# โครงการปรับปรุงพันธุ์สุกรที่มหาวิทยาลัยเกษตรศาสตร์

## Swine Improvement Project at Kasetsart University[1]

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The swine industry in Thailand has proven to be very profitable if correct farming methods are applied. The industry is becoming more and more important because pork is very popular and widely consumed throughout the country. Furthermore, pigs multiply rapidly and are relatively easy to keep, thus helping to stabilize the family as well as the national economy.

According to the statistics reported by the Department of Agricultural Economics in 1963, there are about five million pigs in Thailand with a value of about 2,500 million baht. Over 33 million baht worth of swine was exported in 1963. Most of the pigs raised and sent to the market are the native breeds and crossbreds. The native pigs possess many undesirable characteristics and are deficient in many desirable characteristics, thus, they must be improved genetically. However, they probably possess the ability to withstand and tolerate tropical heat and diseases. One way to improve the native pigs is to cross them with European or American breeds. Some attempt has been made in crossing European breeds with the native pigs, but the results have not been very satisfactory because there were no definite breeding plans and follow-up.

Therefore, there is much need for research to find basic information. It is necessary to set up a breeding program which will introduce desirable characteristics of European or American breeds and at the same time utilizing the desirable characteristics of the native pigs. It will also furnish the basic knowledge necessary for the development of new superior breed or breeds of hogs for Thailand.

The principal objectives of this study are (1) to determine, develop, and test the breeding and selection program which may be used by hog producers to improve the performance and quality of hogs; (2) to investigate the usefulness of a crossbreeding program for the improvement of native hogs for high quality pork production; (3) to study the effects of crossbreeding and inbreeding and the

1. A progress report of Kasetsart / Hawaii University Project No. 11, "Improvement of Swine Production Through Breeding".
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inheritance of the traits; (4) to evaluate and demonstrate the application of such knowledge in a swine breeding program; (5) to develop a breed or breeds of swine most suitable for Thailand conditions.

The points to be emphasized in the investigations are as follows:

1. To study various crossbreds in order to find the best combination of the Native and European or American purebreds with respect to growth and reproduction.

2. To compare the carcass quality of crossbred, Native and European pigs.

3. To study various crossbreeding programs, including the reciprocal crosses.

4. To study the adaptability of the crossbreds to Thailand conditions.

5. To study the heritability of the different traits to be used in forming a breeding program.

6. To study swine feeds and feed additives which have not been used before in swine production.

7. To formulate the new rations at various stages of growth and reproduction.

8. To apply all the information obtained towards the eventual development of a breed or breeds of swine for Thailand.

## RESULTS

This project was approved by the KU/UH Contract on November 20, 1962. In the first year the progress of the project was slow because it started from nothing; there were no buildings and no pigs. Most of the funds came from two important sources, the KU/UH Contract and Kasetsart University. The big part of the money went for feeds and buildings. At the present there are four buildings which were constructed by Kasetsart University at the cost of 290,000 baht. The total floor area is 13,877 square feet with 116 pens. The office is loaned by the Livestock Department.

In the beginning, the foundation stock for the breeding program was donated by the Livestock Department or purchased by the the KU/UH Contract. The American and European purebred animals donated by the Livestock Department were 8 Hampshires, 10 Duroc Jerseys and 10 Large Whites. Thirty native pigs and 12 American Landrace pigs were purchased by KU/UH Contract funds.

Most of the feed and some of the equipment were supported by KU/UH Contract funds.

The total number of pigs that were in the project as of the April 30, 1965 is shown in Table 1.

