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Reproductive Performance of Swine Fed Different Planes of Energy During Gestation

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CONTENTS

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Chapter I

INTRODUCTION

The important position which pork production occupies on the Missouri farm is attested by the fact that twenty to twenty-five percent of the gross farm income comes from the sale of hogs. The profit realized from such sales depends to a large extent on the size and weight of the litter produced by each sow at weaning time. The importance of large litters for profitable pork production can hardly be questioned when one considers that many of the expenses incurred in producing hogs are of the "overhead" type and do not vary much, regardless of the average number of pigs raised for each sow farrowing.

Litter size and weight at weaning is affected by a number of factors including: breeding, nutrition, parasites and diseases, housing and equipment, and management.

The object of these experiments was to study the effect of different levels of feeding during the gestation period on condition and reproductive performance in swine. The experimental results were measured by the performance of the sows and gilts and their litters at farrowing and weaning.

LITERATURE REVIEW

Embryonic Mortality and Post-Natal Deaths

The investigations of many scientists indicate that enormous losses occur in swine as a result of embryonic mortality and post-natal deaths. The work of Hammond (1921), Corner (1923), Crew (1925), Parkes (1925), and Warwick (1928), indicates that the fertile sow normally produces 18 to 20 or more eggs at each ovulation or heat period. Data presented by Robertson, *et al.* (1951), and Squiers, *et al.* (1952), shows that fertilization rates are quite high in swine, probably 90 to 95 percent. Casida (1952) re-evaluated previous estimates and concluded that the number of young born (including stillbirths) was approximately 56 percent of the number of corpora lutea.

Post-natal death losses constitute another large loss to the pork producer. Smith (1952) estimates between 30 to 35 percent of pigs farrowed never live to weaning age.

A number of factors, including nutrition, have been shown to contribute to these losses. Vestal (1938) concluded that perhaps the most common mistake in pig production contributing to the size of the litter farrowed is the neglect of the sow during gestation. Smith (1952) attributes the major cause of losses, from farrowing to weaning, to management and improper quality and quantity of ration fed during gestation.

Nutritional Requirements

The importance of supplying adequate quantities of protein, vitamins, and minerals during gestation cannot be overemphasized. However, Morrison (1956) emphasized that it is just as important not to overfeed pregnant sows at it is to feed them a well-balanced ration.

The influence of nutrition on fetal development begins even before the hour of successful impregnation. This is illustrated by the effect of flushing upon the number of offspring born (Evvard, 1912, McKenzie, 1928, and Zimmerman *et al.* 1957).

Recent experimental work has shown that a contrast in level of feeding of the gilt before and after mating is required to produce highest embryo survival (Chistian *et al.* 1952, Haines *et al.* 1955, Self *et al.* 1955, Hanson *et al.* 1956, Terrill *et al.* 1957). Variations in the nutritional requirement during the gestation are suggested by the progressive increase in the rate of development of the fetus with more than two-thirds of the growth occurring during the last four weeks of the gestation period. Another critical period requiring special consideration is the three weeks immediately following breeding during which time implanation of the fertilized egg is taking place. Since the bodies of the new born pigs are very high in water with the rest of the fetus consisting chiefly of protein, the requirement for protein is perhaps increased more than for total digestible nutrients on net energy during the gestation period.

Condition

That excessive condition of sows may cause low fertility or even complete sterility is a fact clearly established by experience. This is particularly true of sows fitted for show and maintained in extreme condition for a considerable length of time. Lasley (1957) presented data indicating that gilts with thicker backfat at 200 pounds lost more pigs because of embryonic death losses than those with thinner backfat.

Vestal (1938), reporting the results of several experiments with sows and gilts, found a relationship between the strength of the pigs farrowed, the size, and weights, of the litter weaned and the condition of the sows at farrowing. The sows in medium condition farrowed heavier and stronger pigs, weaned a greater percentage of pigs, and weaned litters of greater weight than sows in fat condition.

METHODS AND MATERIALS

General. A total of eight trials were conducted to study the effect of level of feeding during gestation on reproductive performance. Four trials were with gilts and four with sows. The animals used were either purebred Hampshires or Durocs. They were bred to purebred boars of their respective breed. With the exception of trial eight, all trials consisted of two groups. One group was fed on a plane to approximate the level recommended by the National Research Council. The other group was fed a more restricted ration during the gestation period. In trial eight, an additional group of sows was fed on an intermediate plane along with the other two groups. High, intermediate, and low, levels of feeding will be referred to as normal, intermediate, and limited-fed groups, respectively. In addition, reference will be made to normal and limited-fed groups as Lots 1 and 2, respectively, except for trial eight where the additional intermediate group is referred to as Lot 2, with the limited-fed group referred to as Lot 3.

The experiments were conducted from the fall of 1957 through the fall of 1960. Methods and materials for the separate trials were as follows.

Trial I. Ten Hampshire and six Duroc gilts were divided into two equal lots on the basis of litter mates, and/or weight with each lot containing an equal number of Durocs and Hampshires. All gilts were approximately eight months old, and having been liberally fed a well balanced ration prior to the beginning of the experiment, were in high condition at the time they were bred. They were bred the latter part of November and the early part of December so they would farrow during the latter part of March.

Each group was placed in a separate lot at the start of the experiment. Since both lots contained very little green forage, it was considered that the animals were under dry lot conditions. The lots assigned were approximately one-third to one-half acre to allow space for the animals to exercise.

Treatment was the same in both lots from breeding to weaning, except for the amount of shelled corn fed from the beginning of the experiment to the 109th day of gestation. During this part of the gestation period both lots were fed one and one-fourth pounds of the same protein supplement (Table I). In addition, Lot 1 animals were fed five pounds of shelled corn per head per day, whereas Lot 2 animals were fed only three pounds of shelled corn per head per day. These rations provided the minimum requirements of swine for protein, vitamins, and minerals as recommended by the National Research Council. It was also considered that the TDN requirements would be fulfilled for Lot 1, but restricted for Lot 2.

During the gestation period, two 8′ x 8′ portable houses were provided for each lot of gilts. The houses were equipped with wooden floors and with an open door to the south. A central farrowing house equipped with farrowing crates was used for the farrowing quarters. Each crate had heat lamps. The farrowing house was cleaned prior to the start of, and frequently during, the far-

TABLE I-CONSTITUENTS AND PERCENTAGE COMPOSITION GESTATION PROTEIN SUPPLEMENT

Ingredient	Trial 1	Trials 4, 5, 6, 7	Trial 8
Soybean Oil Meal	62.2	62.66	62.2
Tankage	31.0	------	------
Meat and Bone	------	31.00	31.0
Salt	2.0	2.00	2.0
Limestone	1.0	1.00	1.0
Bonemeal	2.0	2.00	2.0
Vitamin A & D Supp.[1]	0.6	-------	0.6
Vitamin A. Supp.[2]	-----	0.14	------
B Vitamin Supp.[3]	0.6	0.60	0.6
B_{12} Supp.[4]	0.6	0.60	0.6
TOTAL	100.00	100.00	100.0

1. Supplied 2,250 units of Vitamin A and 400 units of Vitamin D per gram of supplement.
2. Supplied 10,000 units of Vitamin A per gram of supplement.
3. Supplied 2 grams of riboflavin, 4 grams pantothenic acid, 9 grams niacin, 10 grams choline chloride, and .06 grams folic acid per pound of supplement.
4. Supplied 10 milligrams of B_{12} per pound of supplement.

rowing season. Straw was used for bedding the gilts and their litters while in the crates and individual pens. After farrowing, the gilts and litters were left in the crates from two to five days. They were then moved to individual pens, equipped with heat lamps, within the central house. An adjacent, outside, pen was used by each gilt and litter when weather conditions were favorable.

When the pigs were two to three weeks old, the gilts and litters were moved to pasture lots where three and four gilts and litters occupied a single lot. An old stand of bluegrass pasture was subdivided into four lots, of approximately equal size, to provide pasture lots for all gilts and litters. Each lot was equipped with an open front house with dirt floors.

During the gestation period, the corn and supplement ration was hand fed in equal parts twice daily. On the 109th day of gestation, each gilt was moved to a holding pen within the central farrowing house. At this time, the ration for all gilts was changed to eight pounds of the lactation ration (Table II) plus one pound of bran. This ration was fed, except for the day of farrow, until the fourth day after farrowing. The fourth day following farrowing, the feeding of bran was discontinued and the amount of lactation ration increased rapidly to fourteen pounds per head daily. This level of feeding was continued until the gilts and pigs were moved to pasture, at which time the gilts were self-fed the same ration.

Since both the inside and outside pen in the central farrowing house had concrete floors, it was necessary to prevent anemia. Reduced iron tablets were used for this purpose. Each tablet contained 4.5 grains of iron in base of copper and cobalt sulphates. Two pills were given each pig: the first one on the day of birth and the second one seven days later. Difficulty was encountered with the

TABLE II-CONSTITUENTS AND PERCENTAGE COMPOSITION
GILTS LACTATION RATIONS

Ingredients	Trial 1	Trial 3	Trial 4	Trial 6
Corn	80.5	79.0	79.077	82.75
Soybean Oil Meal	12.0	15.0	15.000	11.00
Tankage	6.0	----	------	-----
Meat and Bone	----	5.0	5.000	5.00
Salt	0.5	0.5	0.5	0.5
Limestone	0.3	0.2	0.2	0.3
Bonemeal	0.4	----	------	0.4
Vitamin A & D Supp.[1]	0.1	0.1	------	-----
Vitamin A[2]	-----	----	.023	-----
B Vitamin Supp.[3]	0.1	0.1	0.1	-----
B_{12} Supp.[4]	0.1	0.1	0.1	0.05
TOTAL	100.0	100.0	100.000	100.00

1. Supplied 2,250 units of Vitamin A and 400 units of Vitamin D per gram of supplement.
2. Supplied 10,000 units of Vitamin A per gram of supplement.
3. Supplied 2 grams of riboflavin, 4 grams pantothenic acid, 9 grams niacin, 10 grams choline chloride, and .06 grams folic acid per pound of supplement.
4. Supplied 10 milligrams of B_{12} per pound of supplement.

first litters in getting the pigs to swallow the pill. Later, the pills were mashed and given in the form of a fine powder. This was a satisfactory method. The creep ration (Table III) was offered the pigs at two to three weeks of age. They were then self-fed until weaned.

Trial II. Experimental animals used in this trial were sows and were the same individuals held over from Trial I. Individuals were assigned to the same feed-level group, for the gestation period, as assigned during the preceding trial. Those that had been on limited feed during Trial I continued on limited feed.

Sows were bred at the first heat period following the weaning of previous litters. They were lotted on oats and rape pasture for three weeks, then transferred to bluegrass for the remainder of the gestation period. A complete mixed feed (15% protein) (Table IV) was fed during the gestation period. The ration was hand fed once a day. During the first month of gestation, Lot 1 was fed six pounds and Lot 2 four pounds. For the remainder of the period Lot 1 was fed five pounds. The amount fed to Lot 2 was reduced to three pounds for three weeks, then to two pounds for the following month, and during the last month of gestation increased back to three pounds.

In general, the sows and litters in this trial were managed the same as the gilts and litters were in the preceding trial. However, there were two exceptions: (1) pigs were injected with 1cc "armidexan" (each cc contained 50 mg. elemental iron as ferric hydroxide in complex with a low molecular weight dextran fraction) in each ham at three to five days of age to prevent anemia; (2) red clover pasture was used during the lactation period.

