EFFECTS OF FEEDING SEQUENCE DURING GESTATION ON REPRODUCTIVE PERFORMANCE IN SWINE

By

L. KEITH CALDWELL

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1968

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
July, 1972

EFFECTS OF FEEDING SEQUENCE DURING GESTATION

ON REPRODUCTIVE PERFORMANCE IN SWINE

Thesis approved:

Irvin T. Omtvedt
Thesis Adviser

J. E. Whitman

E. J. Turman

D. Wurbam
Dean of the Graduate College

ACKNOWLEDGEMENTS

The author wishes to express his sincere appreciation to Dr. I. T. Omtvedt, Professor of Animal Science, for his patient guidance and counsel throughout the course of this study.

Further appreciation is extended to Dr. J. V. Whiteman and Dr. E. J. Turman, Professors of Animal Science, for their assistance in the planning of this study; Mr. D. F. Stephens, Superintendent of the Fort Reno Livestock Experiment Station; and Mr. R. R. Wilson, Swine Herdsman at Fort Reno, for his assistance in caring for the animals and collecting the data.

Appreciation is extended to fellow graduate students of Oklahoma State University for their assistance over the duration of this study.

A special thanks is extended to the author's wife, Judy, for her patience, encouragement and understanding during the course of this study.

TABLE OF CONTENTS

Chapter		Page
I.	INTRODUCTION	1
II.	REVIEW OF LITERATURE	2
	Effects of Feeding Sequence on Number and Weight of Pigs Born	2
	Effects of Level of Energy Intake on Reproductive Efficiency	6
III.	MATERIALS AND METHODS	9
	Trial I	9
	Trial II	13
IV.	RESULTS AND DISCUSSION	15
	Self-Feeding vs. Daily and Three Times a Week Feeding	15
	Gestation Records	15
	Farrowing Records	17
	21-Day Performance	19
	Every Day vs. Three Times a Week Feeding	21
	Gestation Records	21
	Farrowing Records	22
V.	SUMMARY	24
LITERATURE CITED		26
APPENDIX		28

LIST OF TABLES

Table		Page
I.	Gestation Ration	11
II.	Sources of Variation and Degrees of Freedom for Variables in Trial I	12
III.	Sources of Variation and Degrees of Freedom for Variables in Trial II	14
IV.	Means and Standard Errors for Sow Performance During Gestation in Trial I	16
V.	Means and Standard Errors for Farrowing Records in Trial I	18
VI.	Means and Standard Errors for 21-Day Production Records in Trial I	20
VII.	Means and Standard Errors for Gestation Records by Treatment for Trials I and II and Overall	21
VIII.	Means and Standard Errors for Farrowing Records by Treatment for Trials I and II and Overall	23
IX.	Analyses of Variance for Variables in Trial I	29
X.	Analyses of Variance for Variables in Trial II	31

CHAPTER I

INTRODUCTION

Keeping labor requirements to a minimum and sow productivity at a maximum is of great economic importance. As a means of reducing labor input, many swine producers have gone to some type of interval feeding system of their sow herds during gestation. However, the influence of feeding sequence on reproductive performance is not fully understood. The advantages of interval feeding from a labor standpoint are readily apparent, but more work is needed before it can be recommended from a reproductive efficiency standpoint.

This study was initiated to determine the influence of feeding sequence, hand feeding daily and three times a week compared to access to self-feeders for a 3 hour period three times per week, on sow condition, farrowing results and 21-day pig performance.

CHAPTER II

REVIEW OF LITERATURE

Effects of Feeding Sequence on Number and Weight of Pigs Born

Gesell, et al. (1963) studied the effect of length of time between feeding periods on reproductive efficiency. Forty-three gilts were divided into four treatments: 1) hand-fed 4 lbs. per head per day (control); 2) access to self-feeders every second day for 24 hours; 3) continuous access to self-feeders; and 4) access to self-feeders every third day for 24 hours. The gilts consumed an average of 4.00, 9.05, 9.35 and 6.09 lbs. of a 16% protein corn-soy ration, respectively. He concluded that feeding gilts every second or third day did not have a detrimental effect on reproductive efficiency. Treatments two and four farrowed 0.6 and 0.3 more live pigs, respectively, and treatment three farrowed 1.0 less pigs per litter than the control group, but these differences were not significant. However, the decrease in number of live pigs farrowed in treatment three approached significance.