Table 1. *Inventory of animals.*

| Breed or Cross | No. of pigs on hand 4–30–65 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Adult | | Young | | Suckling | | Total number animal on hand |
| | M | F | M | F | M | F | |
| American Landrace | 2 | 5 | 1 | 3 | 24 | 20 | 55 |
| Duroc Jersey | 5 | 8 | – | 1 | – | – | 14 |
| Hampshire | 4 | 7 | – | 1 | 13 | 37 | 62 |
| Large White | 1 | 5 | 11 | 13 | – | – | 30 |
| Native | 5 | 19 | 8 | – | – | – | 32 |
| A.L. × Native | – | – | 1 | 11 | – | – | 12 |
| D. × Native | – | 6 | – | – | – | – | 6 |
| L.W. × Native | – | 5 | – | 3 | – | – | 8 |
| H. × Native | – | – | – | – | 3 | 5 | 8 |
| A.L. × Hampshire | – | – | 10 | 8 | – | – | 18 |
| A.L. × Duroc | – | – | 3 | 3 | 13 | 9 | 28 |
| Total | 17 | 55 | 34 | 43 | 53 | 71 | 273 |

**General Managerial Practices**

All the pigs were raised confined in pens with concrete floors. The area of the floor space in each pen and each house is different. This depends on the stage of growth of the pigs. House No. 1 is called the farrowing house, having a wider space for each pen (164 square feet) than the pen in the other houses (House No. 2 and 3–each pen is 88 square feet; House No. 4–each pen is 124 square feet). In this house, ten pens are specially developed for the farrowing sows. It has a brooder in each pen which has the space of 25 square feet and there are guardrails along the walls but there is no farrowing stall. House No. 1 consists of 5236 square feet and is divided into 26 pens. Houses No. 2 and 3 consist of 4480 square feet and each house is divided into 28 pens. House No. 4 consists of 4161 square feet and is divided into 32 pens.

The feeding of the animals depends upon the stage of growth and reproduction. For different kinds of rations, see the appendix. The method of feeding is hand-feeding or full-feeding by hand twice a day and giving fresh green Para grass between feeding periods. The amount of feed given daily is not restricted except for the pregnant animals. Drinking water is made available at all times. The hog pens are constantly kept dry and clean.

**Baby Pig Loss** The study "Causes of Death of Pigs From Birth to Weaning" was made during the period January1963 to December 1964. There were 259 pigs born to apparently healthy sows (5 Duroc

Jerseys, 5 Hampshires, and 10 Natives). Seventy-seven pigs died during the suckling period. This was 27.2% of all the pigs born alive and 29.7% of all pigs farrowed. The distribution of the death rate by age during the 8-week period is shown in Figure 1.

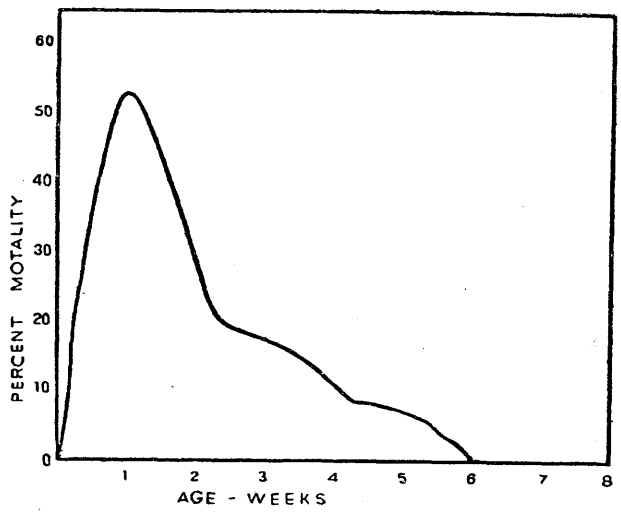


**Fig. 1.** *Distribution of suckling pig mortality to 8 weeks.*

Table 2 shows that the common causes of death were as follows: (1) 30 were crushed by sows; (2) 19 died of general weakness due mainly to a low birth weight of less than one pound; most of them died within a few days after birth and all died within 7 days; (3) 10 died because of various diseases such as pneumonia, impaction of stomach, gastro-enteritis, and hepatitis; (4) 9 were born dead; and (5) 9 died of no apparent cause.

Scouring was observed in almost all litters and as early as one week of age. Some deaths may have been due to scouring which lowered the resistance of the pigs to other diseases.