TABLE III-CONSTITUENTS AND PERCENTAGE COMPOSITION OF CREEP RATIONS

Ingredients	Trials 1 & 2	Trials 3, 4 & 5	Trials 6, 7 & 8
Corn	69.25	59.55	59.395
Rolled Oats	------	7.50	7.50
Soybean Oil Meal	23.00	23.20	23.20
Tankage	5.00	------	-------
Meat and Bone	------	2.50	2.50
Alfalfa Meal	------	2.50	2.50
Dried Whey	------	2.50	2.50
Salt	0.50	------	-------
Salt Trace Minerals	------	0.50	0.50
Limestone	0.50	0.50	0.50
Bonemeal	0.50	0.50	0.50
Vitamin A & D Supp.[1]	0.20	-------	0.20
Vitamin A[2]	------	0.045	-------
B Vitamin Supp.[3]	0.20	0 20	0.20
B_{12} Supp.[4]	0.10	0.20	0.20
Antibiotics[5]	0.50	0.30	0.30
Hygromix[6]	0.25	------	-------
Zine Oxide	------	2.5 gms	2.5 gms
TOTAL	100.00	100.00	100.00

1. Supplied 2,250 units of Vitamin A and 400 units of Vitamin D per gram of supplement.
2. Supplied 10,000 units of Vitamin A per gram of supplement.
3. Supplied 2 grams of riboflavin, 4 grams pantothenic acid, 9 grams niacin, 10 grams choline chloride, and .06 grams folic acid per pound of supplement.
4. Supplied 10 milligrams of B_{12} per pound of supplement.
5. Supplied 3.6 grams chlortetracycline (aureomycin) per pound of supplement in trials 1 and 2. Supplied 10 grams oxytetracycline (terramycin) per pound of supplement in trial 3. Supplied 10 grams chlortetracycline (aureomycin) per pound of supplement in trials 4, 5, 6, 7 and 8.
6. Suppled 12,000,000 units of hygromycin B activity per ton of feed.

Trial III. Purebred Hampshire and Duroc gilts were also used in this trial. A complete 15% protein (Table IV) was fed during gestation with Lot 1 being fed at the rate of six pounds, whereas Lot 2 was fed at the rate of only four pounds per head per day. All other treatments and management practices were the same as for Trial I up to the 109th day of gestation. From the 109th day of gestation to weaning, the treatment of the gilts in both lots was the same and was the same as Trial I with the following exceptions: (1) gilts and litters were not moved to pasture until the pigs were four to five weeks old; (2) pasture used during the lactation period was red clover; (3) the creep ration was placed before the pigs when they were three to five days old.

Trial IV. This trial was conducted during the summer of 1959, with purebred Hampshire and Duroc gilts being used for the experiment. Although it was during the summer, the lots used were so devoid of green feed that this trial was considered to be a dry lot experiment.

TABLE IV-CONSTITUENTS AND PERCENTAGE COMPOSITION GESTATION RATION

Ingredients	Trial 2	Trial 3
Corn	83.00	82.60
Soybean Oil Meal	10.78	10.75
Tankage	5.25	------
Meat and Bone	------	5.25
Salt	0.35	0.35
Limestone	0.17	0.175
Bonemeal	0.35	0.35
Vitamin A & D Supp.[1]	------	0.175
B Vitamin Supp.[2]	------	0.175
B_{12} Supp.[3]	0.10	0.175
TOTAL	100.00	100.00

1. Supplied 2,250 units of Vitamin A and 400 units of Vitamin D per gram of supplement.
2. Supplied 2 grams of riboflavin, 4 grams pantothenic acid, 9 grams niacin, 10 grams choline chloride, and .06 grams folic acid per pound of supplement.
3. Supplied 10 milligrams of B_{12} per pound of supplement.

As in the other trials, both lots received the same treatment from breeding to weaning except for the amount of ration fed from breeding to the 109th day of gestation. During this period, both lots were fed one and one-fourth pounds of the same protein supplement (Table I). Shelled corn was fed along with the supplement at the rate of five and three pounds for Lots 1 and 2, respectively. However, for the first three weeks of July during the second month of gestation, the amount of shelled corn was reduced by one pound per head per day for each lot. A reduction in feed during this period was indicated for both lots since the gilts in Lot 1 appeared to be suffering from the heat and had failed to clean up their feed for three to four successive days, and because the gilts in Lot 2 were gaining faster than desired. After this three week reduced feeding period, both lots were returned to previous feeding levels for the remainder of the gestation period. The gestation ration was hand fed once a day.

With the exception that gilts and litters were kept on concrete until the pigs were weaned, other treatment and management practices were the same as for Trial I.

Trial V. Yearling sows were used in this trial and were the same individuals held over from Trial III. Group feeding levels in this trial, however, were reversed from the feeding levels during Trial III. Sows which had been on the lower feeding level were put on the higher level, whereas those which were on the higher feeding level were put on the lower level.

Since both lots were on bluegrass pasture during the gestation period, only a pound of protein supplement per head per day was fed each group. Four and two pounds of corn for Lots 1 and 2, respectively, was hand fed with the supplement once a day. Other feeding and management practices were the same as for Trial IV which was conducted during the same period.

Trial VI. The gilts in this trial were separated into the respective lots and the experiment started one month prior to the beginning of the breeding season. From the beginning of the experiment until the pigs were weaned, both lots were treated the same with the following exceptions: (1) Lot 1 gilts were fed one and one-fourth pounds of the protein supplement (Table I), and five pounds of shelled corn from the beginning of the experiment to the 109th day of gestation; (2) Lot 2 gilts were fed one and one-fourth pounds of the same protein supplement, but only two pounds of shelled corn from November 10, to November 30. At that time, one week prior to the start of the breeding season, the amount of shelled corn was increased to five pounds, then on the day of breeding the amount was reduced to three pounds per head per day. This level of feeding was continued to the 109th day of gestation.

Following parturition both groups were hand fed for three days, then, commencing the fourth day, they were turned to self-feeders twice a day for a period of one to two hours. Gilts and litters were kept in the farrowing crates until the pigs were ten to fourteen days old. They were then transferred to red clover pasture. As in some of the previous trials, "armidexan" was used to prevent anemia.

Ground corn cobs were used for bedding for the gilts and litters in the farrowing crates.

Trial VII. Sows varying in age from yearlings to four years old were used in this study which was conducted during the same period as the preceding trial. All sows were lotted together and fed at the same rate from the start of the experiment, one week prior to the beginning of the breeding season, until the day the individual sow was bred. During this period, they were fed one and one-fourth pounds of supplement (Table I) plus seven pounds of shelled corn. The day the sow was bred she was transferred to her respective feed-level group and her feed reduced accordingly. The reduction was in amount of corn fed only, since a continuous level of one and one-fourth pounds protein supplement was fed both groups up to the 109th day of gestation. Five pounds of shelled corn was fed to Lot 1 for the entire period. However, the rate varied for Lot 2 since only two pounds was fed for three weeks, then increased to three pounds and increased further to four pounds one month prior to farrowing. Other feeding and management practices were the same as for Trial VI.

Trial VIII. In the final trial, three groups of sows were fed at different levels. A third group of sows was fed at an intermediate level along with two groups fed at levels approximating planes used in other trials. All individuals were assigned to the same lot at the time of weaning their previous litters, and were bred at the first heat period. During this period they were fed one and one-fourth pounds of protein supplement plus seven pounds of shelled corn per day. During the breeding season, an antibiotic was added to the protein supplement at a rate to provide 0.54 gram of antibiotic per sow per day. The day the individual sow was bred, she was moved to her respective feed group lot and her feed was reduced accordingly. A constant level of three-fourths pound of protein supplement (Table I) was fed to all groups to the 109th day of gestation. During this same period, a constant level of shelled corn was also fed and at the rates of four, three and two pounds to Lot 1 (normal), Lot 2 (intermediate), and Lot 3 (limited), respectively. All groups were provided red clover pasture during gestation.

The same feeding and management practices used in Trial VII were used in this trial with the exception that sows were turned to self-feeders twice a day, commencing the day following parturation, for a one hour period. As the pigs became older, the time was rapidly increased to two hours.

For all Trials. Except for a few instances, all sows and gilts were hand bred on the second and third day of heat. Exceptions to this practice were the result of various factors such as failure of some gilts to be in heat the third day, and too many females being in heat at a particular period for the number of boars available to service them.

On the 109th day of gestation, each individual was removed to a holding pen at the farrowing barn, and weather condition permitting, they were washed with warm water and soap. If the weather was inclement, they were brushed only. While the individuals were held in the holding pen, their udders were examined, twice daily, for the presence of milk which was used as the sign of impending parturition. At such time, they were confined to the farrowing crate. On the day of farrow, water was provided but no feed. Although confined to the crate with her litter, the sow was removed twice daily for feed, water and exercise.

As soon as the pigs were born, or shortly thereafter, their umbilical cord was immersed in a five percent tincture of iodine solution. This was repeated within 24 hours. In all other trials, except one and two, a creep ration was placed before the pigs when the litter was three to five days old. Small feeders approximately two and one-half inches deep were used to place the creep ration in, with an additional pan provided to supply water as shown in Figure 1. Up to the age of two weeks, or until the litters were moved to pasture, not more than a pound of creep and only a limited amount of water was placed before the litter at a time. However, both pans were emptied frequently and fresh feed and water added as required. Thereafter, the creep ration was self-fed, as illustrated in Figures 2 and 3.

Boar pigs were castrated at three to four weeks and all pigs immunized for cholera at six to seven weeks of age.

COLLECTION OF DATA

The traits receiving major consideration in the studies were changes in weight and condition during the gestation and lactation period, number of pigs and number of live pigs farrowed, weight of the pigs at birth, causes of post natal deaths, and the size and weight of litters weaned.

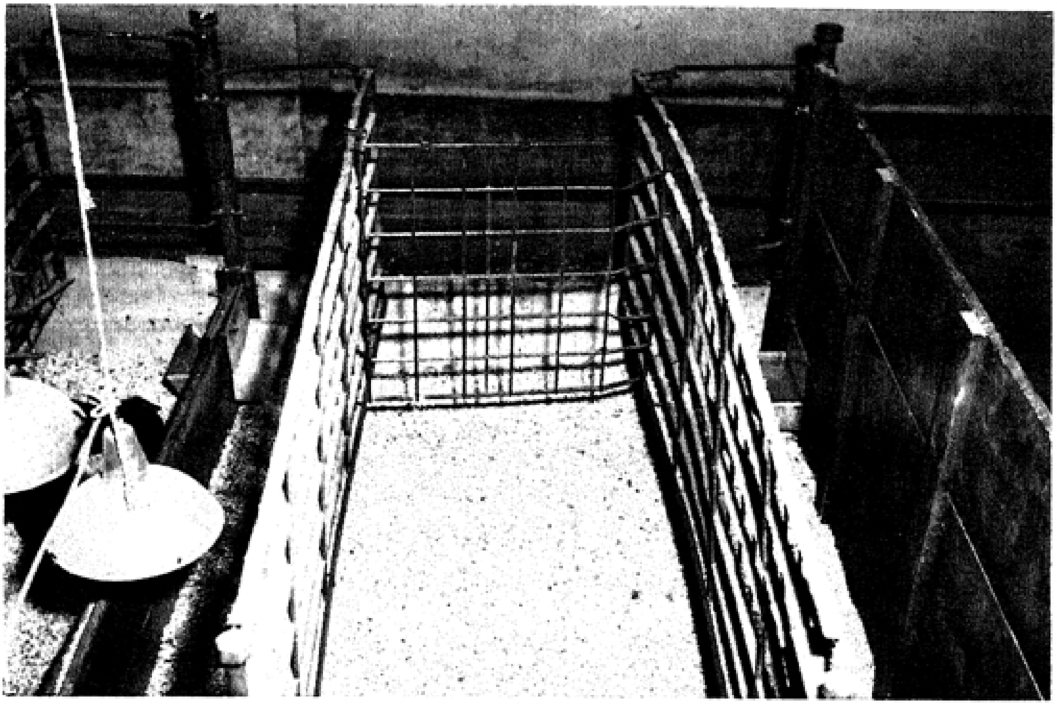

Fig. 1—Locating creep feed and water along the side of the crate and as far to the rear as possible was satisfactory.

