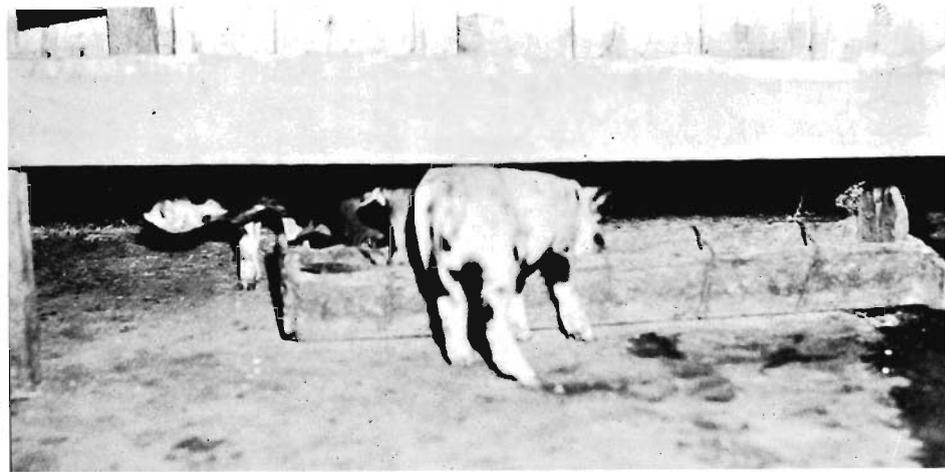
Cracked corn	4 pounds
Rolled barley	4 pounds
Fishmeal	1 pound
Soybean	1 pound

Middlings may be substituted for corn, but a ration which requires more chewing is perhaps to be preferred.

CASTRATION

Male pigs should be castrated between 3 and 7 weeks of age. At this time, they feel the shock much less and are completely recovered before weaning. A castration table, such as that illustrated, will greatly facilitate this operation as well as be very convenient at vaccinating time.

FIG. 7. SIMPLE TYPE OF CREEP.



The pig should be washed thoroughly about the scrotum with a disinfectant solution such as creoline and castrated with a sharp knife. The hands and knife should be sterilized by dipping in a creoline solution before each operation, and care should be taken not to touch any internal parts of the pig which are not removed. The two incisions should be made low down in order to provide drainage and should be some distance apart, for excessive bleeding may result if the cuts are made too close to the median line. The cord can be either scraped or jerked off. If the operation is performed in a sanitary manner, it is best not to put anything in the way of a disinfectant on the incisions. Be sure that the pigs are kept in clean pens for a few days.



FIG. 8. CASTRATION TABLE IN USE.

VACCINATION

If the pigs are to be vaccinated, it is well to have it done before weaning if possible, for the cost of the serum will be less at this age and there will be no period at which they are unprotected.

WEANING THE LITTER

Pigs are commonly weaned at from 8 to 10 weeks of age. If they have not been castrated and vaccinated, this should be done soon, although not for a few days following weaning. If they have been creep-fed, the same feeds should be continued for a time, and, if they are to be raised on garbage, a little garbage should be added to the ration so that they will become

accustomed to it. In the course of 2 or 3 weeks all the grain can be discontinued, for it is not customary to mix grain and garbage feeding if there is sufficient garbage. The sow should be handled carefully at weaning time to be sure that none of her teats are spoiled. Her feed should be cut down materially for a few days before and after weaning. If her udder fills too much, as may be the case with exceptionally heavy milk-producers, it may be necessary to return her to her litter once or twice or to leave one of the weaker pigs with her for a few days.

WORMING

The condition of the pigs should be noted and, if they are known to be wormy, as evidenced by worms passing out in the feces or by autopsy of pigs which may have died, they should be treated. Suggestions may be obtained from your county agent regarding worm expellants. All pigs should be kept off infected ground until they weigh about 100 pounds. After they arrive at this weight they are less subject to damage from intestinal worms. At that time they may be placed in dry lots if it is desired. Of course, if clean pastures are available, they can be placed in them at any time; the sooner, the better.

FEEDING

METHODS OF FEEDING

There are two methods of feeding pigs which are on grain rations. They may be hand-fed or fed by means of a self-feeder. Self-feeding usually produces faster gains, although much the same results can be obtained by heavy feeding at the regular feeding time so that there is feed before them most of the time. Self-feeders save labor but are somewhat expensive to build. However, they last for years and undoubtedly save labor. Care should be taken to see that hogs on dry feed always have access to plenty of clean water.

The young gilts which are to be kept for breeding may be fed with the barrows, if more convenient, but when they reach a weight of about 150 pounds, they should be separated from the fattening herd and fed more slowly. Otherwise, they may be too fat at breeding time.