Using 71 Hampshire and Yorkshire gilts and sows, the previous study was continued by Becker, et al. (1964). Using the same treatments and experimental design as Gesell, et al. (1963), they noted that gilts continuously self-fed a high energy ration tended to farrow fewer total and live pigs but slightly heavier pigs than gilts fed a limited feed intake, but these differences were not significant. Based on their

results, they concluded that limiting the feed intake of pregnant gilts by providing limited access to a self-feeder proved a satisfactory technique. In order to control weight gains to the proper extent, sows and gilts must not have free access to the self-feeders during more than 24 of 72 hours. When gilts had free access to the self-feeder 24 of 48 hours, they could consume as much feed as those fed continuously.

Ray and McCarty (1964) studied the effect of temporary fasting following breeding on reproductive performance. One hundred-twenty two gilts were mated and assigned to: 1) 0 hours off feed (control); 2) 24 hours off feed; 3) 48 hours off feed; or 4) 72 hours off feed. The animals were slaughtered 25 to 33 days after mating and the number of corpora lutea and embryos were determined. Ovulation rate was slightly lower in gilts from which feed was withheld but the difference was not significant. The number of embryos was essentially the same for each treatment. These results suggest that feed intake can be reduced to zero for periods up to 72 hours following mating without detrimentally affecting reproductive performance up to 33 days post-breeding.

Diggs and Baker (1966) used two treatments each for gilts and sows to determine the effect of interval feeding on the number of live pigs at birth. One group of gilts was fed a complete ration daily at a rate of 1.25% of their body weight and the other group was given access to a self-feeder for 24 of 72 hours. The sows received the same treatments except those fed daily received 1.00% of their body weight. They found no significant treatment differences in the number of live pigs born.

Tribble (1966) found no significant differences in the number or weight of pigs born alive between two treatments in which one group was fed 4 lbs. of feed per head daily and the other group was fed 4 lbs. per

head every other day for 60 days following breeding while on alfalfa-brome pasture. He concluded that sow performance can be maintained by limiting the feed intake of sows on pasture during mid-gestation.

Libal and Wahlstrom (1969) conducted two trials, one in the winter and one in the summer with two treatments in each trial, utilizing 20 sows and 26 gilts with an equal number of sows and gilts in each treatment. The first treatment group was fed a bulky ration consisting of 30% dehydrated alfalfa, 30% ground oats and 30% corn. The second treatment group was fed a high concentrate ration containing 79% corn with no dehydrated alfalfa or ground oats. The animals in both treatments were given access to a self-feeder for two hours on Monday, Wednesday and Friday. No additional feed was available.

In the winter trial, sows on the higher energy ration farrowed 1.0 more live pigs but had 0.5 more stillborn pigs per litter than the low-energy group. Pig birth weights were similar for both groups. However, the gilts on the low-energy ration produced 0.8 more and slightly heavier pigs than the higher energy group. It should be noted that in this trial the gilts on the low-energy ration gained 35 lbs. and the high-energy group lost 9 lbs. The author attributes this to extremely cold and stormy weather that occurred during this trial.

In the summer trial 26 sows and 20 gilts were utilized. The sows on the high-energy ration farrowed 2.1 more live pigs per litter than the low-energy group. However, the gilts on the bulky ration farrowed 0.9 more live pigs than the high-energy group.

The author attributes the differences between gestation gain in the summer and winter trials to the difference in maintenance requirements for winter and summer.