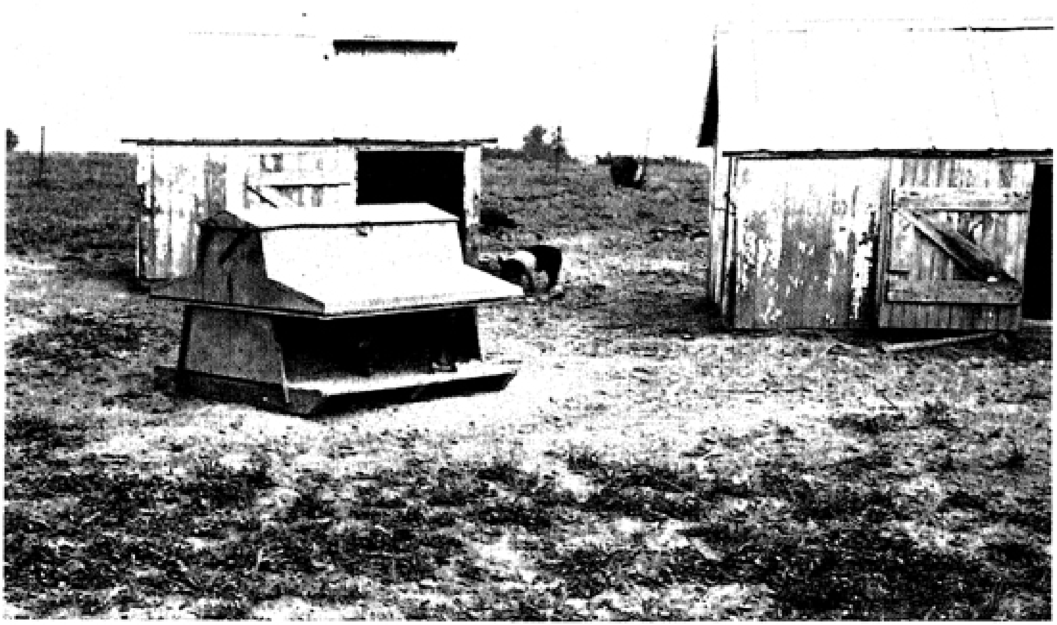

Fig. 2—An excellent creep feeder on pasture.

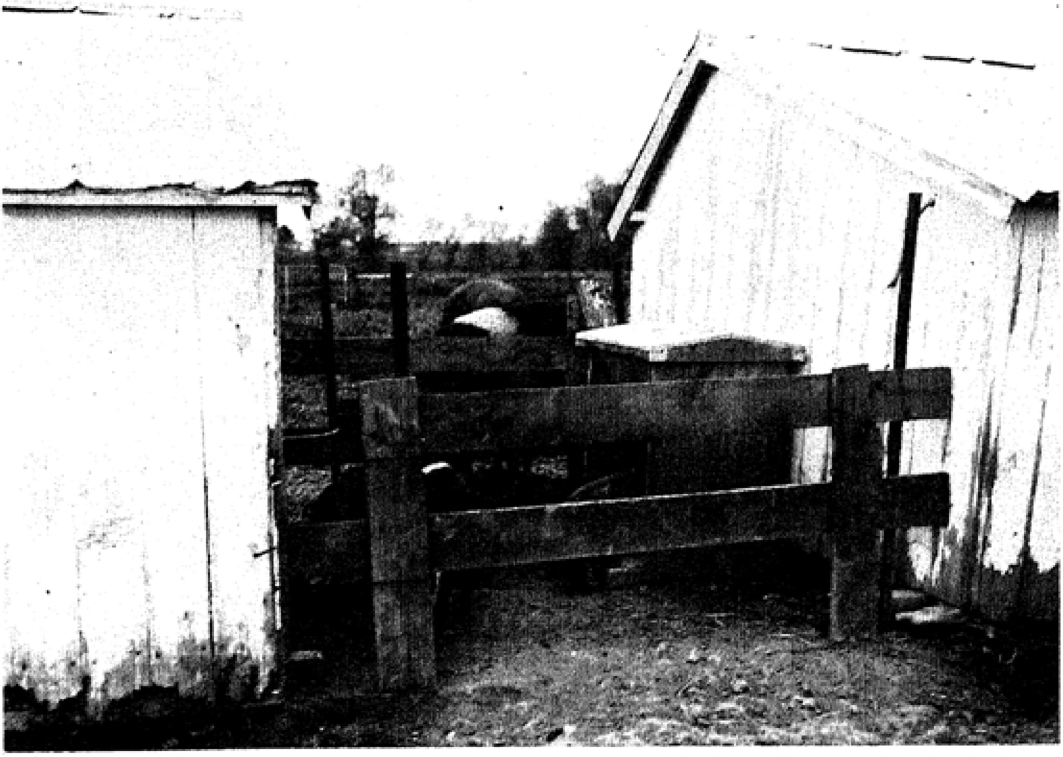

Fig. 3—Another type of creep feeder in an excellent location—adjacent to the sleeping quarters.

Weights of the sows were taken at breeding, at two week intervals thereafter during gestation, on the 109th day of gestation, within 24 hours after parturition, and again at weaning time. The pigs were weighed at birth and again at weaning.

The effect of the feeding level during gestation on the condition of the sow and her subsequent performance was studied, using the backfat probe technique developed by Hazel *et al.* (1952) Probes were taken at breeding, 109th day of gestation and at weaning. Measurement of backfat thickness was taken to the nearest tenth of an inch and converted to millimeters. Small incisions were made with a scalpel through the skin over the animal's back and a narrow metal ruler was pressed through the layer of fat to the firm tissue underneath. The ruler was marked by a sliding metal clip, then withdrawn and the measurement read.

Three measurements were taken on each individual about 1.5 inches off the midline of the body, immediately behind the shoulders, over the loin, and over the rump.

Within 24 hours of farrow, the pigs were individually ear notched, weighed, sex noted, and the data recorded. Observations were made on the health of the pigs throughout the lactation period. In the case of deaths, the cause was noted or determined by autopsy at the School of Veterinary Medicine.

Composition and constituents of the sow's lactation rations are shown in (Table V).

TABLE V-CONSTITUENTS AND PERCENTAGE COMPOSITION SOWS LACTATION RATIONS

Ingredients	Trial 2	Trial 5	Trial 7	Trial 8
Corn	80.5	79.077	82.75	79.0
Soybean Oil Meal	12.0	15.000	11.00	15.0
Tankage	6.0	------	-----	----
Meat and Bone	----	5.0	5.0	5.0
Salt	0.5	0.5	0.5	0.5
Limestone	0.3	0.2	0.3	0.2
Bone Meal	0.4	------	0.4	----
Vitamin A & D Supp.[1]	0.1	------	-----	0.1
Vitamin A Supp.[2]	----	0.023	-----	----
B Vitamin Supp.[3]	0.1	0.1	-----	0.1
B_{12} Supp.[4]	0.1	0.1	.05	0.1
TOTAL	100.0	100.000	100.00	100.0

1. Supplied 2,250 units of Vitamin A and 400 units of Vitamin D per gram of supplement.
2. Supplied 10,000 units of Vitamin A per gram of supplement.
3. Supplied 2 grams of riboflavin, 4 grams pantothenic acid, 9 grams niacin, 10 grams choline chloride, and .06 grams folic acid.
4. Supplied 10 milligrams of B_{12} per pound of supplement.

ANALYSIS OF DATA

Computation of chi-square for homogeneity of variance by Bartlett (1937) for different size samples was used to test the variance between trials for both sows and gilts.

Analysis of variance as introduced by Fisher (1923) was used to test the significance between trials, breeds, and treatment means for the different variables studied. Tables of significant differences utilized were those organized by Fisher and Yates (1953).

Calculations of 'students' t-test and its distribution as discovered by Gossett (1908) and perfected by Fisher (1924) was applied to the standard error of the difference of means for the length of gestation of the two breeds.

The straight line functional relationship between the variables was determined by the least squares method as outlined by Ezekiel (1956). Curvilinear functions between variables were also determined by methods of Ezekiel (1956).

RESULTS AND DISCUSSION

Effect on Change in Weight During Gestation. The weight changes during gestation for gilts and sows are shown in Tables VI and VII. The limited-fed sows and gilts were fed to gain slightly more than one half the rate of gain of the normal-fed groups. Limited-fed gilts gained an average of 66 to 78 pounds

TABLE VI-WEIGHT CHANGES DURING GESTATION--GILTS

Lot Treatment*	First Month 1 Normal	 2 Limited	Breeding to 109th Day 1 Normal	 2 Limited
Trial 1				
a) Durocs	39	22	136	76
b) Hampshires	29	18	104	60
Average	33	20	116	66
Trial 3				
a) Durocs	33	18	131	88
b) Hampshires	29	14	123	61
Average	31	16	127	75
Trial 4				
a) Durocs	37	27	146	94
b) Hampshires	29	16	114	68
Average	31	18	123	75
Trial 6				
a) Durocs	45	17	135	95
b) Hampshires	35	32	115	70
Average	38	27	121	78

*Normal and limited represents the different planes of feeding.

TABLE VII-WEIGHT CHANGE DURING GESTATION--SOWS

Lot Treatment	First Month 1 Normal	 2 Limited	Breeding to 109th Day 1 Normal	 2 Limited
Trial 2				
a) Durocs	1	14	85	73
b) Hampshires	29	20	111	67
Average	25	18	108	69
Trial 5				
a) Durocs	--	--	122	94
b) Hampshires	--	--	103	89
Average	--	--	109	90
Trial 7				
a) Durocs	29	-16	107	54
b) Hampshires	15	- 8	101	55
Average	19	-11	103	55

Lot Treatment[1]	First Month 1 Nor.	 2 Inter.	 3 Ltd.	Breeding to 109th Day 1 Nor.	 2 Inter.	 3 Ltd.
Trial 8						
a) Durocs	0	9	- 7	101	66	51
b) Hampshires	18	16	25	101	77	53
Average	11	14	13	101	73	52

1. Nor = Normal, Inter. = Intermediate, and LTD. = Limited, for the different planes of feeding.

during the gestation period for the various trials, compared to an average gain of 116 to 127 pounds made by normal-fed gilts. Sows were fed to make less total gains than gilts. Gains made by normal-fed sows averaged from 101 to 109 pounds, whereas the limited-fed sows gained an average of 52 to 90 pounds during gestation.

During the first month of gestation, normal-fed gilts gained at a rate of slightly more than a pound per day compared to a rate of approximately two-thirds pound for limited-fed gilts. With the exception of one trial, comparable rates of gain were made by normal and limited-fed sows. The one exception being Trial 7, in which the ration of the limited-fed sows was restricted to the point that the sows lost weight during the first month of gestation.

There was a tendency for Durocs to make greater gains than Hampshires, paricularily the gilts. This tendency, although to a lesser extent, was also true for gains made by the sows. However, this tendency could be expected since the Durocs were generally the "boss" sows at the feed trough. Approximately fifty percent additional feeder space was provided limited-fed groups to partially insure that individuals could secure their share of the ration.

Effect on Condition During Gestation. Changes in backfat probe by breeds, lots, and trials for gilts and sows are shown in Tables VIII and IX. In all trials, normal-fed gilts gained backfat during gestation, with an average gain of one to 16 millimeters for the different trials. The limited-fed gilts lost backfat during gestation in three of the four trials. Average losses were four to five millimeters. In Trial 4 the limited-fed gilts gained an average of one millimeter of backfat during gestation. Normal-fed gilts had approximately one-half inch more backfat at farrowing than limited-fed gilts.

TABLE VIII-CHANGE IN BACKFAT PROBE (MILLIMETERS) DURING GESTATION--GILTS

Lot	1				2			
Treatment	Normal				Limited			
Probe[1]	Shld	Loin	Rump	Avg.	Shld	Loin	Rump	Avg.
Trial 1								
a) Durocs	+15	+15	+12	+14	+ 1	- 3	- 6	- 3
b) Hampshires	+10	+ 5	+ 4	+ 6	- 5	- 4	- 4	- 4
Average	+12	+ 9	+ 7	+ 9	- 3	- 4	- 5	- 4
Trial 3								
a) Durocs	0	- 3	- 1	- 1	- 6	- 3	- 4	- 4
b) Hampshires	+ 7	+ 1	+ 2	+ 3	- 9	- 3	- 4	- 5
Average	+ 4	- 1	0	+ 1	- 7	- 3	- 4	- 5
Trial 4								
a) Durocs	+26	+15	+12	+19	+17	+ 3	+ 7	+ 9
b) Hampshires	+24	+10	+10	+15	- 5	- 3	+ 1	- 2
Average	+25	+11	+10	+16	+ 1	- 1	+ 3	+ 1
Trial 6								
a) Durocs	+15	+ 2	+ 3	+ 7	-13	- 9	- 5	- 9
b) Hampshires	+14	+ 9	+ 2	+ 8	- 4	- 1	- 3	- 3
Average	+14	+ 7	+ 2	+ 8	- 7	- 4	- 3	- 5

1 Shld = Shoulder, and Avg. = Average of the three probes. Normal and limited represent the different planes of feeding.

TABLE IX-CHANGE IN BACKFAT PROBE (MILLIMETERS) DURING GESTATION--SOWS

Lot	1				2			
Treatment	Normal				Limited			
Probe	Shld	Loin	Rump	Avg.	Shld	Loin	Rump	Avg.
Trial 2								
a) Durocs	+ 8	+ 3	+7	+6	-6	0	0	-2
b) Hampshires	+ 8	+ 1	+1	+3	+1	0	-3	-1
Average	+ 8	+ 1	+2	+4	-2	0	-2	-1
Trial 5								
a) Durocs	+13	0	+5	+6	+15	+8	+11	+11
b) Hampshires	+21	+ 6	+4	+10	+10	+3	+3	+5
Average	+18	+ 4	+4	+9	+12	+4	+5	+7
Trial 7								
a) Durocs	+19	+ 8	+1	+9	-7	-5	-4	-6
b) Hampshires	+10	+ 4	+1	+6	-2	-2	-3	-2
Average	+13	+ 5	+1	+6	-2	-2	-3	-2

	Normal				Intermediate				Limited			
	Shld	Ln	Rp	Avg.	Shld	Ln	Rp	Avg.	Shld	Ln	Rp	Avg.
Trial 8												
a) Durocs	+16	+13	+10	+13	-2	-1	+6	+1	+ 5	-1	+3	+2
b) Hampshires	+23	+ 7	+ 3	+11	+9	+6	+4	+6	+14	+1	+5	+7
Average	+20	+ 9	+ 6	+12	+5	+4	+5	+4	+11	0	+4	+5

Shld = Shoulder, Ln = Loin, Rp = Rump, and Avg. = Average of the three probes.
Normal and limited represents the different planes of feeding.