**Table 2.** *Causes of death of suckling pigs.*

| Causes of Death | Number of pigs | Percentage of all pigs farrowed | Percentage of all losses | Percentage of all pigs farrowed alive |
|---|---|---|---|---|
| Low birth weight | 19 | 7.3 | 24.6 | 7.6 |
| Pathological | 10 | 3.8 | 12.8 | 4.0 |
| Born dead | 9 | 3.5 | 11.8 | – |
| Crushed by sow | 30 | 11.6 | 39.0 | 12.0 |
| No apparent cause | 9 | 3.5 | 11.8 | 3.6 |
| Total | 77 | 29.7 | 100.0 | 27.2 |

Birth weight, survival rate and weaning weight are shown in Table 3. The bigger the animals at birth, the higher the survival rate and weaning weight. This may be explained by the fact that the bigger the animals are at birth, the stronger and more active they are. Most of the lower weight animals were born from the Native mother.

**Table 3.** *The effect of weight of individual pigs at birth on their survival and on their weaning weight.*

| Birth weight | Number of pigs | | | Percentage weaned of total | | Average weaning weight |
|---|---|---|---|---|---|---|
| | Farrowed | Born dead | Died during suckling | Farrowed | Farrowed alive | |
| lb. | | | | | | lb. |
| 0.1 – 0.5 | 14 | 1 | 7 | 42.85 | 46.15 | 11.25 |
| 0.6 – 1.0 | 50 | 4 | 12 | 68.00 | 72.90 | 14.10 |
| 1.1 – 1.5 | 76 | 2 | 24 | 65.77 | 67.56 | 13.59 |
| 1.6 – 2.0 | 54 | – | 13 | 75.92 | 75.92 | 18.52 |
| 2.1 – 2.5 | 21 | – | 8 | 61.90 | 61.90 | 20.70 |
| 2.6 – 3.0 | 25 | – | 4 | 84.00 | 84.00 | 23.54 |
| 3.1 – 3.5 | 11 | – | – | 100.00 | 100.00 | 21.94 |
| 3.6 – 4.0 | 7 | 2 | – | 71.40 | 100.00 | 34.80 |
| 4.1 – 4.5 | 1 | – | – | 100.00 | 100.00 | 46.00 |
| Total | 259 | 9 | 68 | | | |
| Average | | | | 70.30 | 73.85 | 22.72 |

Table 4 shows the comparison of baby pig losses during the poriod May 1, 1964 to November 30, 1964 which was 45.21% with the period December 1, 1964 to April 30, 1965 which was 10.2%. It is seen that the death losses during the first period were much too high. Thus, in 1965, the general managerial and feeding practices were improved.

At the suggestion of the Advisor, the slatted floors were placed inside the brooder area for the bay pigs. These slatted floors served to keep the baby pigs off the damp dirty concrete floors and kept them dry and clean. Cases of scours were reduced significantly.

During the first few days after birth, the baby pigs were confined in the brooder and released only to nurse the sows. Confinement of the baby pigs reduced the chances of sows crushing them.

It is seen that the use of slatted floors in the brooders and confinement of the baby pigs for a few days except for nursing reduced the baby pig losses significantly.

**Table 4.** *Death losses of baby pigs.*

| Breed or Cross | 5-1-64 to 11-30-64 | | | | | 12-1-64 to 4-30-65 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Farrowing | | No. born alive | Died suck-ling | % Death | Farrowing | | No. born alive | Died suck-ling | % Death |
| | Sows | Gilts | | | | Sows | Gilts | | | |
| A.L. | 4 | – | 34 | 5 | | 4 | – | 45 | 1 | |
| D. | 2 | – | 17 | 5 | | – | – | – | – | |
| H. | – | – | – | – | | 1 | 5 | 64 | 6 | |
| L.W. | 2 | – | 18 | 11 | | – | 3 | 31 | 7 | |
| N. | 1 | – | 15 | 15 | | – | – | – | – | |
| A.L.×N. | 8 | – | 89 | 54 | | – | – | – | – | |
| D.×N. | 1 | – | 14 | 4 | | – | – | – | – | |
| L.W.×N. | 3 | – | 25 | 6 | | – | – | – | – | |
| A.L.×D. | 1 | – | 12 | 5 | | 1 | 2 | 35 | 3 | |
| A.L.×H. | 3 | – | 18 | 2 | | 1 | – | 12 | 2 | |
| H.×N. | – | – | – | – | | 1 | – | 9 | 1 | |
| Total | 25 | – | 242 | 107 | 45.21 | 8 | 10 | 196 | 20 | 10.20 |