FEED CONSTITUENTS

Feeds are made up of various compounds of which the following are the most important:

Carbohydrates. These feeds are made up of two general classes—the starches and the sugars—both of which are compounds of carbon, hydrogen, and oxygen. They are products of sunlight acting on the green chlorophyll in plants in such a way as to cause the combination of carbon dioxide from the air with water (hydrogen and oxygen) taken up through the roots. The carbohydrates comprise about three-fourths of the dry matter of plants, including roots and seeds. They furnish heat and energy for life and, aside from those portions which may be utilized in the production of milk, are usually converted into fats and stored in the body in that manner. The carbohydrates in seeds or grains are usually more concentrated and of a higher digestibility than in other portions of the plant, a fact which accounts for the higher value of grains as feeds.

Fats. These substances are like carbohydrates in that they are also made up of carbon, hydrogen, and oxygen, but, due to the fact that they contain much less oxygen, they have a higher fuel or oxidizing value. Fats, when burned, give off $2\frac{1}{4}$ times as much heat as carbohydrates or proteins and their energy equivalent is therefore figured as being $2\frac{1}{4}$ times greater in computing rations. They are utilized for the same purposes as carbohydrates.

Proteins. The essential difference between these foods and the carbohydrates and fats is that they contain nitrogen in addition to the three elements making up the former. Certain proteins also contain sulphur and phosphorus. Some proteins are more nearly complete than others. Those contained in animal products, such as meat or milk products, are better than those contained in vegetable products, such as corn or soybeans. For this reason, it is always well to include some animal product, such as tankage, fish meal, or skimmilk, in hog rations. Proteins form an important part of all muscles and are essential constituents of blood, nerve, gland, skin, hair, horn, and hoof tissues. They are absolutely necessary for growth.

The minimum percentage of crude protein and the maximum percentage of fiber are marked on the bag of all imported feeds. As the proteins are mostly digestible and the fiber is largely indigestible by hogs, the value of various feeds can be more or less judged by the proportions of these constituents. The total amount of digestible nutrients in a feed is determined by adding the percentages of carbohydrates and protein to $2\frac{1}{4}$ times the fat. This gives a comparison on the basis of total energy value.

The average composition of the various feeding-stuffs can be obtained by consulting digestibility tables, such as those contained in Morrison's "Feeds and Feeding" and Anderson's "Swine Enterprises." (See appendix).

Minerals. While not capable of being burned or producing energy, minerals are essential to life. They form the major portion of bones and teeth and are contained in smaller quantities in all of the body tissues. Those most likely to be lacking are calcium, phosphorus, sodium, and chlorine. The last two of these are contained in ordinary salt (sodium chloride) and are easily supplied through the addition of 1 percent of Hawaiian salt to the ration. Salt in small quantities has been referred to as "white gold" but should not be fed in amounts of over 1 percent well mixed in the feed, for in large quantities it is toxic to hogs. Grains are deficient in calcium (lime) and may be lacking in phosphorus and iodine as well. As no evidence of a lack of iodine has been reported in Hawaii, we apparently need not be concerned about it. Otherwise adequate rations usually carry sufficient phosphorus. Bonemeal is a good source of both calcium and phosphorus, while ground coral and oystershell are excellent sources of calcium. One percent of one of these substances added to the ration costs very little and insures against deficiencies which, while they may not be noticeable, may nevertheless tend to produce slower gains or weaker litters.

Vitamins. These substances are necessary to the proper growth and development of the animal but, fortunately, are usually present in sufficient quantities in good rations, provided some uncooked green forage is included in the daily ration. Sunshine will replace vitamin D in preventing the development of rickets in small pigs.

Water. We often do not think of water as a food, but the lack of it will cause death quicker than the lack of any of those foods previously mentioned. Clean water should be kept before the hogs at all times, and they should be prevented from drinking from wallows or dirty pools by the addition of creoline or crank-case oil to such places.

FEEDS FOR SWINE

Garbage represents probably 75 percent of the feed used for pork production in Hawaii. Under most conditions, this is the

cheapest feed available, and, since feeding garbage results in a waste product being converted into human food, it is a practice to be recommended. The Territorial Board of Health requires that all garbage be cooked before it is fed, so the consumer need have no fear of infection from hogs fed in this manner. Garbage varies tremendously in value, depending upon its source, that from hotels and army camps being much superior to that from plantation camps and ordinary households. Competition for garbage is very keen, and, when all costs of collection, as well as payments for the garbage itself, are figured in, in certain cases it would undoubtedly prove more economical for the feeder to buy concentrates. The possibility of feeding grain and local feeds should serve as a safety valve and prevent the bidding for garbage from going beyond its actual value. Good garbage is usually fairly well balanced and can be fed without supplements. However, that which carries exceptionally large proportions of fats, rice, or poi can be made to produce better gains by the addition of small amounts of a protein supplement, such as fishmeal or tankage. When a cheap source of garbage is available it does not usually pay to feed grain with it to older hogs unless faster gains are desired for some particular market condition.