Limited-fed sows made only slight changes in backfat thickness during gestation. In two trials, they lost an average of one to two millimeters, whereas in the other two trials they gained five to seven millimeters of backfat during gestation. Average gains of four to 12 millimeters in backfat thickness were made by normal-fed sows.

The changes in backfat made by normal-fed sows during gestation were comparable to changes in backfat thickness made by normal fed gilts. However, limited-fed sows tended to maintain backfat thickness, whereas limited-fed gilts tended to lose backfat during gestation, Perhaps, because most trials with sows were conducted on pasture, whereas the trials with gilts were conducted in dry lot. Being on pasture, the consumption of grass by limited fed sows partially offset the effect of the reduction in concentrates fed.

In those trials where the sows were on pasture during gestation the amount of grass consumed appeared to be inversely related to the amount of concentrates fed. This is illustrated in Figure 4, which shows a rank growth of grass in the lot pastured by the normal-fed group compared to the scant growth in the limited-fed lot.

Effect on Performance at Farrowing. In all trials, larger litters were farrowed by limited-fed gilts than by normal-fed gilts as shown in Table X. Statistically, the size of the litter farrowed was not significantly greater for limited-fed gilts than for normal-fed gilts in Trials 1, 4, and 6 as indicated by analysis of variance

Fig. 4—Limited-fed sows during gestation, on the left, consumed more grass than the more liberal-fed group on the right.

Table XI. The analysis indicated a significant interaction between breeds and rations. The average size of the litter farrowed by Durocs in two of the three trials did vary more between feed-level groups than for Hampshires; however, this difference could be a reflection on the curvilinear relationship obtained for total gain during gestation and the number of pigs farrowed. In these same two trials, the Durocs were also the "bosses" at the feed trough and undoubtedly ate more than their share of the ration. Thus, the large gains of 140 to 150 pounds made by the Durocs in the normal-feed group, and the smaller litters farrowed by them, would be indicative of the aggressiveness of the Durocs in these experiments. Since a different ration (complete feed) was used in Trial 3 than in the other three trials with gilts, this trial was not included in the analysis of variance calculations.

Before computing the analysis of variance, computation of the test for homogeneity of variance for samples differing in size was applied to the average size of litters farrowed and weaned for the different trials with both sows and gilts. Corrected Chi-square values obtained for size of litter farrowed were 1.21 and .758, each with three degrees of freedom for gilts and sows, respectively. For

TABLE X-EFFECT OF LEVEL OF FEEDING DURING GESTATION ON FARROWING AND WEANING RESULTS OF GILTS

Trials	1		3*		4		6	
Lots	1	2	1	2	1	2	1	2
Treatments	Nor	Ltd	Nor	Ltd	Nor	Ltd	Nor	Ltd
Number in Lot	8	8	8	8	7	7	7	6
Avg. No. Pigs Farrowed	8	9.87	8	8.1	6.86	7.57	9.4	9.8
Avg. Birth Weight (lbs)	2.6	2.6	2.95	2.72	3.04	2.75	2.47	2.59
Avg. No. Pigs Weaned	4.4	6.8	6.87	5.87	3.57	5.3	4.8	5.0
Avg. Weaning Weight (lbs)**	23.3	21.8	39.9	38.7	29.4	27.9	28.2	30.2
Percentage Weaned	55.0	69.6	85.9	72.3	52.0	70.0	51.5	50.8

* Gilts were fed a complete mixed feed (15% protein) in this trial.

** Weaning weights were converted as follows: Trial 1 to 42 day weights, Trial 4 to 49 day weights, and Trials 3 and 6 to 56 day weights.

Nor = Normal, Ltd = Limited, which represent the different planes of feeding. Avg. = Average

TABLE XI-ANALYSIS OF VARIANCE NUMBER OF PIGS FARROWED BY GILTS[1]

Source	Degrees Freedom	Sum of Squares	Mean Squares	F Ratio
Total	42	330.47	------	------
Trials	2	42.10	21.05	3.1 NS
Breeds	1	1.21	1.21	.18 NS
Rations	1	10.84	10.84	1.59 NS
T x B	2	4.42	2.21	.33 NS
T x R	2	5.53	2.765	.41 NS
B x R	1	29.77	29.77	4. 378 *
T x B x R	2	25.90	12.95	1.90 NS
Error	31	210.70	6.8	

1. Three trials conducted, with the amount of shelled corn fed during gestation being the only variable between rations fed normal and limited fed groups.
* Probability $< .05$.
NS = Not Significant.

size of litter weaned, the corrected Chi-square values were 2.158 for gilts and .75 for sows, each with three degrees of freedom. All corrected Chi-square values were not significant.

The advantage in size of litters farrowed by limited-fed gilts over normal-fed gilts averaged from 0.1 to 1.8 pigs per liter for the different trials.

The average size of litters farrowed, for all four trials combined, was 8.83 for limited-fed gilts compared to 8.07 for normal-fed gilts. This amounts to a 9.4 percent increase in size of litters farrowed by limited-fed over normal-fed gilts.

Advantages in the average litter size farrowed by sows, between feed-level groups, were inconsistent for the four trials (Table XII). Larger litters were farrowed by limited-fed sows in two of the four trials, whereas normal-fed sows farrowed larger litters in the other two trials. Analysis of variance (Table XIII) for number of pigs farrowed by normal and limited-fed sows indicated that the size of litter farrowed was not significantly affected by the level of feeding. An average of 10.1 pigs was farrowed by normal-fed sows in the four trials, compared to an average of 10.2 pigs, farrowed by limited-fed sows. A greater percentage of pigs, farrowed by limited-fed sows and gilts, were alive at birth than for normal-fed groups; with six and four percent more of the pigs alive at birth for limited-fed sows and gilts, respectively.

Although a record was not kept of the assistance given individual sows and gilts during parturition, it was observed that sows and gilts in the normal fed groups required more assistance than those in limited fed groups.

Average birth weights were slightly larger for pigs farrowed by normal-fed gilts, although in Trial 6 birth weights of pigs were greater for pigs farrowed by limited-fed gilts. Advantages in birth weights of pigs farrowed by normal-fed gilts varied from -0.12 to +0.25 pound. It is possible that a part of the difference in birth weights is explained by the difference in size of litter farrowed. Correlation analysis (Table XIV) indicated a significant negative relationship ($r = -.405$, $P < .01$) between size of litter farrowed and average birth weight of pigs farrowed.

TABLE XII-EFFECT OF LEVEL OF FEEDING DURING GESTATION ON FARROWING AND WEANING RESULTS OF SOWS

Trials	2*		5		7		8		
Lots	1	2	1	2	1	2	1	2	3
Treatment	Nor	Ltd	Nor	Ltd	Nor	Ltd	Nor	Inter	Ltd
Number in Lot	7	8	3	3	10	9	8	8	8
Avg. No. Pigs Farrowed	10.1	9.5	9.3	12.7	9.1	9.5	11.5	7.75	10.63
Avg. Birth Wt. (lbs)	2.93	2.84	2.9	2.48	2.86	3.09	3.18	3.07	2.61
Avg. No. Pigs Weaned	5.71	7.62	4.3	9.3	5.3	5.6	8.1	6.0	7.5
Avg. Weaning Wt. (lbs)**	34.2	34.0	26.4	26.1	45.5	39.0	42.13	41.29	39.46
Percentage Weaned	56.4	60.3	47.0	71.7	58.2	58.9	70.7	77.4	70.6

* Sows in this trial were fed a complete mixed feed (15% protein).

** Weaning weights were converted as follows: Trials 2, 7 and 8 to 56 day weights, and Trial 5 to 49 days.

Nor = Normal, Ltd = Limited, representing different planes of feeding. Avg = Average, No. = Number, and Wt. = Weight.

TABLE XIII-ANALYSIS OF VARIANCE NUMBER OF PIGS FARROWED BY SOWS

Source	Degrees Freedom	Sum of Squares	Mean Squares	F Ratio
Total	55	440.13	-----	-----
Trials	3	32.68	10.89	1.20 NS
Breeds	1	2.71	2.71	.30 NS
Rations	1	.86	.86	.09 NS
T x B	3	7.39	2.46	.27 NS
T x R	3	21.39	7.13	.78 NS
B x R	1	3.93	3.93	.43 NS
T x B x R	3	7.03	2.34	
Error	40	364.14	9.104	

NS = Not Significant.

TABLE XIV-CORRELATION BETWEEN FACTORS OF PERFORMANCE AND LITTER SIZE AT BIRTH[1]

X	Gilts Coefficient of Correlation	Gilts Regression Coefficient	Sows Coefficient of Correlation	Sows Regression Coefficient
1. Gain in Weight First Month	-.05475	-.0112	+.0867	+.0128
2. Gain in Weight Breeding to 109th day	-.077	-.0064	+.2444	+.0223
3. Change Backfat Probe Breeding to 109th day (Shoulder)	-.344**	-.0691	+.055	+.0120
4. Change Backfat Probe Breeding to 109th day (Loin)	-.285*	-.0934	+.147	+.0609
5. Change Backfat Probe Breeding to 109th day (Rump)	-.443**	-.2067	+.173	+.0859
6. Change Backfat Probe Breeding to 109th day (Average)	-.306*	-.0932	+.1204	+.0452
7. Number Live Pigs Farrowed	+.824**	+.8455	+.64**	+.78
8. Average Birth Weight[2]	-.405**	-.079	-.2965*	-.0366
9. Average Size Litter Weaned[2]	+.588**	+.5586	+.563**	+.507

1. Litter size at birth = y for factor 1 through 6.
2. Litter size at birth = x for factors 7, 8, and 9.

* Probability < .05.

** Probability < .01.

These birth weights for the different feed-level groups closely paralleled the results secured by Terrill *et al.* (1957) for their 4.5 and 6 pounds feeding levels.

Correlations between various factors of performance and size of litter farrowed are shown in Table XIV. Significant negative relationships were found between changes in backfat probe from breeding to the 109th day at the shoulder, loin, rump, and the average of the three probes and the size of the litter farrowed by gilts. However, positive relationships were found between these same factors and the size of the litter farrowed by sows, but the values obtained were not statistically significant. The correlation values obtained for the relationship between the changes in backfat probe at each of the three locations and the size of litter farrowed by gilts indicated a closer relationship between the change in backfat probe at each of the three locations and the size of litter farrowed by gilts indicated a closer relationship between the change in backfat probe at the rump than for the change in backfat at either of the other two probes. A correlation value ($r = -.443$, $P < .01$) was obtained between the change in backfat at the loin and the number of pigs farrowed. For the other two relationships, an intermediate correlation value ($r = -.344$, $P < .01$) was obtained for the change in backfat at the loin and the number of pigs farrowed. A graphic illustration of the relationship between the changes in backfat probe and the number of pigs farrowed by gilts is shown in Figure 5. The positive, non-significant, correlation values obtained for the relationship between changes in backfat probe at the three locations and the number of pigs farrowed by sows; indicated the highest, intermediate and least relationship for the change in backfat probe at the rump, loin, and shoulder, respectively.