**Feeding Practices**

Feed costs make up more than three-fourths of the swine production costs. Feeding is important for the strength, survival, size and quality of pigs at weaning and marketing periods. Thus, it is very important that boars, gestating sows, lactating sows, and growing pigs at all stages are properly fed. All the rations for this project were formulated according to the requirements set forth by the U.S. National Research Council. Formulas for the various rations are given in the appendix.

Besides developing the basic rations for all classes of pigs for the project, some studies were made to determine the effects of feeding different levels of sweet potatoes and cassava meal to swine.

The levels of dried sweet potato meal tried were 20, 30, 40, and 50 percent of the rations. The rate of gain and feed efficiency were very poor for the high levels of sweet potatoes. It seems that the maximum level should be about 20 percent. More work needs to be done to get a more definite answer.

The levels of cassava meal tried were 10-15, 20-25 and 30-35 percent of the ration. Fairly good results were obtained by all levels. Again, more work needs to be done to establish definite recommendations.

**Breeding Practices**

To develop a new breed of swine for Thailand, first, it is necessary to find out many basic information. Therefore, the breeding program is divided into three steps.

1. The first step will be concerned with the crossbreeding and reciprocal crosses. The purpose is to make com-

parisons between the native pigs and crosses between European and/or American breeds and the crossbreds of Native crossed with the different breeds of European or American breeds. The comparisons will be made especially on the economically important traits. In the crossbreeding program, one male will be mated randomly with one female. The breeding plan is shown in Table 5.

**Table 5.** *Crossbreeding plan.*

| Female / Male | (5) Native | (5) Duroc | (5) Hampshire | (5) Large White | (5) Landrace |
|---|---|---|---|---|---|
| (5) Native | X | X | X | X | X |
| (5) Duroc | X | X | X | X | X |
| (5) Hampshire | X | X | X | X | X |
| (5) Large White | X | X | X | X | X |
| (5) Landrace | X | X | X | X | X |

Note: (–) = Number of animals
X = Mating

2. Then the selected animals in the first step will be used for crossing with the other breeds to make the breed crosses and rotational crosses. The comparison will be made among the different crossing methods such as the criss-cross, reciprocal cross and rotational cross.

3. The selected animals in the second step will be used as foundation stock to continue the lines to develop the new breed. Selections will be made on the basis of the records made in performance tests, conformation, carcass quality, adaptability to Thailand's environmental conditions, etc. Therefore, a flexible system of inbreeding will be applied within lines in order to fix desirable qualities and to increase prepotency.

**Selection of Breeding Stock**

Maximum benefits from crossbreeding will be obtained by careful selection and performance-testing of the breeding stock used.

The genetic merits of the boars will be selected on the basis of superior records for the economically important traits—growth rate, feed efficiency, and carcass quality as well as desirable conformation.

Replacement gilts will be selected on the basis of the dam's productivity, growth rate, back fat thickness and desirable conformation.

Data to be recorded are as follows:

1. Reproduction
   a. Length of gestation period
   b. The number and weight

of pigs born per litter (dead and alive)

c. The number and weight of pigs weaned per litter

d. Abnormalities or inheritance defects

e. Age of gilt and boar at first farrowing and first service

2. Growth and growth pattern

a. Weaning weight at 56 days of age

b. Growth pattern from weaning to marketing. All pigs will be weighed at 14-day intervals from the 56th day of age until they are slaughtered at 100 kg. body weight.

3. Feed efficiency. Each litter will be fed separately. The amount of feed eaten by the pigs during the feeding period will be divided by the gains made during this same period to determine the amount of feed required per unit of gain.