Concentrates

Barley has long been the base for rations made up largely of imported feeds. While it is usually only about 90 percent as efficient in producing gains as is corn, because of the high fiber content of the hulls, barley can usually be purchased on our local markets at a cost sufficiently below that of corn to justify its use.

Corn is generally recognized as being one of the best hog feeds when balanced with a good protein supplement. However, because it is not grown to a greater extent on the West Coast, it is usually too expensive for local pork production. Where local corn is available, as on Molokai and in Kohala, Hawaii, more hogs should be raised and fed on corn.

Oats are nearly always too high in price to produce economical results and, unless they are hulled, are not suitable for hogs, because of their high fiber content.

Wheat is seldom seen in Hawaii in the form of the whole grain, but the by-products from the manufacture of flour are widely used. *Standard wheat middlings* is the best of those

used locally. It carries almost double the protein content of corn or barley but is somewhat lower in total nutrients. *Wheat bran and wheat mixed feed* (often sold locally as *mill run*) are still lower in total nutrients and are too bulky to be fed in large amounts to growing or fattening hogs. However, bran or mill run, which serves the same purpose and usually sells for \$2 less per ton, because it takes a lower freight rate, makes an excellent feed for sows shortly before and following farrowing, due to its laxative and cooling action.

Rice is ordinarily too high in price to be used as a hog feed. However, it is conceivable that in times of a surplus or when low grade rice is available it might be used to advantage. Rice, when used for livestock feed, is ordinarily utilized in the "rough" or "paddy" form and should be finely ground before it is fed. It is said to be worth about 90 percent as much as barley in nutritive value. *Brewer's rice* was found to be more valuable than barley in trials conducted in California. *Rice bran and rice polish* may be used in quantities up to 40 percent of the ration for older animals, but these feeds are too laxative for animals under 75 pounds when used to the same extent.

Pineapple bran is just coming into its own as a feed for hogs. It is probably worth slightly less than three-fourths as much as rolled barley for older hogs. Due to its high fiber content and low total nutrients it is not well adapted to pigs under 60 pounds except in small quantities. However, it has produced excellent results with hogs weighing over 125 pounds in proportions of over 60 percent of the ration. Because of the fact that it contains only 1 percent of digestible protein it is necessary to utilize protein supplements of good quality with it. Pineapple bran for swine feeding should be finely ground.

Kiawe bean meal made from the bean of the algaroba tree (*Prosopis chilensis*) makes a very satisfactory hog feed when dried and ground and is a better feed for swine than pineapple bran, for it is higher in both protein and total nutrients. It is not the equal of barley, however. The whole beans are more generally used and make a good fattening feed when properly supplemented. Because they contain even more fiber than pineapple bran, they should not be fed in large quantities to young animals. Older hogs which have been on a concentrated ration should be changed gradually to a kiawe ration in order that they can become accustomed to the larger amounts of fiber.

Cassava meal, made either as a by-product in the manufacture of starch or from the whole dried cassava, is used to a limited

extent as a feed for hogs in the territory. It is very low in protein but is otherwise about the equal of grain feeds. Cassava roots should not be fed without first being cooked or sliced and dried, because of the danger of prussic acid poisoning in the fresh material.

Molasses is the cheapest feed we have available locally and deserves much wider use. While it is laxative in its effect, if not used in too large quantities it makes a good addition to the ration. For weanling pigs it probably should not be fed in amounts greater than 10 percent of the ration, while mature hogs can use as much as 25 percent with safety. As it contains practically no fiber, it fits in well with feeds such as pineapple bran, which are very high in fiber, provided that ample protein supplements and green feeds are used. Tests conducted at the Hawaii Agricultural Experiment Station have shown molasses to have a nutritive value about equal to barley when fed to fattening hogs in amounts of 10 to 20 percent of the ration. These results are somewhat better than ordinarily would be expected, however, for molasses contains more water and, consequently, about three-fourths of the total digestible nutrients of barley.

Roots and Fruits

Sweet potatoes are high in solids and make a good starch feed. Wider use should be made of this tuber in the rural areas, for yields of 10 to 20 tons per acre can be grown. The choicest potatoes can be sold and the balance, including the tops, can be fed. They are ordinarily rated as being worth from one-fourth to one-third as much as grain for hog feeding. Dr. F. G. Krauss reported gains of 1 pound pork for each 12½ pounds sweet potatoes plus the tops fed to swine on his Haiku farm. Sweet potatoes should be cooked before feeding, unless the hogs do the digging and then should be supplemented with good protein feeds.

Edible canna is another crop which might be used more widely, for hogs like both the roots and the tops.

Bread fruit is very high in solids for a fruit and makes a good feed where it is available. It should be planted and used more widely in districts such as Kona.