The difference in relationship between the changes in backfat probes and the number of pigs farrowed for sows and gilts would tend to indicate that the presence of fat itself is not the underlying cause for reducing the number of pigs farrowed. However, the higher negative correlation for the backfat change at the rump and the number of pigs farrowed by gilts would tend to favor this opinion. The fact that a hog tends to finish from anterior to posterior and then dorsally to ventrally would also support this theory since the change in backfat at the rump would more closely follow the change in condition which would occur dorsally to ventrally within the posterior body compartment. The fact that the change in backfat at the other locations is related to the number of pigs farrowed may be due only to the association with the change in backfat at the rump.

Since the factors affecting reproduction are so numerous and interrelated, definite conclusions cannot be drawn from these results; however, the difference found for sows and gilts for the relationship between changes in backfat and the number of pigs farrowed does suggest a possible explanation for this phenomenon. Due to the competition between true growth and reproduction, the immature gilt fed to grow and fatten at an optimum physiological level would not be functioning physiologically at the optimum level for reproduction. Thus, reducing the level of energy fed below a certain point which would reduce the rate of growth below the optimum level, would reduce the competitive relationship and result in increased reproductive performance of gilts. Even though the sow would tend to fatten, being mature, she would tend to make little true growth; thus, the competitive relationship between true growth and reproduction would not be as great in the sow as in the gilt. Thus, the changes in backfat, although not true growth, would merely be an indication of the level of true growth being made by the gilt and would reflect upon the reproductive performance. It is also possible that if the mature animal was fed to fatten at or near an optimum physiological level there might be competition with reproductive performance. The antagonism could result between competition for certain nutrients such as protein, or vitamins, or it could result from a competition in

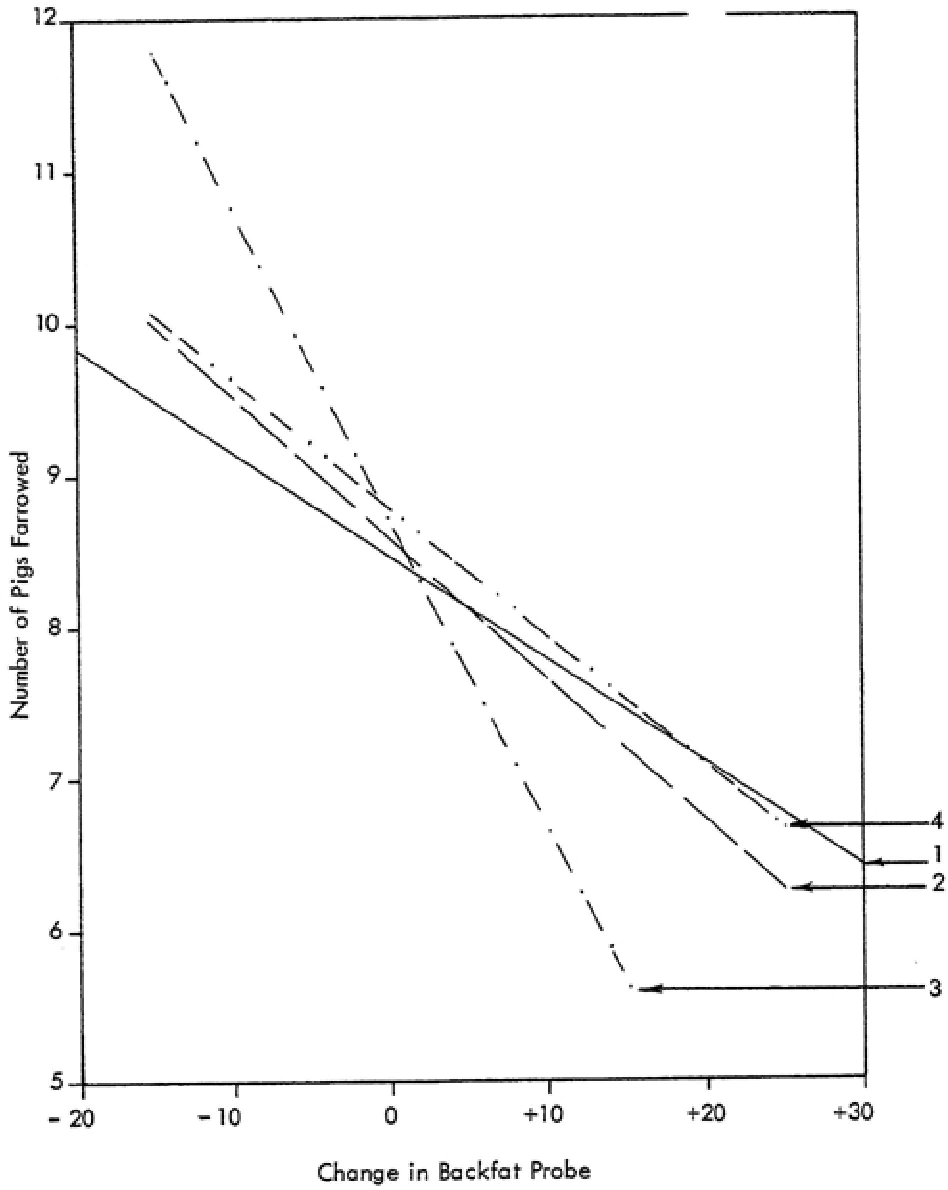

FIGURE 5 RELATIONSHIP BETWEEN GAIN OR LOSS IN BACKFAT PROBE FROM BREEDING TO 109th DAY AND NUMBER OF PIGS FARROWED

1. Change in Backfat at Shoulder $y = 8.47 + (-.069)x$
2. Change in Backfat at Loin $y = 8.61 + (-.0934)x$
3. Change in Backfat at Rump $y = 8.70 + (-.2067)x$
4. Change in Backfat Overall $y = 8.69 + (-.0932)x$

the synthesis and utilization of certain hormones.

Results secured by some scientists including Hogan *et al.* (1927), McKenzie (1928), Donald *et al.* (1938), and Stewart (1945) indicated a relationship between weight gained the first four weeks after breeding and the size of the litter farrowed. Another factor of performance, total gain made during gestation, was found by McKenzie (1928), Zeller *et al.* (1937) and Stewart (1945) to be related to the number of pigs farrowed. Correlation analysis between each of these performance factors and the size of litter farrowed in these trials indicated a non-significant relationship as shown in Table XIV. Although a positive, non-significant, correlation was obtained for both factors of performance and size of litter farrowed by sows, a negative non-significant relationship for each factor was obtained for gilts.

When all trials with gilts were combined, and the gilts grouped according to gain in weight from breeding to 109th day of gestation, best reproductive performance as to size of litter farrowed and weaned (Table XV) was made by those gilts gaining from 80 to 99 pounds. Gilts gaining from 60 to 79 pounds during gestation farrowed 1.5 fewer pigs; however, they weaned an average of only 0.2 of a pig less than the above group. Gilts gaining from 40 to 60 and from 100 to 140 pounds weaned 10 to 20 percent fewer pigs than those gaining from 80 to 100 pounds.

A graphic illustration of the relationship between the gain in weight during gestation and the number of pigs farrowed by gilts is shown in Figure 6. Although the straight line relationship between gain in weight during gestation and number of pigs farrowed was not significant, the analysis of variance (Table XVI) indicated a significant curvilinear relationship between the same two factors when the gilts were grouped by gain in weight during gestation as done in Table XVI. Other workers including Hogan *et al.* (1927), McKenzie (1928), Zeller *et al.* (1937), Donald *et al.* (1938), and Stewart (1945), have indicated a relationship between gain in weight during gestation and the number of pigs farrowed. However, none of these reports indicated that the relationship was curvilinear.

Length of gestation was not affected by treatment, although a significant difference was found between breeds. A frequency distribution for the length of gestation for Hampshires and Durocs is shown in Table XVII. A mean of 112.95 days ± 1.256 was determined for Hampshires and 114.6 days ± 1.285 for the length of gestation for Durocs. The distribution of "t" indicated a probability of less than .001 for the standard error of the difference of means for the two breeds. Similar results for variation in length of gestation by different breeds was reported by Carmichael *et al.* (1920).

Effect on Feed Consumption During Lactation. Both sows and gilts fed a limited ration during gestation tended to eat more feed when self-fed during lactation than those fed a normal level of feed. Average feed consumption of gilts and sows during gestation and lactation and creep consumption of pigs is shown in Tables XVIII and XIX. Average results indicated that limited-fed sows and gilts consumed 221 pounds less feed during gestation, whereas normal-fed sows and gilts consumed 65 pounds less feed during lactation. The overall average feed consumption for both gestation and lactation was 156 pounds less for the limited-fed sows and gilts.

TABLE XV-REPRODUCTIVE PERFORMANCE OF ALL GILTS ACCORDING TO GAIN IN WEIGHT FROM BREEDING TO 109th DAY OF GESTATION

Number of Gilts	Gain in Weight Breeding to 109th Day	Average Size Litter Farrowed	Average Size Litter Weaned
1	20 to 39 lbs.	4.00	4.00
8	40 to 59 lbs.	8.75	4.88
7	60 to 79 lbs.	8.00	6.00
14	80 to 99 lbs.	9.50	6.20
12	100 to 119 lbs.	8.60	4.90
11	120 to 139 lbs.	8.30	5.50
4	140 to 159 lbs.	7.25	4.25

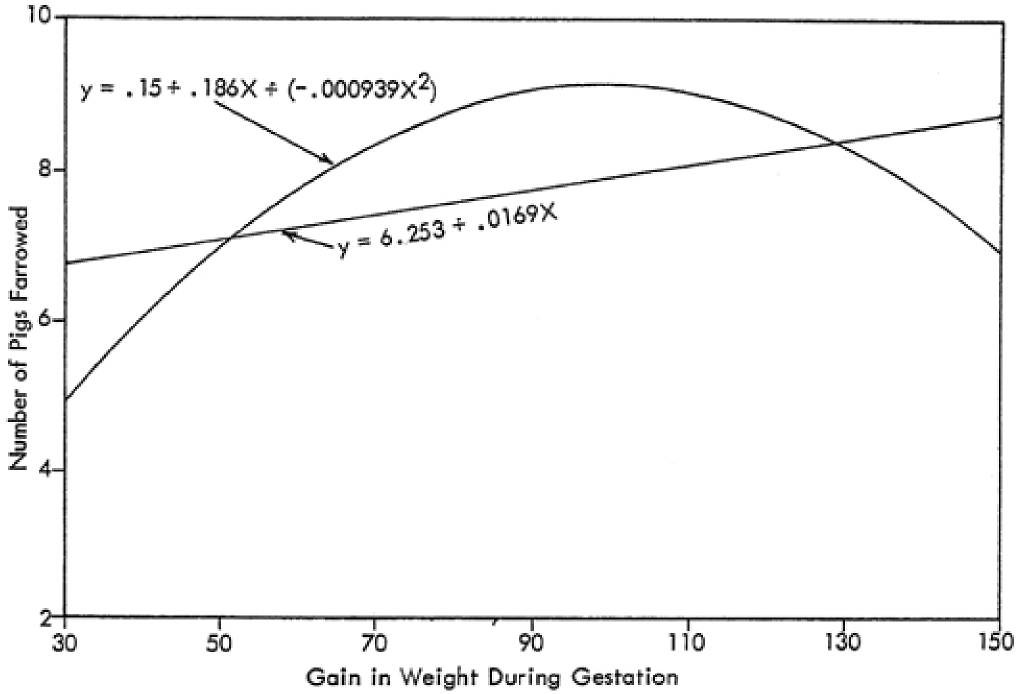

FIGURE 6 RELATIONSHIP GAIN IN WEIGHT DURING GESTATION AND NUMBER OF PIGS FARROWED

TABLE XVI-ANALYSIS OF VARIANCE GAIN IN WEIGHT BY GILTS AND NUMBER PIGS FARROWED

Source	Degrees Freedom	Sum of Squares	Mean Squares	F Ratio
Total	6	19.46	3.24	------
Due to Linear Regression	1	3.196	3.196	2.8923
Due to Quadratic Regression	1	11.842	11.842	10.7167*
Deviation from Quadratic Regression	4	4.422	1.105	

* Probability < .05.