4. Carcass quality. When the pigs reach the marketing weight (100 kg.) they will be weighed and slaughtered to find the following characteristics:

a. Dressing percentage

b. Carcass measurement

1) Carcass length

2) Backfat thickness

3) Lean cuts (ham, loin, picnic, Boston butt)

4) Loin eye area

5. Live animal scores. All pigs will be rated individually by scoring when they reach 90 kg. Scoring will be done by a committee of two or three men.

The results of the studies on litter size, birth weight, growth rate during suckling period, weaning weight, comparative studies on growth rate and feed efficiency from weaning to market weight, and carcass characteristics are shown in Tables 6, 7 and 8.

These are only preliminary data on a limited nuber of animals. Therefore, no conclusions are drawn. They are presented only to show trends as seen thus far.

**Table 6** *Litter size, birth weight, weaning weight and rate of gain of pigs farrowed.*

| Observation \ Crosses or breeds | L.W.×N. | D.J.×N. | A.L.×N. | A.L.×H. | H. | D.J. | N. |
|---|---|---|---|---|---|---|---|
| No. of pigs farrowed | 43 | 40 | 18 | 14 | 51 | 40 | 53 |
| No. of litters | 4 | 4 | 2 | 2 | 5 | 5 | 5 |
| Litter size | 10.7 | 10.0 | 9.0 | 7.0 | 10.2 | 8.0 | 10.6 |
| Litter size at weaning | 8.5 | 6.0 | 7.0 | 6.5 | 7.4 | 5.2 | 6.8 |
| Birth weight (lbs.) | 1.2 | 1.4 | 1.1 | 2.8 | 1.9 | 2.9 | 1.4 |
| Weaning weight (lbs.) | 14.4 | 16.4 | 16.3 | 23.3 | 19.3 | 18.9 | 15.5 |
| Rate of gain (lbs.) | 0.24 | 0.27 | 0.27 | 0.37 | 0.31 | 0.29 | 0.25 |

*LW = Large White
N = Native
AL = American Landrace
DJ = Duroc Jersey
H = Hampshire

**Table 7.** *Carcass quality of crossbreds.*

| Observation \ Crosses | Large White × Native | Duroc × Native |
|---|---|---|
| No. pigs slaughtered | 7 | 7 |
| Av. liveweight before slaughter (kg.) | 100.94 | 100.92 |
| Av. dressing percentage | 73.97 | 74.25 |
| Av. backfat thickness (mm.) | 45.76 | 46.018 |
| Av. loin eye area (sq. in.) | 3.648 | 3.335 |
| Av. % lean | 25.12 | 26.904 |
| Av. % loin and tenderloin | 5.51 | 5.604 |
| Av. % bacon | 23.04 | 23.424 |
| Av. % head | 7.90 | 7.58 |
| Av. % bone | 15.34 | 15.44 |
| Av. carcass length (mm.) | 745 | 735 |
| Av. % fat | 27.64 | 26.18 |

**Table 8.** *Growth rate and feed efficiency of various breeds and crosses.*

| Breed* or cross | | No. of pigs | Average initial weight | Average final weight | Period of test | Average daily gain | Feed efficiency |
|---|---|---|---|---|---|---|---|
| | | | (1bs) | (1bs) | (days) | (1bs) | |
| D.J. | (F) | 9 | 41.33 | 182.22 | 140 | 1.01 | 3.72 |
| D.J. | (M) | 11 | 41.45 | 200.18 | 140 | 1.14 | 3.30 |
| Hampshire | (F) | 8 | 26.00 | 133.67 | 140 | 0.79 | 3.72 |
| Hampshire | (M) | 14 | 28.50 | 154.21 | 140 | 0.89 | 3.69 |
| DJ × N | (F) | 10 | 24.70 | 199.40 | 182 | 0.97 | 3.88 |
| DJ × N | (M) | 2 | 28.00 | 215.00 | 182 | 1.02 | 3.86 |
| LW × N | (F) | 6 | 19.00 | 203.60 | 182 | 1.05 | 4.18 |
| LW × N | (M) | 8 | 21.12 | 210.37 | 182 | 1.12 | 3.91 |
| N | | 11 | 20.63 | 145.45 | 182 | .60 | 4.25 |