Avocados are also fairly high in solids and, due to their high oil content, make an excellent addition to a fattening ration. They tend to produce a soft pork, however, and should not make up over 50 percent of the ration.

Other fruits which are sometimes available and can be used to advantage are bananas, papayas, mangoes, guavas, and the fruit of the cactus.

Vegetables which are not fit for the market, or may represent a surplus, can often be utilized as hog feed. Such crops as taro, carrots, and beets will be consumed in larger amounts if cooked.

Protein-rich Supplements. The feeds previously discussed, with the exception of some of the wheat by-products, are all too low in protein to be fed without being supplemented by feeds which are richer in this respect.

Tankage, meat meal, or meat scraps are about the same thing and constitute our best known protein supplements. Products of different companies may vary as much as 20 percent in protein content, so, in buying these feeds, the hog raiser should check the labels on the bags in order to know what he is getting. As previously stated, meat proteins are more complete than those of plant origin and should be included to a limited extent in nearly all rations.

Fish meal is comparable to tankage in feeding value and in a number of trials has produced better results. Fish meal and tankage are both fairly high in mineral content but, because they usually comprise less than 15 percent of the total ration, they should not be depended on to supply all the necessary minerals.

Soybean oil meal from the Orient is our most common plant protein supplement and is one of the best. However, as intimated above, neither this nor any of the other plant proteins should be used as the sole supplement for grain-fed hogs unless the price differential is very great. Such feeds are good when mixed half and half with either fish meal or tankage to balance the ration.

Sesame oil meal and *peanut oil meal*, although not always available, can sometimes be purchased to advantage and can be figured equal to soybean meal in nutritive value. The *whole peanut*, where it can be grown cheaply and is not more valuable for market, makes an excellent feed for swine. Fattening hogs fed on peanuts tend to produce soft pork, but, as our market does not object seriously to this condition, this feed can be utilized well for a part of the ration.

Copra meal is often an economical feed to buy, for it is fairly high in protein and rates with corn in total energy value.

Because it is somewhat lacking in palatability for hogs, it probably should not make up more than 20 percent of the ration. *Coconuts* may be split in half and fed to swine, for they are very fattening.

Skimmilk and *buttermilk* are excellent protein supplements but are seldom available in sufficient quantity to figure much in pork production in Hawaii.

Slaughter-house offal is available in some of the rural districts and makes a good supplement. It should be cut up and cooked before feeding.

Green Forages

Clean pastures, where available, undoubtedly form the best basis for hog raising, provided they are kept clean by rotating them frequently. Rotation is absolutely essential, however, if pigs under 100 pounds in weight are to be kept on the ground, for unrotated paddocks become a breeding place for roundworms and other parasites. It is probable that over 95 percent of our hogs are raised on either concrete or board floors in locations where there is no opportunity to develop pasture. This makes it imperative that greens be provided in some form.

Alfalfa is undoubtedly one of the best feeds and, where it or other forages are not available in the fresh form, alfalfa meal may be used to advantage. Stem meal, which is frequently imported, should not be used for this purpose.

Honohono (*Commelina nudiflora*) is the green feed most commonly used in Hawaii. However, in too many cases it is cut up and cooked with the other feeds, thus destroying many of the vitamins so badly needed by hogs kept in confinement.

Mexican Grass (*Ixophorus unisetus*) is a very palatable grass frequently used. It does well where it can be irrigated with the wash water from the piggery. Care should be taken, however, in feeding any of these feeds irrigated in this way, for they are almost sure to be contaminated. The safest way is to feed only the upper portions of such grass or, better still, to get that which is to be fed raw from safer locations. *Other grasses* are commonly used, and any grass which proves palatable is ordinarily satisfactory for this purpose. Grasses are not, of course, as valuable as legumes, which should be used whenever practical.

Koa haole (*Leucaena glauca*), while it may cause hogs to lose their hair if fed in large quantities, is a valuable legume and grows readily at the lower elevations.

Sweet-potato tops have already been mentioned, but should be utilized when available.

Purslane or *pigweed* (*Portulaca oleracea*) is very palatable and makes a fine pig feed where it can be collected from adjoining fields.

Commercial Feeds. There are a number of good commercial rations on the market, most of which are well-balanced feeds. If they can be purchased at a figure not too much above the cost of a home-mixed feed, the grower may do well to use them and save himself the labor of mixing as well as the trouble of buying a large variety of feeds. The choice of feeds is largely a matter of costs, and he will have to determine for himself what feeds will prove the most economical.

When losses are figured in, one can scarcely hope to average a pound of gain for less than 5 pounds of grain. This means that, if the ration costs 2 cents a pound, the feed cost of gains will be 10 cents a pound and, with hogs selling at 14 cents, little profit is left when all other costs are deducted. If the hogs are not to be fed garbage, the operator should study his hog ration and feed costs carefully. Wider use of locally produced feeds, such as fine pineapple bran, molasses, and home products, seems to be the solution.