TABLE XVII-LENGTH OF GESTATION FOR HAMPSHIRE AND DUROC SOWS AND GILTS

Day	Hampshires	Durocs
110	3	----
111	7	----
112	18	1
113	25	5
114	22	14
115	6	10
116	1	6
117	----	----
118	----	2
Mean	112.95	114.6
Standard deviation	$\pm$1.256	$\pm$1.285

TABLE XVIII-AVERAGE FEED CONSUMPTION OF GILTS DURING GESTATION AND LACTATION AND CREEP CONSUMPTION OF PIGS*

Trial	1		3		4		6	
Lot	1	2	1	2	1	2	1	2
Treatment	Nor	Ltd	Nor	Ltd	Nor	Ltd	Nor	Ltd
Gilts (per head)								
a) Breeding to 109th day								
Shelled Corn (lbs)	545	327	---	---	514	306	545	327
Supplement (lbs)	136	136	---	---	136	136	136	136
Gestation Ration (lbs)	---	---	654	436	---	---	---	---
b) 109th day to weaning								
bran (lbs)	8	8	7	7	8	8	8	7
Lactation Ration (lbs)	490	559	605	651	607	697	640	700
PIGS (per pig)**								
Creep (lbs)	7.1	4.9	20.5	17.4	6.4	5.8	10.8	12.5

* All trials were conducted in dry lot during gestation during the winter with the exception that Trial 4 was conducted during the summer. During lactation, gilts and litters in Trial 1 were pastured on bluegrass, in Trials 3 and 6 on red clover, and in Trial 4 were kept on concrete until weaning.

** Weaning ages were as follows: Trial 1, six weeks; Trials 3 and 6, eight weeks; and Trial 4, seven weeks.

Nor = Normal, Ltd = limited, representing the different planes of feeding during gestation.

Gain or Loss of Weight During Lactation. In all trials, gilts which had been limited-fed during gestation, gained weight during lactation; by comparison normal-fed gilts lost weight in three of the four trials (Table XX). Normal and limited-fed sows lost weight during lactation in two trials and gained weight in the other two trials (Table XXI). During the lactation period limited-fed gilts gained 27 pounds and limited-fed sows gained 17 pounds more than normal-fed groups. Since normal-fed groups had gained more weight during gestation, the overall change in weight from breeding to weaning resulted in the normal-fed gilts being 30 pounds heavier and normal-fed sows 20 pounds heavier at weaning than the respective limited-fed groups.

TABLE XIX-AVERAGE FEED CONSUMPTION OF SOWS DURING GESTATION AND LACTATION AND CREEP CONSUMPTION OF PIGS*

Trial Lot Treatment	Nor	Ltd	Nor	Ltd	Nor	Ltd	Nor	Inter	Ltd
Sows (per head)									
a) Breeding to 109th day									
Shelled Corn (lbs)	---	---	436	218	545	316	436	327	218
Supplement (lbs)	---	---	109	109	136	136	82	82	82
Gestation Ration (lbs)	576	336	---	---	---	---	---	---	---
b) 109th day to weaning									
Bran (lbs)	7	7	8	8	8	8	8	8	8
Lactation Ration (lbs)	542	576	552	587	808	943	845	714	895
Pigs (per pig)**									
Creep (lbs)	13.4	12.6	4.5	5.6	18.1	15.1	25.1	31.4	18.8

* Sows in Trials 2 and 5 were pastured on bluegrass, in Trial 8 on red clover, during the gestation period in the summer, in Trial 7 they were in dry lot during the winter. During lactation sows and pigs in Trials 2, 7, and 8 were pastured on red clover, and in Trial 5 they were kept on concrete to weaning.

** Weaning ages were as follows: Trials 2, 7, and 8 were 56 days, and Trial 5 was 49 days.

Nor = Normal, Inter = Intermediate, Ltd = limited, representing the different planes of feeding during gestation.

TABLE XX-GAIN OR LOSS OF WEIGHT FARROWING TO WEANING--GILTS

Lot Treatment (during gestation)	1 Normal	2 Limited
Trial 1		
a) Durocs	+16	+23
b) Hampshires	-15	+22
Average	- 5	+22
Trial 3		
a) Durocs	-35	+30
b) Hampshires	-50	- 1
Average	-42	+19
Trial 4		
a) Durocs	- 9	- 8
b) Hampshires	- 3	+30
Average	- 5	+24
Trial 6		
a) Durocs	+54	+51
b) Hampshires	+51	+38
Average	+52	+43

Normal and Limited represent the different planes of feeding during gestation.

A negative relationship was determined for the change in weight during lactation and the size of litter weaned for both sows and gilts (Table XXII), although the values obtained were not significant.

Gain or Loss in Condition During Lactation. Normal-fed gilts lost an average of four to nine millimeters of backfat during lactation, whereas the gilts

TABLE XXI-GAIN OR LOSS OF WEIGHT FARROWING TO WEANING--SOWS

Lot Treatment (during gestation)	1 Normal		2 Limited
Trial 2			
a) Durocs	-26		+ 3
b) Hampshires	-32		-31
Average	-31		-18
Trial 5			
a) Durocs	+ 2		-18
b) Hampshires	-20		- 8
Average	-12		-11
Trial 7			
a) Durocs	+50		+80
b) Hampshires	+14		+49
Average	+26		+59
Lot Treatment	1 Nor	2 Inter	3 Ltd
Trial 8			
a) Durocs	+63	-12	+77
b) Hampshires	-16	+26	+10
Average	+13	+12	+35

Nor = Normal, Inter = Intermediate, Ltd = Limited representing the different planes of feeding during gestation.

TABLE XXII-CORRELATION BETWEEN SIZE OF LITTER WEANED AND FACTORS OF PERFORMANCE[1]

Y	Gilts Coefficient of Correlation	Gilts Regression Coefficient	Sows Coefficient of Correlation	Sows Regression Coefficient
1. Average Weight Pigs Weaned[2]	-.0536	-.134	-.2233	-.60
2. Gain or Loss in Weight Farrow to Weaning	-.15	-2.632	-.0368	-.73
3. Change Backfat Probe Farrow 4. to Weaning (Shoulder)	+.083	+.418	-.17	-.936
4. Change Backfat Probe Farrow to Weaning (Loin)	+.115	+.343	-.177	-.524
5. Change Backfat Probe Farrow to Weaning (Rump)	-.06	-.173	-.238	-.486
6. Change Backfat Probe Farrow to Weaning (Average of the three probes)	+.068	+.218	-.208	-.653

1. Size of litter weaned = x.
2. Weaning weights were all converted to 56 day weights for correlation analysis.

which were limited-fed during gestation, gained in backfat during lactation in three of the four trials (Table XXIII). An average of seven millimeters of backfat was lost during lactation by normal-fed gilts whereas the limited-fed gilts made an average gain in backfat for the four trials of one millimeter. A comparison of condition at weaning time for normal-fed gilts in all four trials showed a

TABLE XXIII-CHANGE IN BACKFAT PROBE (MILLIMETERS) DURING LACTATION--GILTS

Lot	1				2			
Treatment	Normal				Limited			
Probe	Shld	Loin	Rump	Avg.	Shld	Loin	Rump	Avg.
Trial 1								
a) Durocs	- 4	-12	-14	-10	+ 1	0	+4	+2
b) Hampshires	-13	- 8	- 5	- 9	+ 3	0	+3	+2
Average	-10	- 9	- 7	- 9	+ 2	0	+4	+2
Trial 3								
a) Durocs	-13	- 6	- 4	- 8	- 6	-1	-2	-3
b) Hampshires	-15	- 2	- 4	- 7	-12	-3	-5	-6
Average	-14	- 4	- 4	- 7	- 9	-2	-3	-4
Trial 4								
a) Durocs	-22	-14	- 4	-13	- 5	0	-3	-3
b) Hampshires	-16	- 3	+ 1	- 7	+ 7	+4	+1	+4
Average	-19	- 7	- 1	- 9	+ 5	+3	0	+3
Trial 6								
a) Durocs	-13	- 5	- 5	- 8	- 3	+1	-1	-1
b) Hampshires	- 5	- 4	0	- 3	+ 5	+6	+8	+6
Average	- 7	- 4	- 1	- 4	+ 3	+4	+5	+4

Shld = Shoulder, Avg = Average of the three probes.

Normal and Limited represents the different planes of feeding during gestation.

net gain of one millimeter of backfat over the condition at breeding time, whereas limited-fed gilts had lost two millimeters of backfat from breeding to weaning.

Sows, limited-fed during gestation, tended to maintain condition during lactation, whereas normal-fed sows tended to lose a little in condition (Table XXIV). Both limited and normal-fed sows made slight average increases in backfat thickness from breeding to weaning for the four trials. Average increases of one millimeter of backfat were made by limited-fed sows, whereas normal-fed sows made an average increase of five millimeters.

In general, those sows and gilts which gained condition during the gestation period, lost condition during the lactation period. Those which lost condition during gestation tended to gain backfat during the lactation period.

The coefficient of correlation values computed for the relationship between size of litter weaned and changes in backfat probes during lactation (Table XXII), were not significant for sows or gilts.

Performance of Litters. In three of the four trials with gilts no difference in strength of pigs was noted between pigs farrowed by different feed-level groups. However, pigs farrowed by limited-fed gilts in Trial 3 were weaker at birth than pigs from the normal-fed gilts. The results secured in Trial 3 could have been due to the ration fed. A complete mixed feed (15% protein) was fed to both groups and, therefore, the reduced ration fed limited-fed gilts constituted a reduction in protein, vitamins, and minerals, as well as energy. The limited-fed gilts received only four pounds per day of the complete feed, and as a result they

TABLE XXIV-CHANGE IN BACKFAT (MILLIMETERS) DURING LACTATION--SOWS

Lot	1				2			
Treatment	Normal				Limited			
Probe	Shld	Loin	Rump	Avg.	Shld	Loin	Rump	Avg.
Trial 2								
a) Durocs	- 5	-13	-2	-7	+5	+2	+1	+3
b) Hampshires	+ 1	+ 1	0	+1	-2	0	+1	0
Average	0	- 1	0	0	+1	+1	+1	+1
Trial 5								
a) Durocs	-10	+ 3	+5	+1	-10	-6	0	-5
b) Hampshires	+ 5	+ 5	+3	+4	-11	-1	+1	-4
Average	- 3	+ 4	+4	+3	-11	-3	+1	-4
Trial 7								
a) Durocs	- 8	- 2	0	-3	+4	-1	+1	+1
b) Hampshires	-11	- 5	0	-5	-2	0	+1	-1
Average	- 9	- 4	0	-5	0	0	+1	0

	1				2				3			
	Normal				Intermediate				Limited			
	Shld	Ln	Rp	Avg.	Shld	Ln	Rp	Avg.	Shld	Ln	Rp	Avg.
Trial 8												
a) Durocs	+17	+9	+6	+11	+1	+4	-2	+1	+10	+10	+9	+10
b) Hampshire	-15	-7	-1	- 7	+6	-1	+3	+3	- 7	- 3	-4	- 4
Average	+ 3	-7	-2	- 7	+4	+1	+1	+2	- 3	+ 2	+1	0

Shld = Shoulder, Ln = Lin, Rp = Rump, Avg. = Average of the three probes.
Normal, intermediate, and limited, represents the different planes of feeding during gestation.

received only .6 pound of protein compared to the National Research Council's recommendation of .9 pound. In the other three trials, an equal quantity of supplement was fed both feed-level groups. The quantity of supplement fed provided both groups with adequate protein, vitamins, and minerals, to meet the recommendations of the National Research Council.

The amount of the complete feed fed the sows in Trial 2 also did not provide the recommended protein allowance for the limited-fed group. However, they were fed or maintained on pasture during the gestation period. The additional nutrients supplied by the pasture apparently were sufficient to offset the deficiency in the limited concentrates fed.

With the exception of one trial each with sows and gilts, average birth weights were larger for the pigs farrowed by normal-fed groups. Since a significant negative correlation was obtained for average birth weight and litter size at birth for both sows and gilts (Table XIV), some of the difference in birth weight could be due to the size of the litter farrowed by gilts. However, it is not understood why the pigs farrowed by sows averaged heavier at birth, in three of the four trials, for the group which farrowed the larger litters at birth.

Significant, positive correlations (Table XIV) were determined between the litter size at birth and, (1) number of live pigs farrowed, and (2) the average size litter weaned. Only a slight variation was found between the coefficient of correlation values obtained for sows and gilts for the above factors.