*Crosses are Male × Female DJ = Duroc Jersey
LW = Large White N = Native

**SUMMARY**

This project was set up primarily to improve swine production through breeding and to develop a breed or breeds of swine for Thailand. The project was approved for support by the Kasetsart University/University of Hawaii Contract on October 20, 1962. It actually got underway about June 1963. For the foundation stock, the Livestock Department donated Hampshire, Large White and Duroc Jersey boars and gilts; native pigs were purchased by the Contract from the South; and the Contract imported American Landrace from the Jack Ching Farm in Hawaii. In two years the inventory of pigs has grown from nothing to 273 pigs.

One of the major problems was baby pig scours and losses. This was largely corrected by using slatted floors in the brooder area and increased attention after farrowing.

The results of the studies on litter size, birth weight, growth rate, weaning weight, market weight, feed efficiency and carcass characteristics are given.

With much of the managerial problems well under control, more attention can be concentrated on breeding plans.

**Plans for the Future**

1. Will continue to make comparisons of the economic traits of various breeds and crossbreds in order to find out the best combination of crosses.

2. Studies will be made of different methods of crossing to find out the best method or methods to use in this project.

3. The best crosses will be se-

lected for use as foundation stock and will be used in developing a breed or breeds of swine for Thailand.

4. In addition to the breeding program, effort will be made constantly to find ways of improving feeding and other managerial practices.

## สรุป

โครงการนี้ได้ดำเนินการเพื่อที่จะบำรุงพันธุ์และปรับปรุงการผลิตสุกรให้ดีขึ้น โดยอาศัยวิธีการผสมพันธุ์ จุดมุ่งหมายของโครงการนี้ ก็เพื่อที่จะสร้างพันธุ์สุกรพันธุ์ใหม่ที่ดีและเหมาะสมกับประเทศไทย โครงการนี้ได้รับการเห็นชอบ และความช่วยเหลือภายใต้สัญญาร่วมระหว่างมหาวิทยาลัยเกษตรศาสตร์และฮาไวอี และจากการช่วยเหลือของมหาวิทยาลัยเกษตรศาสตร์ให้ทุนในการก่อสร้างคอกสุกรเป็นเงิน 290,000 บาท โครงการนี้ได้เริ่มดำเนินงานเมื่อเดือนมิถุนายน 2506

กรมปศุสัตว์ได้ให้การช่วยเหลือด้านพันธุ์สัตว์ โดยมอบสุกรพันธุ์แฮมเชียร์ลาร์จไวท์และดูรอคให้จำนวนหนึ่ง ส่วนสุกรพื้นเมืองและพันธุ์อเมริกันแลนเดรซนั้นได้จัดซื้อโดยสัญญาเกษตรศาสตร์ฮาไวอี ภายในเวลา 2 ปี โครงการนี้ได้เพิ่มจำนวนสุกรสำหรับใช้เป็นสุกรพื้นฝูงและการทดลองเป็น 273 ตัว

การศึกษาของโครงการได้กระทำอย่างละเอียด เริ่มด้วยการเลี้ยงสุกรในระยะต่างๆ ซึ่งได้พบว่าปัญหาใหญ่ที่ควรแก้ไขด่วนได้แก่ โรคขี้ขาวและการตายของลูกสุกรเป็นจำนวนมากเมื่ออยู่ในระยะดูดนม ปัญหาเหล่านี้ได้แก้ไขด้วยวิธีการเลี้ยงดู การให้อาหาร ปรากฏว่าได้ลดปริมาณการตายของสุกรอย่างมีนัยสำคัญในทางสถิติ (ตารางที่ 2–4)

ผลของการศึกษาที่น่าสนใจในเรื่องขนาดของครอก น้ำหนักแรกคลอด อัตราการเจริญเติบโต น้ำหนักหย่านม ประสิทธิภาพของการใช้อาหาร และคุณภาพของทรากของสุกร ได้แสดงไว้ในตารางที่ 5–6