FIG. 9. MAKING A HOME-MIXED RATION.



SUGGESTED RATIONS

Rations similar to the following may be used for various classes and ages of hogs:

SOWS WITH PIGS, AND PIGS WEIGHING UP TO 75 POUNDS

1. 40 pounds rolled barley
25 " fine pineapple bran
10 " molasses
10 " soybean oil meal
8 " fish meal
5 " alfalfa meal
1 pound steamed bonemeal
1 " salt
2. 38 pounds rolled barley
30 " kiawe beans or meal
10 " molasses
10 " soybean oil meal
5 " fish meal
5 " alfalfa meal
1 pound steamed bonemeal
1 " salt
3. 43 pounds rolled barley
35 " standard wheat middlings
10 " soybean oil meal
5 " fish meal
5 " alfalfa meal
1 pound steamed bonemeal
1 " salt

FATTENING PIGS

1. 38 pounds fine pineapple bran
20 " rolled barley
20 " molasses
10 " soybean oil meal
5 " fish meal
5 " alfalfa meal
1 pound steamed bonemeal
1 " salt

2. 40 pounds kiawe beans or meal
 23 " rolled barley
 20 " molasses
 5 " soybean oil meal
 5 " fish meal
 5 " alfalfa meal
 1 pound steamed bonemeal
 1 " salt
3. 63 pounds rolled barley
 20 " standard wheat middlings
 5 " soybean oil meal
 5 " fish meal
 5 " alfalfa meal
 1 pound steamed bonemeal
 1 " salt

DRY SOWS AND BOARS

1. 30 pounds fine pineapple bran
 25 " molasses
 23 " rolled barley
 10 " soybean oil meal
 5 " fish meal
 5 " alfalfa meal
 1 pound steamed bonemeal
 1 " salt
2. 30 pounds fine pineapple bran
 30 " kiawe beans or meal
 15 " molasses
 10 " soybean oil meal
 8 " fish meal
 5 " alfalfa meal
 1 pound steamed bonemeal
 1 " salt
3. 40 pounds kiawe beans
 20 " rolled barley
 20 " molasses
 8 " soybean meal
 5 " fish meal
 5 " alfalfa meal
 1 pound steamed bonemeal
 1 " salt

In the foregoing rations any of the following changes may prove economical:

Fresh greens may be substituted for alfalfa meal.

Corn may be substituted for barley.

Tankage may be substituted for fish meal.

Sesame or peanut oil meal may be substituted for soybean meal.

Powdered coral or oyster shell may be substituted for bone-meal.

DISEASES AND PARASITES

Hog Cholera heads the list as our most serious disease in Hawaii, as elsewhere. This is a condition which is, however, inexcusable, for we have definite means of preventing cholera through immunization. No intelligent person would think of buying a new house or car without having it insured, yet many of our hog breeders, who operate in congested areas, and have nearly everything they own invested in hogs, neglect to insure their herds against cholera by having them given the double treatment. Yet the chance of the scourge striking in these areas is many times greater than that of fire.

The disease is highly contagious and, because the virus may be carried from pen to pen, or from farm to farm, by men, dogs, flies or birds, it spreads very quickly.

The symptoms are not always the same, but usually the hog goes off-feed, appears sluggish, walks slowly with a weaving gait of the hind legs, shows a rise in temperature (103° - 106°), alternates between scouring and constipation, and usually shows red or purplish discoloration of the ears and belly. As soon as the owner becomes suspicious of cholera, he should call a veterinarian at once for the protection of himself and his neighbors. It is illegal to conceal the presence of the disease. He will be able to save many of the pigs which are not too far gone by the use of hog cholera serum in large doses.

Prevention through the use of the so-called double treatment or simultaneous method is much more to the point, however. This consists of injecting a definite amount of serum containing anti-bodies at one place on the hog and a much smaller amount of virus containing the live organisms which cause the disease under the skin at another point. This gives the hog a very mild form of cholera and sets up an immunity which is life-

long in most cases. It is essential that all untreated hogs on the premises be immunized. Otherwise, they may pick up the organism and contract the disease.

As the cost of the treatment is proportional to the size of the hog, it is more economical to treat all pigs while they are small. Where breeding is carried on throughout the year, it is best to plan to vaccinate every 2 or 3 months. Great care should be taken to see that no pigs are missed, for it is very easy to get some of the older pigs mixed up and not treat them. If there is any doubt, they should be inoculated again, for reinoculation can do no harm and, in fact, intensifies the immunity.

Hog "flu" or swine influenza and pneumonia are somewhat sporadic in occurrence but seldom cause many fatalities in a herd unless accompanied by cholera. However, they may prove very serious and good care, a laxative diet, and protection from drafts are indicated.