Normal-fed gilts, in Trial 3, weaned a greater percentage of pigs farrowed and as a result weaned larger litters. This probably reflects back on the strength of the pigs at birth, since the limited-fed gilts, which had not received the recommended amount of protein during gestation, had farrowed weaker pigs. In the other three trials with gilts, in which only the amount of grain was limited, the limited-fed groups weaned significantly larger litters (Analysis of Variance, Table XXV).

TABLE XXV-ANALYSIS OF VARIANCE NUMBER OF PIGS WEANED BY GILTS[1]

Source	Degrees Freedom	Sum of Squares	Mean Squares	F Ratio
Total	42	238.98	------	------
Trials	2	10.88	5.44	1.04 NS
Breeds	1	.05	.05	.01 NS
Rations	1	25.38	25.38	4.865*
T x B	2	5.92	2.96	.57 NS
T x R	2	7.98	3.99	.76 NS
B x R	1	11.10	11.10	2.13 NS
T x B x R	2	15.93	7.965	1.53 NS
Error	31	161.74	5.217	

1. Three trials conducted, with the amount of shelled corn fed during gestation being the only variable between rations fed normal and limited fed groups.

* Probability .05.

NS = Not Significant.

In Trial 6, both groups of gilts weaned approximately the same percentage of pigs. However, in the other two trials the limited-fed gilts not only weaned larger litters but also weaned from 15 to 18 percent more of the pigs farrowed. These results were rather unusual since limited-fed gilts had also farrowed larger litters than the normal-fed gilts. From these results and the observation in Trial 4 that fewer pigs from limited-fed gilts were afflicted with joint infections, it was reasoned that pigs from limited-fed gilts could be more resistant to some stress factors.

Weaning results with sows were quite similar to the results with gilts, in that limited-fed sows weaned larger litters in three of the four trials, and weaned as large as or a greater percentage of their pigs farrowed in all four trials. However, in Trial 8, normal-fed sows weaned larger litters than the limited-fed sows. The size of the litter weaned was not significantly different between feed-level groups (Table XXVI) although there was a significant difference in size of litter weaned between trials. This difference in size of litter weaned is mainly due to the larger litters weaned by both feed-level groups in Trial 8. Some of this difference is attributed to the fact that all sows in all feed-level groups in Trial 8 were fed antibiotics at breeding. Results of Dean *et al.* (1960) indicate that sows receiving high level antibiotics at breeding farrow, and wean, larger litters than control sows.

The farrowing and weaning results of the sows fed the intermediate level

TABLE XXVI-ANALYSIS OF VARIANCE NUMBER OF PIGS WEANED BY SOWS

Source	Degrees Freedom	Sum of Squares	Mean Squares	F Ratio
Total	55	357.13	-----	------
Trials	3	48.19	16.06	3.1288*
Breeds	1	11.31	11.31	2.20 NS
Rations	1	15.02	15.02	2.93 NS
T x B	3	6.76	2.253	.44 NS
T x R	3	38.31	12.77	2.49 NS
B x R	1	14.82	14.82	2.89 NS
T x B x R	3	17.40	5.80	1.13 NS
Error	40	205.32	5.133	

* Probability < .05.
NS = Not significant.

during gestation in Trial 8 were not as satisfactory as the results secured from either the normal or limited-fed groups. Since these results are not understood, no explanation for them is offered.

With the exception of Trial 6 with gilts, the weaning weights were all larger for the pigs from normal-fed than for those from limited-fed sows and gilts. Weaning weights tended to be greater for the feed-level groups which farrowed larger pigs. Pigs farrowed by limited-fed gilts were heavier at birth, in Trial 6. This may explain why they were also heavier at weaning. Average weaning weights for all four trials favored pigs from normal-fed gilts by 0.55 pound and pigs from normal fed sows by 2.4 pounds.

Average creep consumption per pig for the different trials is shown in Table XVIII and XIX. Since the pigs were weaned at different ages, no comparison of the amounts consumed can be made between trials. However, it is evident that the heavier weaning pigs also ate more creep feed. Considering the above data and the data on birth and weaning weights, it is possible that pigs were larger at weaning because they were heavier at birth and, therefore, had the capacity to consume more creep to grow faster.

Some of the difference in amount of creep eaten was due to the difference in ages of the pigs weaned. In addition, some of the increased creep consumption in the later trials was probably due to: (1) a more palatable creep ration; (2) making the creep and water available to the pigs at an earlier age. In the early trials, the creep and water was offered to the pigs at 10 to 14 days of age, or at the time they were moved to pasture. In later trials, the creep feed and water were offered to the pigs by the time they were three to five days old and while still in the crates. A few litters took to the creep feed quite readily and were consuming it within minutes after it was offered. With few exceptions all litters were consuming some creep feed by the time they were a week old. It was generally observed that the water was consumed more readily than the creep feed and that the availability of the water affected the consumption of the creep feed. During periods when water was not available, the consumption of the creep feed was also diminished.

Livability of the Pigs. The cause of mortality was determined for 392 pigs and is shown along with the age at mortality in Table XXVII. The cause of death of approximately 75 additional pigs was not determined. Out of the 392 deaths in which the cause was determined, 94 percent was due to four factors: (1) Born dead, 50.5 percent; (2) born weak, 17.86 percent; (3) overlaid, 15.56 percent, and (4) navel ill, 10.2 percent.

In addition to those born dead, 29.85 percent more of the deaths occurred within the first seven days; this amounts to approximately 80 percent of the total losses. With the exception of navel ill, greatest death losses from the various causes occurred during the first week. More death losses from navel ill occurred during the second, third, and fourth, weeks than during other periods. Photographs of pigs showing symptom's of two stages of navel ill is illustrated in Figures 7 and 8.

Correlation analysis indicated a close relationship between birth weights and the percentage of pigs weaned. A coefficient of correlation ($r = +.94$, $P < .001$) was obtained for the relationship. The percentage weaned for the different birth weights is given in Table XXVIII. In addition, a graphic illustration of the relationship is shown in Figure 9. Analysis of variance (Table XXIX) indicated significant linear and curvilinear relationships between birth weights and percent livability. These results tended to indicate that, regardless of the cause of death, one of the most important factors determining whether the pig lived to weaning age was its weight at birth.

The increasing percentage of pigs weaned from those with heavier birth weights indicates the importance of striving for larger pigs at farrowing. As indicated by Smith (1952) there are a number of influences which are responsible for differences in birth weights including: (1) sex; (2) age of dam; (3) crossbreeding; (4) size of litter; (5) vigor of parents; and (6) nutrition during foetal growth. Considering nutrition as one of the fundamental factors determining the size of the pig at birth, he stressed the importance of providing adequate protein, minerals, and vitamins, during the gestation period.

Management Factors. Additional feeder space was required by limited-fed groups, particularily gilts, over the requirement for normal-fed groups. The additional feeder space was required to allow the more timid animals the opportunity to get their share of the ration. Probably more important than the amount of feeder space was the number of feeding areas per group of sows or gilts. In some instances "boss" sows or gilts would practically control four to five feet of linear feeding space. On the other hand, when the feed was placed in more than one area the animals would tend to move from one area to the other and, as a result, the "boss" animals controlled less actual feeder space. Approximately three linear feet of feeder space per head was provided limited-fed groups compared to two linear feet per head for normal-fed groups.

Either straw or ground corn cobs provided the bedding while the animals were confined to the farrowing crates. Straw was less satisfactory than the ground corn cobs in that straw tended to bunch up along the edge and in the corners of

TABLE XXVII-AGE AND CAUSE OF MORTALITY (392 pigs) TO WEANING

	Total	Days							Weeks						
		1	2	3	4	5	6	7	1st	2nd	3rd	4th	5th	6th	7th
Born Dead	193	--	--	--	--	--	--	--	---	---	---	---	---	---	---
Weak	70	26	21	9	3	4	2	3	68	2	---	---	---	---	---
Overlaid	61	14	2	2	5	4	1	3	31	18	7	2	3	---	---
Navel Ill	40	--	--	--	--	1	1	1	3	10	7	9	4	4	3
Starved	8	1	2	2	3	--	--	--	8	---	---	---	---	---	---
Salmonella	4	--	1	--	--	1	--	--	2	2	---	---	---	---	---
Atresia Ani	4	1	2	--	--	--	--	--	3	---	1	---	---	---	---
Edema	3	--	--	--	--	--	--	1	1	---	---	---	---	2	---
Swine Virus Pneumonia	2	--	--	--	--	--	--	--	---	---	---	1	1	---	---
Scours	1	--	--	--	--	--	1	--	1	---	---	---	---	---	---
Hernia	1	--	--	--	--	--	--	--	---	---	---	1	---	---	---
TOTAL	392	42	28	13	11	10	5	8	117	32	15	13	8	6	3

TABLE XXVIII-BIRTH WEIGHT OF 1431 PIGS AND PERCENTAGE WEANED*

Birth Weights (lbs)	Number Born	Percentage Weaned
0.8-1.0	10	0
1.1-1.3	26	4
1.4-1.6	54	20
1.7-1.9	89	40
2.0-2.2	119	49
2.3-2.5	139	61
2.6-2.8	242	75
2.9-3.1	202	73
3.2-3.4	226	78
3.5-3.7	155	83
3.8-4.0	82	85
4.1-4.3	30	90
4.4-4.6	8	87
4.7-4.9	6	100
5.0-5.2	1	100
5.3-5.5	1	100

*Coefficient of correlation. $r = +.94$ $P < .001$.

TABLE XXIX-ANALYSIS OF VARIANCE BIRTH WEIGHT AND PERCENT LIVABILITY

Source	Degrees Freedom	Sum of Squares	Mean Squares	F Ratio
Total	15	16895.0		
Due to Linear Regression	1	14970.6	14970.6	940.36**
Due to Quadratic Regression	1	1717.4	1717.4	107.88**
Deviations from Quadratic	13	207.0	15.92	

**Probability < .005.

the crate. The ground corn cobs were most satisfactory in that they tended to remain more evenly distributed over the entire area of the crate. In addition, they kept the bedded area drier. The excellence of ground corn cobs for bedding is shown quite clearly in Figure 10. Regardless of the type of bedding used, the practice of turning the sows out twice a day for feed and water also aided in keeping the bedding dry. When turned out twice a day, a majority of the animals developed the habit of voiding most of their urine and feces soon after being removed from the crate.

There is a tendency sometimes for sows and pigs, when turned to pasture, to overcrowd into one area of a building or to overcrowd into one house when a number of small houses are used for each lot. Since this situation had occurred in previous trials, an attempt was made to alleviate it in Trial 7. The method used was to confine the sow and her litter or in the case of double units to confine two sows and litters to the unit overnight. This was satisfactory for those pens in which the sows were confined overnight. However, one pen of sows and their lit-

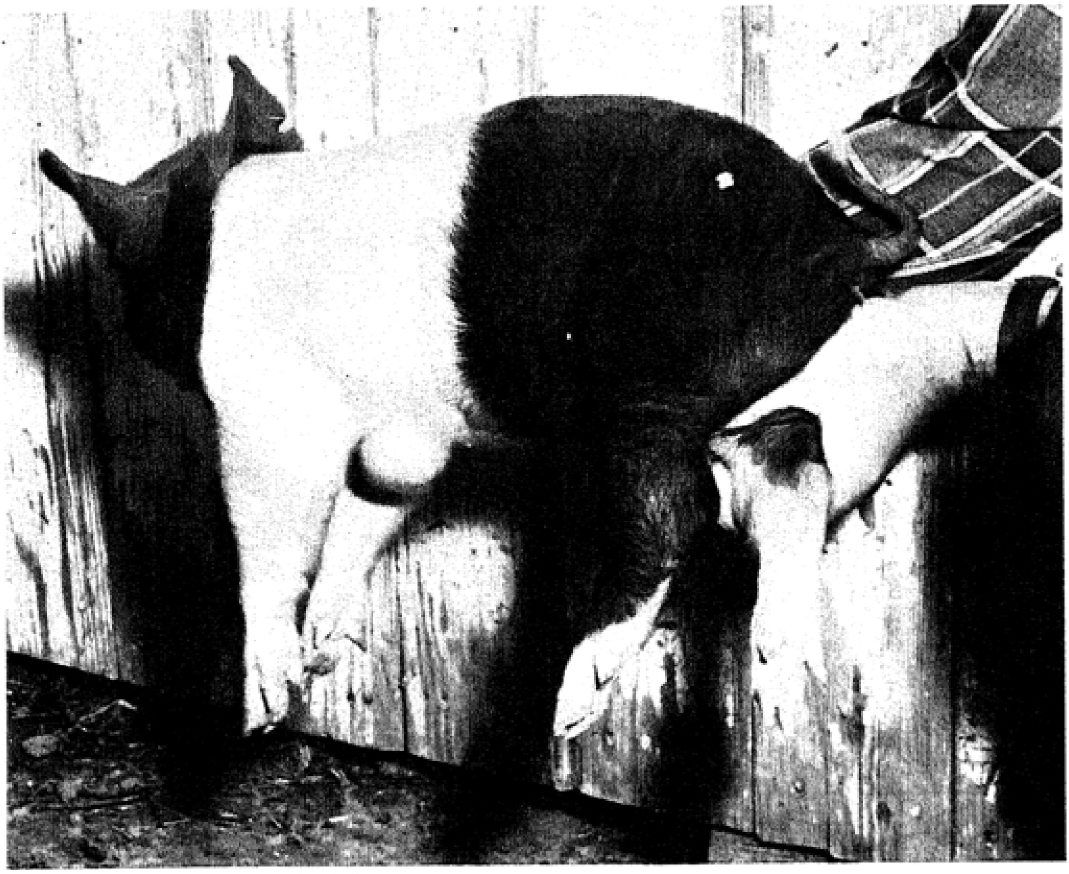

Fig. 7—Pig showing stage of navel ill with enlarged joints.