Baird (1970), using 25 sows, studied the effects of twice daily feeding, once daily feeding and feeding every second day on reproducive performance in swine. He found no statistically significant differences in the number or strength of pigs born alive. He also reported no significant differences between treatments of 24, 48 and 72 hours interval feeding on the number or weight of live pigs farrowed. However, the pigs from the sows that were self-fed for two hours at 48 and 72 hour intervals were slightly heavier at birth. Since labor was considerably reduced with longer feeding intervals, even though there was no significant reduction in reproductive performance, he concluded that one could nearly double his operation without increasing labor by using this system of feeding.

Numerous investigators have reported that sows with large gestation gains tended to have smaller litters. When sows were given access to a self-feeder for more than 24 of 72 hours, weight gains were significantly larger than hand-fed sows as was reported by Gesell, et al. (1963), Becker, et al. (1964), Diggs and Baker (1966), Weise, Ross and Tribble (1967), Svjgr (1968) and Baird (1970).

Cook and Kroening (1969), using nine sows in each treatment for Trial I with the treatments being reversed in Trial II, found that it was more economical to hand-feed sows a high energy ration during gestation than to limit feed intake by self-feeding a bulky ration. They also found no significant differences due to treatment effect on the number of pigs born, average birth weight, total litter weight at birth or pig mortality. However, the trend in this study was for the hand-fed sows to have fewer (10.37 vs. 11.86) but heavier pigs (2.73 lbs. vs. 2.57 lbs.) than the self-fed sows.

Effects of Level of Energy Intake on Reproductive Efficiency

Dean, et al. (1958) fed one group of eight sows to gain approximately one pound per day during gestation and another group of eight sows to gain approximately 0.5 pounds per day. The condition of the gilts was determined by backfat probe at breeding, mid-gestation, farrowing, and six weeks after farrowing. Thirty additional gilts were probed at breeding, mid-gestation, farrowing, and six weeks after farrowing to include a larger number of gilts for correlation analysis of the effects of condition on the number of pigs farrowed. He found a significant ($P<.05$) negative correlation ($r=-.31$) with backfat probe at farrowing and the number of pigs farrowed.

Gossett and Sorensen (1959), using 52 gilts, studied the effects of a low energy ration on reproductive phenomena. One group was given a control ration containing 93 therms of energy per 100 pounds of feed and the other group was given 55 therms of energy per 100 pounds of feed. The gilts were selected and put on test at weaning. At 40 days post-breeding, all were slaughtered and ovulation rates, number of normal, live embryos, and percent of live embryos were determined. His data demonstrated that maximum ovulation rates and higher embryonic survival can be attained by reducing the energy content of rations fed to developing and gestating gilts provided the ration contains essential nutrients necessary for optimum growth of immature animals. This is in agreement with work done with gilts by Libal and Wahlstrom (1969).

Sorensen, Thomas and Gossett (1961) used 98 gilts with the same experimental design as Gossett, et al. (1959). He found that gilts on the high energy ration ovulated 1.3 more ova than the low energy gilts.

This difference was statistically significant ($P<.01$). However, gilts fed at the low energy level had significantly more embryos ($P<.01$) but gained significantly less ($P<.01$) than the high-energy group. Although the differences in the number of live embryos were not significant, the low-energy gilts had 0.9 more live embryos than the gilts fed the high-energy ration.

Henson, Eason and Clawson (1964) applied two pregestation treatments (3 lbs. vs. 5 lbs. of feed per day during rearing) to 168 gilts. At the time of breeding, one-half of each treatment remained on their level of feeding while the other half was switched to the opposite level. The average birth weight of the pigs was significantly heavier for pigs farrowed by the gilts on the high level during rearing and gestation. However, the number of live pigs farrowed was not significantly different.