Hog pox in a light form has apparently been found on both Maui and Oahu. It is caused by a virus and is evidently distantly related to the poxes of poultry and man. Lesions in the form of reddish eruptions occur on the belly and the ears most commonly, although in more severe cases lesions may be found over the entire body. It is usually found on suckling pigs although it may attack older hogs as well. It is accompanied by a rise in temperature and, if good care is not given, the affected animals may contract pneumonia and be lost. It is not ordinarily fatal if not complicated by secondary invaders. Pigs suffering from pox should be fed a light, laxative ration and their bodies should be rubbed with sulphur mixed with oil.

Anemia may occur in small pigs raised on concrete or plank floors. It is a nutritional disease caused by the lack of iron and possibly copper in the milk of the mother. The affected pigs are less active and their skin is white in color. Thumps, or difficult breathing, is a common symptom, as is also white scours. Anemia is characterized by an impoverished condition of the blood, which can be corrected only through the treatment of the pigs, for it does not seem to be possible to increase the iron content of the sow's milk by feeding more iron to her. One method of preventing the development of anemia is to keep some clean sod or even clean red earth in the pen where the little pigs, as well as the sow, can have access to it. Another method of treatment is to swab the sow's udder daily with a solution made up to 1 pound of dried ferrous sulphate dis-

solved in a quart of hot water until the pigs are about 6 weeks of age. This practice should be started when the pigs are 3 or 4 days old. If preferred, this solution may be given twice a week individually to the small pigs, starting with about $\frac{1}{4}$ teaspoonful at 1 week of age and increasing to a teaspoonful at 4 weeks of age.

Rickets or paralysis due to a lack of vitamin D in the ration, is sometimes seen here in pigs that are confined and do not have access to sunshine and pasture. It usually can be prevented by providing direct sunlight and an abundance of green feed. In severe cases, it may be necessary to feed codliver oil to the affected animals. Pigs 2 weeks old should be given $\frac{1}{2}$ teaspoonful while pigs weighing 75 pounds should be given a tablespoonful daily until they recover.

Necrotic enteritis, or necro-bacillosis, is a disease usually affecting the intestines of young hogs. Diarrhea is usually one of the first symptoms to be noted. As the disease progresses the pigs become weak, unthrifty, pot-bellied, and tend to have a dry, scurvy skin. The mucous membrane lining and intestine becomes ulcerated and blackened in appearance. Treatment of advanced cases is very difficult. Affected animals should be segregated and placed on pasture, if possible. Pigs which are raised under clean, sanitary conditions and are well-fed seldom develop "necro." Necrotic areas sometimes develop at various points on the head, causing "bull-nose" or ulcerations of the gums or lips. Pigs which are anemic are much more subject than others to this type of infection.

Actinomycosis, a fungus which causes lumpy-jaw in cattle, frequently shows up on hogs in the form of a large lump or tumor on the sides or udders of older hogs. In extreme cases, lumps may be found over all parts of the body, including the legs and feet. In generalized cases, it is best to get rid of the animal. Where only 2 or 3 lumps occur, the tumor should be washed clean with disinfectant, and a good sized cut should be made in the lower side so that drainage will be established. The tumor should not be opened, however, until it has become slightly soft. All pus should be squeezed out on a bag and burned, great care being taken not to get any on the floor. The empty tumor should then be "swabbed out" thoroughly with an abundance of iodine. The hog should be kept in a pen by itself, and the pen should be disinfected daily with a strong creoline solution. The incision should be painted daily with



FIG. 10. LOADING CHUTE.

iodine until it has healed. In cases that are somewhat generalized results can often be obtained by giving a level teaspoonful of potassium iodide daily in the feed.

Tuberculosis in hogs is, fortunately, rare in Hawaii, probably because most garbage is cooked and hogs do not follow cattle in the feed lot. In case he finds it in his herd, the owner should call a veterinarian to advise him concerning the best steps to take.

Abortion sometimes occurs in hogs here, but so far it has not been shown to be caused by the abortion bacillus. If many abortions occur within a herd, a veterinarian should be called to check for contagious abortion by means of the blood test. If reactors are found, they should be removed from the herd and the premises should be thoroughly disinfected.