Fig. 8—Pig in a more advanced stage of navel ill.

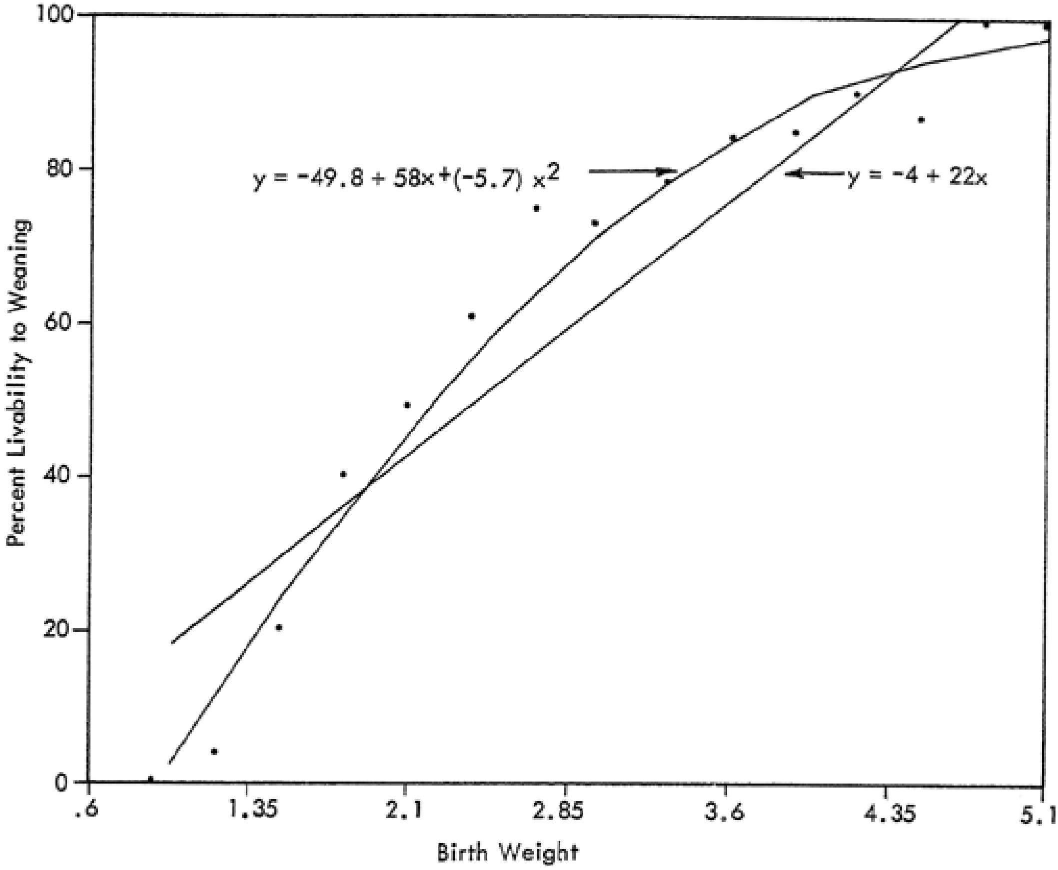

FIGURE 9 RELATIONSHIP BIRTH WEIGHT AND PERCENT LIVABILITY TO WEANING

ters were confined to the houses for only a four hour period during the day. This was not satisfactory. Although a separate house was provided each sow and litter in this pen, three of the four sows overcrowded into a single house and, as a result, overlaid six pigs during the first three nights. This overcrowding occurred on the second and third nights even after the sows and their litters had been individually separated, although not confined, to the individual houses the evening before. Apparently, the sow is a creature of habit and prefers a location in a new environment which she selects the first night.

Whether the litters were raised in confinement or on pasture, there was no difference noted in thriftiness of the pigs at weaning time. Photographs of representative litters indicating the equality of thriftiness of pigs raised under the two systems is shown in Figures 11, 12, and 13.

One of the major problems on most farms today is the problem of conserving labor. This is more of a problem on swine producing farms during the farrowing season. One of the factors which contributes to the increased requirement for labor during the farrowing season is the practice of hand feeding the

Fig. 10—The excellence of ground corn cobs for bedding is illustrated by the uniform distribution and dryness of the bed.

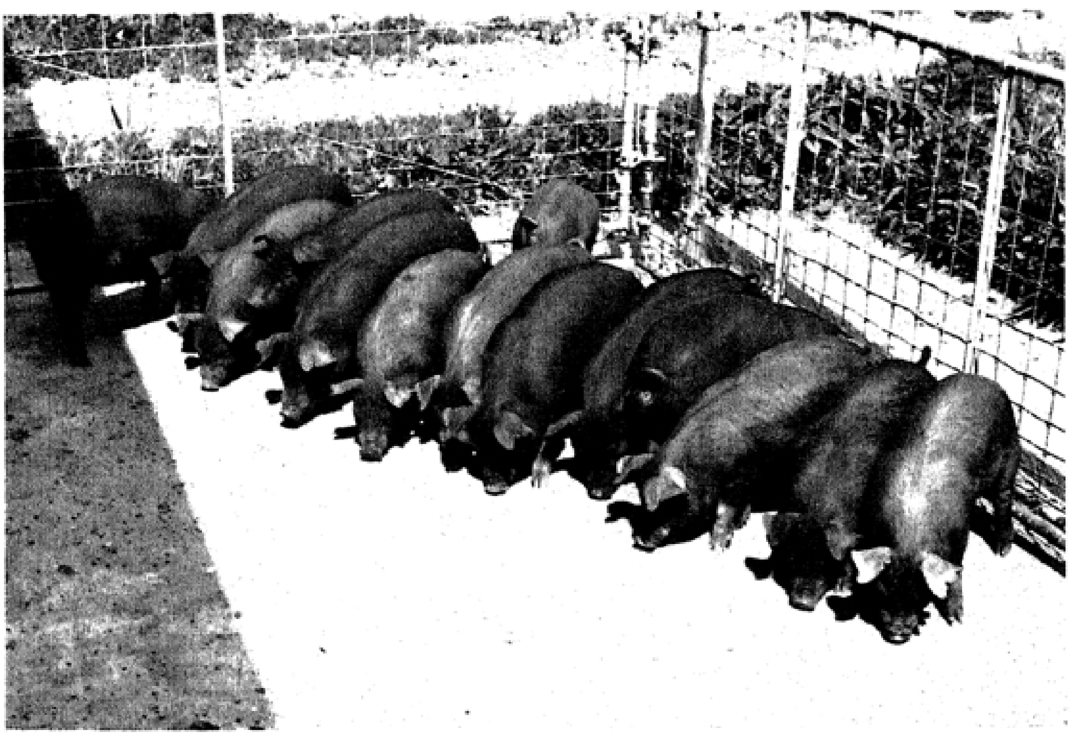

Fig. 11—Litter of 14 pigs raised on concrete to weaning.

Fig. 12—Litter of 11 pigs, approximately 6 weeks old, raised on concrete.

Fig. 13—Sows and their litters on pasture.

sow for a 10 to 14 day period following parturition. It would seem that labor would be conserved if the animals could be self-fed following parturition. Therefore, sows and gilts, in Trials 6, 7, and 8, were turned to self feeders for one to two hours twice a day commencing the fourth day following parturition, except in Trial 8 where the sows were turned to self feeders the day following parturition. This was satisfactory.

In addition to the creep ration itself, other factors considered to affect the creep consumption of the pigs after transfer to pasture or dry lots were: (1) getting the pigs started on the creep while confined to the crate and by the time they were a week old; (2) location of the creep; (3) availability of water adjacent to the creep. Figure 1 illustrates the containers and the location of the creep and water within the crate which proved most satisfactory in these trials. On pasture, the most suitable location for the creep apparently was adjacent to the sleeping quarters. Locating the creep adjacent to the sows' feed and water proved satisfactory only when they were also in the immediate area of the sleeping quarters. Creep feeders used on pasture and the most suitable location for them are shown in Figures 2 and 3.

Considering the amount of water consumed and its effect on creep consumption when it was not available, the importance of providing an adequate supply of water cannot be overemphasized. Since water plays such a vital role in all body functions, it is probably more important to supply enough to the very young pig than to supply the creep ration even though the pig is nursing its dam.

SUMMARY AND CONCLUSIONS

Studies were made on the effect of feeding different levels of energy on the condition and reproductive performance of sows and gilts.

Limited-fed sows and gilts were fed to gain slightly more than one half the rate of gain of the normal-fed groups, with the sows being fed to make less total gain than gilts during gestation. When all trials with gilts were combined, and the gilts grouped according to gain in weight from breeding to 109th day of gestation, best reproductive performance as to size of litter farrowed and weaned was made by those gilts gaining from 80 to 99 pounds. A significant curvilinear relationship was obtained for the relationship between gain in weight during gestation and the number of pigs farrowed by gilts.

Change in backfat probe of gilts during gestation was significantly correlated with the number of pigs farrowed. Significant negative relationships were obtained for the change in backfat probe at the shoulder, loin, rump, and the average of the three probes with the number of pigs farrowed. For sows, non-significant, positive values were obtained for the relationships between these same changes in backfat probes and the number of pigs farrowed.

Although the size of the litters farrowed by limited-fed gilts were larger than for more liberally-fed gilts in each of the four trials, statistically the difference was not significant in three of the four trials in which only the amount of shelled corn was the difference in ration fed the two groups of gilts. However, the size of the litter weaned was significantly larger for the limited-fed gilts in these same three trials.

In the four trials with sows, larger litters were farrowed by limited-fed sows in two trials, whereas the more liberal-fed sows farrowed larger litters in the other two.

The average size of the litter farrowed, for all four trials combined, was 8.83 for limited-fed gilts as compared to 8.07 for normal-fed gilts. With sows, an average of 10.2 pigs was farrowed by limited-fed sows, compared to an average of 10.1 pigs farrowed by normal-fed sows in the four trials.

A greater percentage of pigs, farrowed by limited-fed sows and gilts, were alive at birth than for normal fed groups; with six and four percent more of the pigs alive at birth for limited fed-sows and gilts, respectively.

Length of gestation was not affected by feeding level, although a significant difference was found between the Hampshire and Duroc breeds.

A significant negative relationship was obtained for the size of litter farrowed and average birth weight of pigs farrowed. Thus, the average birth weights were greater for the smaller litters.

Statistical analysis indicated significant linear and curvilinear relationships between birth weights and percent livability of pigs to weaning. These results indicated that, regardless of the cause of death, one of the most important factors determining whether the pig lived to weaning age was its weight at birth.

Average weaning weights tended to be greater for the smaller litters at weaning time.

In general, those sows and gilts which gained in condition during the gestation period, lost condition during the lactation period, whereas those which lost condition during gestation tended to gain backfat during the lactation period.

Both sows and gilts fed a limited ration during gestation tended to eat more feed when self-fed during lactation than those fed a normal level of feed. Limited-fed sows and gilts ate an average of 221 pounds less feed during gestation, whereas the normal-fed sows and gilt consumed 65 pounds less feed during lactation. The overall average feed consumption for both gestation and lactation was 156 pounds less for the limited fed sows and gilts.

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