Mayrose, Speer and Hays (1966) individually fed 64 sows in each of three trials to compare the responses of level of feed intake prior to breeding and during early pregnancy (from 14 days prior to breeding to 21 days after breeding) and during the last one-third of gestation (84 days post-breeding until farrowing) on reproductive performance. From 21 to 84 days post-breeding the sows were fed the low level (4 lbs. per day). The treatments were arranged in a 2 x 2 factorial (high-high, high-low, low-high, and low-low). The results suggested that sows fed the higher level (6 lbs. per day) both at breeding and during the last one-third of gestation gained significantly more weight and farrowed fewer pigs than sows on other treatments. Sows fed the high level at breeding time, regardless of late gestation treatment, farrowed significantly heavier pigs than those fed the low level at breeding, regardless of late gestation treatment. His data suggested that increasing

the level of feed intake during the last third of gestation had no significant effect on birth weight of pigs.

Elsley, MacPherson and McDonald (1968) reported no consistent effects on number of pigs born when he studied the effects on 52 gilts of high and low energy intakes, 8.3 therms per day and 5.2 therms per day, respectively. However, the higher energy intakes during pregnancy and lactation did increase the weights of the pigs at eight weeks of age.

Buitrago, Maner and Gallo (1970) divided 18 gilts into three treatments at the time of breeding: 1) 3.0 therms; 2) 6.0 therms; and 3) 9.0 therms of metabolizable energy per day. Treatment one produced the fewest (6.3 compared to 10.3 and 9.8 for treatments 1 and 2, respectively) and lightest pigs (2.05 lbs. compared to 2.24 and 2.84 in treatments 1 and 2, respectively). This suggests that the energy available was not adequate for the gilts to perform normally. This evidence is in agreement with Gesell, et al. (1963), Becker, et al. (1964) and Svajgr (1968).

Frobish and Steele (1970) randomly allotted 40 gilts to daily energy intakes of 3.0 therms, 4.5 therms, 6.0 therms or 7.0 therms of energy per day. He reported no significant differences in the number of total and live pigs farrowed per litter between energy intakes. However, as the energy level increased, the gilts gained more weight and tended to have fewer pigs. However, live pig weight increased significantly ($P<.01$) in a linear manner with increasing energy levels. He concluded that each 1.5 therm increment increase in daily energy intake accounted for 0.55 fewer live pigs farrowed and 0.27 lbs. heavier pigs at birth.

CHAPTER III

MATERIALS AND METHODS

This study was conducted at the Fort Reno Livestock Research Station, El Reno, Oklahoma, during the spring and summer of 1970 and 1971. Two trials were conducted to determine the effects of feeding sequence during gestation on the reproductive performance of swine.

Trial I

Sixty Duroc-Beltsville No. 1 crossbred sows averaging 321.4 lbs. at breeding were used. All sows had raised one litter prior to being allotted to this study. Two weeks prior to breeding, all sows were fed six pounds of a 16 percent protein ration daily. At breeding, each sow was weighed and randomly allotted to one of three treatments: 1) hand-fed an average of 4.48 lbs. of feed every day; 2) hand-fed every Monday, Wednesday and Friday at the same total pounds per week as treatment 1; or 3) given access to a self-feeder for three hours (7:30-10:30 a.m.) every Monday, Wednesday and Friday. There were two replicates of each treatment with 10 sows in each gestation pen. Sows were allotted to the second replication after all sows in Replication I had been allotted.

The breeding season began February 15 and continued for six weeks utilizing proven fertile, unrelated Duroc and Yorkshire yearling boars. One sow in treatment 2 failed to conceive during this period and was removed from the study. Breed of boar was rotated within each treatment

so one-half were bred to boars of each breed. Six 2-acre, dry lot, gestation pens were used with each pen equipped with an automatic waterer and combination sprinkler shade. Individual sow feeding stalls were used for the hand-fed groups and the self-fed groups had a pen in the corner of each lot with self feeders.

All treatments were fed the same 16 percent protein (wheat-milo-soybean meal) ration given in Table I. Feed records were kept on each treatment so that feed costs could be determined. Feed costs were based on the prices paid by the University Feed Mill in Stillwater, Oklahoma, on June 1, 1972.