Worms of many varieties parasitize swine, doing particular damage to younger pigs. The round-worm, *Ascaris suis*, is probably the most injurious of these and, fortunately, the same measures which prevent its development are fairly effective in controlling most of the others. These measures consist almost entirely of thorough sanitation, which has already been discussed in the sections on the care of the sow at farrowing time and the care of the sow and litter. While many "worm remedies" are on the market, dependence on them for protection is

like "locking the barn door after the horse has been stolen," for most of the damage has been done before the worms are sufficiently developed to be reached by expellants. Contrary to what was formerly thought, the most serious damage from round-worms occurs in pigs under 50 pounds in weight and is to the lungs and liver rather than to the intestines. While they are in the lungs and liver, the worms are not affected by any of the common treatments. The secret of keeping pigs free from round-worms is to keep them always away from contaminated premises so that they have no opportunity to pick up the eggs of the worms which are passed out in the manure. Under Hawaiian conditions, where most pigs are raised in confinement and never get on the ground, it is fairly easy to prevent serious infestations of worms by the following methods:

1. Scrub pens thoroughly with boiling water to which lye has been added at the rate of 1 can to 20 gallons of water before putting sows in farrowing pens.
2. Scrub sows well with soap and water and rinse them with creoline solution.
3. Remove manure from pens daily.
4. Remove all litter and scrub pens thoroughly every 3 days.
5. Be sure pens are tight so that the small pigs cannot run outside.
6. Keep all pigs off ground which may be infested until they weigh at least 100 pounds.

Lice are very common on hogs in the territory and may cause considerable damage to young pigs as well as discomfort to the older ones. They are easily controlled by dipping, spraying, or rubbing with used crank-case oil. Care should be taken to see that this oil does not contain too much gasoline, however, or

FIG. 11. FEED TRUCK.



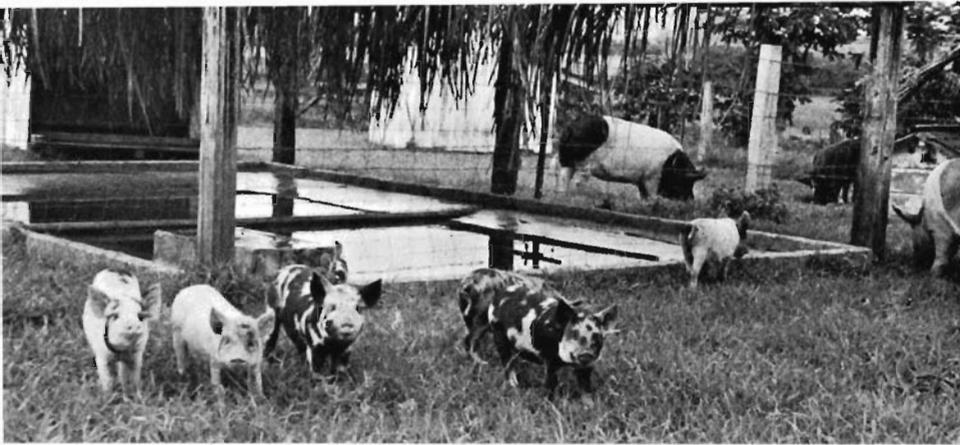


FIG. 12. A GOOD WALLOW ON A KAUAI FARM.

the pigs may be blistered. They should also not be placed in a sunny pen without adequate provision for shade, because they are easily overheated following this treatment. This procedure should be repeated in 12 to 14 days in order to kill any lice which may have hatched from the eggs which were not destroyed by the first application of oil.

Mange is a skin eruption caused by small mites which burrow into the skin itself or into the hair follicle, depending on the type of mite present. The same treatment suggested for lice will be found effective for mange, although the addition of about 1 percent of creoline to the oil will help.

OTHER RECOMMENDATIONS

Hog rings are helpful in preventing excessive rooting and digging up of pens and pastures. A ringer and 100 rings can be purchased for less than 50 cents. Rings are also convenient to use for whipping the ends of ropes to keep them from fraying.

Loading chutes similar to the one illustrated are a great labor saver.

Feed trucks operated on tracks are being used for distributing feed in a number of the larger piggeries in the territory and help to get away from the difficult job of carrying feed to the hogs.

Herd records are too seldom kept by hog producers in Hawaii. Even the owner of a grade herd should keep records of the breeding date, farrowing date, number of pigs born, date of weaning and number of pigs weaned, etc., in order to conduct his business more intelligently. In order to do this, some system of identification is necessary, and for this purpose the ear-notching method previously described is perhaps the simplest.

Shade is especially necessary for hogs which are not housed, as they are easily overheated. Swine do not perspire as do most other animals and are therefore easily overheated by bright sunlight or over-exercise. Animals which are suffering from the heat cannot make efficient use of their feed.

Wallows, where animals can relax and cool themselves in hot weather, add much to their comfort. They also provide an easy means of controlling lice and mange, for a little crank-case oil kept on the surface of the water is very effective for treatment of these parasites. The oil, with a little creoline added, also has the advantage of preventing the hogs from drinking from the wallow. Dirt or mud wallows should not be permitted, however, for they cannot be maintained in a sanitary condition.

DEFINITION OF TERMS

Boar—an uncastrated male of any age.

Barrow—a male castrated while sexually immature.

Stag—a male castrated after becoming sexually mature.

Sow—a female of any age.

Gilt—a young sow.

Shote—a young barrow or gilt of approximately 75 to 150 pounds.