การศึกษาขณะนี้มุ่งไปในเรื่องการผสมข้ามพันธุ์แบบต่างๆ เช่นการไขว้พันธุ์และแบบสลับหมุนเวียน ฯลฯ ซึ่งบางโครงการย่อยได้ทำไปแล้วและกำลังดำเนินต่อไป คือ

1. เปลี่ยนลักษณะต่าง ๆ ที่สำคัญในทางเศรษฐกิจของลูกผสม ที่มาจากการผสมข้ามพันธุ์แบบต่างๆ เพื่อให้ทราบว่าลูกผสมใดให้ผลดีและได้รับการถ่ายทอดของลักษณะพันธุ์ในทางพันธุกรรมอย่างใดบ้าง

2. เพื่อศึกษาวิธีการผสมข้ามพันธุ์แบบต่าง ๆ ว่าวิธีการใดที่เหมาะสมที่สุดในการที่จะนำไปใช้แนะนำประชาชน เพื่อผลิตสุกรเป็นการค้า

3. ลูกผสมที่ดีที่สุดจะใช้เป็นสุกรพื้นฝูงต่อไป เพื่อผลิตสุกรพันธุ์ใหม่ในอนาคต.

4. พร้อมกันนี้ยังได้ศึกษาเรื่องอาหาร การให้อาหาร และการปฏิบัติรักษาที่ถูกต้องในการเลี้ยงสุกรด้วย

## APPENDIX

### RATION

| Feed ingredient | Creeping feed | Growing pigs | | | Boar | Lactating sow | Before & after farrowing |
|---|---|---|---|---|---|---|---|
| | | 10–25 kg | 25–60 kg | 60–100 kg | | | |
| Rice bran | 10 | 30 | 40 | 47 | 40 | 27 | 67 |
| Broken rice | 12 | 20 | 25 | 30 | 35 | 15 | 10 |
| Corn | 25 | 30 | 18 | 10 | 10 | 35 | 10 |
| Peanut meal | 5 | 3 | 3 | 2 | 4 | 4 | 3 |
| Soybean oilmeal | 15 | 5 | 9 | 6 | 6 | 6 | 6 |
| Fish meal | 7 | 12 | 3 | 3 | 5 | 8 | 4 |
| Bone meal | – | – | – | – | – | 1 | – |
| Skim milk | 15 | – | – | – | – | 5 | – |
| Oyster shell | – | – | 1.5 | – | – | – | – |
| Sugar cane | 10 | – | – | – | – | – | – |
| Salt | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Trace minerals | 100 gm | 100 gm | 100 gm | 100 gm | 100 gm | 100 gm | 100 gm |
| Antibiotics mix (20 ppm)[1] | 500 gm | – | – | – | – | – | – |
| Vitamin $B_{12}$ | 15 gm | 15 gm | 10 gm | 10 gm | 10 gm | 15 gm | 30 gm |
| Vitamin mix ($A+D_3+B_2$)[2] | 5 gm | 5 gm | 5 gm | 5 gm | 5 gm | 5 gm | 4.5 gm |
| Methionine | 300 gm | – | – | – | – | – | – |
| Calcium pantothenate | 42 gm | 42 gm | – | – | – | 5 gm | 20 |
| Furazolidone mix (11%) | – | – | – | – | – | – | 150 gm |

1. Active ingredient: Chlortetracycline/Aureomycin
2. Trade Name: Rovimix $AD_3B_2$
3. Trade Name: Nf-180

## APPENDIX

### RATION

| Feed ingredient | Gestating sow |
|---|---|
| Rice bran | 40 |
| Broken rice | 20 |
| Corn | 25 |
| Supplement | 15 |
| Salt | 0.5 |
| SUPPLEMENT | |
| Fish meal | 30 |
| Soybean oil meal | 35 |
| Peanut oil meal | 15 |
| Koa haole *Leucaena glauca* leafmeal | 14 |
| Bone meal | 4 |
| Oyster shell | 1 |
| Trace minerals | 400 gm |
| Rovimix $AD_3B_2$ | 80 gm |
| Calcium panthothenate | 75 gm |
| Choline | 310 gm |
| Vitamin $B_{12}$ mix | 75 gm |