At 109 days post-breeding, the sows were taken from their gestation pens, washed, weighed and moved into the central farrowing house at Fort Reno. Two extremely fat sows from treatment 3 (one from each replicate) died from heat exhaustion in the farrowing house prior to farrowing.

Sow gestation gain was calculated based on 109-day weight minus breeding weight. A 9 point condition scoring system was used (9 denoted excessively fat and 1 denoted extremely thin with 5 being average). The farrowing data included total number of pigs farrowed, number of live pigs per litter, individual pig weights, litter weights and survival percentage for the first 24 hours. The sows remained in the farrowing house for one week after parturition at which time they were moved to the sow nursery facility. At 21 days post-farrowing, the number of live pigs per litter, individual pig weights, litter weights and survival percentages were obtained.

Each variable was subjected to an analysis of variance by methods described by Snedecor and Cochran (1967). The analysis was carried out

TABLE I

GESTATION RATION

Ingredient[a]	Percentage
Wheat (12% Crude Protein)	50.0
Milo (8% Crude Protein)	26.2
Soybean meal (44% Crude Protein)	11.5
Tankage (50% Crude Protein)	5.0
Alfalfa pellets (17% Crude Protein)	5.0
Dicalcium phosphate	1.0
Ground limestone	0.3
Trace mineral salt	0.5
Premix 9258[b]	0.5
Total	100.0

Proximate Composition	Calculated Percentage
Protein	16.0
Calcium	0.7
Phosphorous	0.6

[a] Aureo Sp-250 was added at a rate of 5 lbs. per ton during breeding and 2.5 lbs. per ton during gestation.

[b] Premix 9258 contained 300,000 USP units of vitamin A, 30,000 USP units of vitamin D_3, 400 mg. of riboflavin, 2,174 mg. of D-calcium pantothate, 2,000 mg. of pantothenic acid, 3,000 mg. niacin, 100,000 mg. choline chloride, 1.5 mg. vitamin B_{12}, 600 I.U. of vitamin E, 2 gm. of iron, 1 gm. of manganese, 1 gm. of copper and 9 gm. of zinc per pound.

using the mathematical model given by,

$$Y_{ij} = \mu + r_i + t_j + (rt)_{ij} + e_{ij}$$

where,

Y_{ij} = individual observation of the variable.

μ = mean observation of the variable.

r_i = an effect of the ith replication (i_1 = Rep I, i_2 = Rep II)

t_j = an effect of the jth treatment (j_1 = Treatment 1, j_2 = Treatment 2 and j_3 = Treatment 3).

$(rt)_{ij}$ = an effect for the interaction of the ith replication with the jth treatment.

e_{ij} = failure of the stated model to estimate the variable.

The general analysis of variance table with the degrees of freedom is given in Table II with the individual analyses for each variable given in the Appendix.

TABLE II

SOURCES OF VARIATION AND DEGREES OF FREEDOM FOR VARIABLES IN TRIAL I

Source	d.f.
Total	56
Replications (R)	1
Treatments (T)	2
R x T	2
Error[a]	51

[a]Error term used to test treatments, replications and replication X treatment.

Trial II

Trial II was conducted at the Fort Reno Livestock Research Station to study the effects of sequence of feeding during gestation on the reproductive performance of gilts. Twenty-seven sexually mature Hampshire gilts averaging 296.8 lbs. at breeding were used in this study. These gilts were also bred during February and March and the treatments were the same as Trial I with the exception that treatment 3, access to a self-feeder for three hours every Monday, Wednesday and Friday, was omitted. All gilts were mated to unrelated Hampshire boars and allotted to their respective treatment immediately after breeding as in Trial I. Fourteen gilts were randomly allotted to treatment 1, (hand-fed every day) and 13 gilts were randomly allotted to treatment 2, (hand-fed every Monday, Wednesday and Friday). Those on treatment 2 received the same total pounds of feed per week as did those on treatment 1.