Purebred—an animal carrying 100% the blood of one breed.

Grade—an animal carrying 50% of one breed.

Crossbred—an animal carrying 50% the blood of two breeds.

Scrub—an animal of unknown breeding.

Sire—the father.

Dam—the mother.

Farrow—to give birth.

Litter—a group of pigs born of one sow at a single farrowing. (Do not refer to each pig as a litter).

Ton Litter—a litter which reaches one ton (2000 pounds) in weight when 180 days of age.

FIG. 13. DUROC JERSEY—TAMWORTH CROSSBRED LITTER ENTERED IN TON LITTER CONTEST BY LAHAINALUNA SCHOOL.



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ANALYSES OF FEEDS

The following list shows total dry matter and digestible nutrients of some of the feeds commonly available in Hawaii. Those unmarked are taken from "Feeds and Feeding" 20th edition, by Morrison and are used by special permission of the author. Those marked with an asterisk are taken from published and unpublished data of the Hawaii Agricultural Experiment Station of the University. In the case of feeds with which trials have not been conducted, digestibility figures have been assumed.

	Total Dry Matter	Digestible Protein	Total Digestible Nutrients
CONCENTRATES:			
Barley (Pacific Coast) -----	89.9	6.9	78.8
Cassava, dried -----	94.4	1.5	77.6
Coconut oil meal -----	90.7	18.7	80.8
Corn, No. 1 -----	87.2	7.3	82.5
Corn, No. 3 -----	83.5	7.0	79.0
Fishmeal, 60% -----	92.2	48.8	67.7
Fishmeal, Haw'n Tuna* -----	90.1	44.3	61.4
Garbage -----	39.3	2.2	34.6
Kiawe bean meal* -----	89.2	6.0	55.6
Linseed oil meal -----	91.3	30.6	78.2
Molasses, cane -----	74.1	.9	56.6
Oats -----	91.2	7.0	72.2
Peanut with hulls -----	94.1	20.2	103.5
Peanut oil meal -----	93.4	38.0	82.1
Pigeon pea seed and pod meal* _	88.5	11.8	55.5
Pigeon pea seed meal* -----	87.7	14.9	55.4
Pineapple bran -----	90.2	.9	64.9
Rough rice (paddy) -----	88.6	6.3	69.1
Rice bran -----	91.1	8.8	67.7
Rice, brewers -----	88.0	5.4	79.7
Rice polish -----	90.5	9.3	85.7
Sesame oil meal -----	93.5	36.0	76.6
Soybeans -----	90.2	32.8	86.2
Soybean oil meal -----	91.7	37.7	82.2
Tankage, 60% -----	92.2	56.4	78.0
Wheat bran -----	90.9	13.0	69.5
Wheat mixed feed (Standard) _	90.6	13.9	73.5
Wheat middlings -----	90.0	14.4	78.4
LIQUID FEEDS:			
Buttermilk -----	9.4	3.3	9.1
Buttermilk, semi-solid -----	29.9	10.7	27.3
Cow milk -----	12.8	3.3	16.2
Skimmilk -----	9.6	3.5	8.6

	Total Dry Matter	Digestible Protein	Total Digestible Nutrients
DRY ROUGHAGES:			
Alfalfa meal	90.4	10.6	50.3
Alfalfa leaf meal	91.9	16.2	57.4
Alfalfa stem meal	92.4	5.9	43.0
GREEN ROUGHAGES:			
Alfalfa	25.4	3.4	14.7
Cabbage	9.4	1.9	8.1
Desmanthus virgatus*	30.0	7.5	17.0
Honohono*	10.6	.8	14.1
Koa haole tops and pods*	30.7	4.8	17.3
Mexican Grass*	25.0	.9	15.1
Napier grass*	23.8	.6	12.2
Para grass (Panicum)*	25.6	1.2	14.7
Pigeon pea, top 1/3 with pods*	50.0	6.5	33.6
Purslane (pigweed)	10.3	1.8	6.5
Sweet potato tops*	12.3	2.0	7.6
Taro tops*	15.4	1.2	9.7
ROOT CROPS, NOT DRIED:			
Canna, edible*	26.3	.8	20.2
Carrots	11.9	.8	9.6
Cassava	32.6	.3	17.9
Sweet potato*	31.1	1.4	21.8
FRUITS:			
Avocado*	23.3	1.0	27.3
Banana, Chinese*	22.1	1.2	12.6
Breadfruit*	41.3	1.0	26.1
Coconut*	54.6	3.8	81.5
Guava*	14.0	.7	6.4
Kiawe beans*	84.7	6.0	53.0
Mango*	16.8	.4	11.1
Papaya*	11.4	.3	7.1

Cooperative Extension Work
in Agriculture and Home Economics
University of Hawaii and
U. S. Department of Agriculture
Cooperating.

Acts of Congress of May 8 and June 30, 1914.