The gilts were fed 6 lbs. of a 16% protein ration for two weeks prior to breeding.

Two 2-acre dry-lots similar to those described in Trial I were used with the gilts on the same treatment maintained in the same lot. Both treatment groups were fed an average of 4.1 lbs. per day of the same 16% protein ration shown in Table I. Total feed consumption was not recorded in this trial since both treatment groups were limited to the same feed intake. The gilts were moved to the central farrowing house 109 days post-breeding.

The data obtained in Trial II included gestation gains, farrowing condition scores, total number of pigs farrowed, number of live pigs per litter, pig weights, litter weights and survival percentage for the first 24 hours. Subsequent performance was not included because

adequate, comparable nursery facilities were not available for all litters.

Each variable was subjected to an analysis of variance outlined by Snedecor and Cochran (1967) and described in Trial I. The sources of variation and the degrees of freedom are given in Table III. The analyses for each variable in this trial are given in the Appendix.

TABLE III

SOURCES OF VARIATION AND DEGREES OF FREEDOM FOR VARIABLES IN TRIAL II

Source	d.f.
Total	65
Season (S)	1
Treatment (T)	1
S x T	1
Error[a]	62

[a]Error term used to test seasons, treatments and season X treatment.

CHAPTER IV

RESULTS AND DISCUSSION

Self-Feeding vs. Daily and Three Times a Week Feeding

The results are summarized in Tables IV, V and VI, and the analyses of variance are presented in the Appendix.

Gestation Records

Feed consumption, sow gestation gains and sow condition scores at farrowing are given in Table IV. In this trial, the self-fed sows consumed an average of 8.39 lbs. of feed daily compared to 4.48 and 4.34 lbs. for treatments 1 and 2, respectively. The differences in the average amount of feed consumed per day by treatments 1 and 2 were a result of the differences in the breeding times of the sows. Feed levels were increased for all sows in the gestation pen at the same date rather than on an individual sow basis; therefore, those that bred later in the breeding season were on the low level of feeding for a shorter period immediately after breeding and were on a higher level of feed intake per day for a longer period because of later farrowing. The average feed cost per sow per gestation (109 days post-breeding) for the self-fed sows was $34.20 while for treatments 1 and 2 it was $18.27 and $17.69, respectively.

TABLE IV

MEANS AND STANDARD ERRORS FOR SOW PERFORMANCE DURING GESTATION IN TRIAL I

Replication	Treatment	No. Sows	Sow Breeding Wt., lb.	Feed Per Day, lb.	Sow Gest. Gain, lb.	Sow Cond. Score
I	1	10	321.2	4.64	73.60 ± 9.96	4.80 ± 0.13
	2	9[1]	337.9	4.32	62.11 ± 11.77	4.56 ± 0.29
	3	9[2]	321.9	8.56	144.22 ± 17.57[c]	6.11 ± 0.35[e]
II	1	10	314.7	4.33	87.80 ± 16.36	4.30 ± 0.25
	2	10	303.2	4.37	78.80 ± 10.18	5.00 ± 0.30
	3	9[2]	332.4	8.21	189.33 ± 9.51[d]	7.33 ± 0.24[f]
Overall	1	20	318.0	4.48	80.70 ± 7.84[a]	4.55 ± 0.18[a]
	2	19	319.6	4.34	70.89 ± 8.04[a]	4.79 ± 0.19[a]
	3	18	327.2	8.39	166.78 ± 8.26[b]	6.72 ± 0.19[b]

[1]One sow failed to breed.

[2]One extremely fat sow died from heat exhaustion in the farrowing house prior to farrowing.

[a,b]Values with different superscripts within columns are significantly ($P<.01$) different.

[c,d]Values with different superscripts within columns are significantly ($P<.01$) different.

[e,f]Values with different superscripts within columns are significantly ($P<.05$) different.

The difference in sow gestation gains was significant ($P<.01$) with the self-fed sows having 86.1 lbs. and 95.9 lbs. more gain than treatments 1 and 2, respectively. With scores of 4 to 5 considered to be the ideal sow condition score, the self-fed sows had an overall score of 6.72 compared to 4.55 for treatment 1 and 4.79 for treatment 2. This difference was significantly ($P<.01$) higher for the self-fed sows. The sows in Replication II out gained and had higher condition scores ($P<.05$) than those in Replication I of the self-fed treatment. These differences were partially due to chance differences in sow condition when they were bred.

These results suggest that even though the self-fed sows were limited to three hours of feeding three days a week, they did regulate their intake to more than compensate by consuming larger quantities of feed when given access to it. These results are similar to those obtained by Svajgr (1968). It should be pointed out that the self-fed sows appeared to be under greater stress when confined to the farrowing crates prior to farrowing due to their excessive body condition as indicated by the fact that two of the sows in treatment 3 died prior to farrowing. The group that was hand-fed three times a week had comparable gestation performance to the control group, treatment 1.

Farrowing Records

The farrowing results are given in Table V. Even though the treatment differences for number of pigs farrowed were not significant, overall there was a trend for the fatter, self-fed sows to farrow fewer pigs than those fed every day. Weise, et al. (1967) and Svajgr (1968) noted similar non-significant differences. However, the self-fed sows

TABLE V

MEANS AND STANDARD ERRORS FOR FARROWING RECORDS IN TRIAL I

Replication	Treatment	No. Sows	No. Pigs Farrowed/Litter		Pig Wt. lb.	Litter Wt. lb.	Survival Percentage At 24 Hours
			Total	Live			
I	1	10	12.4 ± 0.73	11.7 ± 0.34	2.83 ± 0.13	34.83 ± 2.15	100.00 ± 0.00
	2	9[1]	12.6 ± 0.67	12.1 ± 0.70	2.96 ± 0.13	36.97 ± 3.90	96.77 ± 2.32
	3	9[2]	9.8 ± 1.05	9.6 ± 1.14	3.12 ± 0.16	29.73 ± 3.32	98.99 ± 1.01
II	1	10	11.7 ± 0.92	11.4 ± 0.90	2.96 ± 0.17	34.17 ± 2.88	98.52 ± 0.99
	2	10	10.3 ± 1.21	10.1 ± 1.19	2.72 ± 0.18	28.16 ± 3.37	100.00 ± 0.00
	3	9[2]	12.3 ± 1.00	11.4 ± 1.00	3.31 ± 0.18	40.26 ± 3.46	100.00 ± 0.00
Overall	1	20	12.1 ± 0.66	11.6 ± 0.64	2.90 ± 0.11[a]	34.50 ± 2.03	99.26 ± 0.73
	2	19	11.4 ± 0.67	11.1 ± 0.65	2.83 ± 0.11[a]	32.33 ± 2.08	97.88 ± 0.75
	3	18	11.1 ± 0.69	10.5 ± 0.67	3.22 ± 0.12[b]	34.99 ± 2.14	99.49 ± 0.77

[1]One sow failed to breed.

[2]One extremely fat sow died from heat exhaustion in the farrowing house prior to farrowing.

[a,b]Variables with different superscripts within columns are significantly ($P<.05$) different.

produced significantly ($P<.05$) heavier pigs at birth. This coincides with results obtained by Becker, et al. (1964) and Baird (1970). Treatment also seemed to have little effect on either litter weight or survival percentage during the first 24 hours post-farrowing. The differences in performance of Replications I and II in treatment 3 resulted in a significant ($P<.05$) replication X treatment interaction for total number of pigs born and a significant ($P<.01$) replication X treatment interaction for litter weight.

The productivity records for the sows that were hand-fed three times a week was comparable to those daily fed, but the overall means tended to favor the daily fed group.

21-Day Performance

The results of 21-day pig performance are summarized in Table VI. There were no significant differences due to treatment; however, the farrowing trends were maintained through 21 days post-partum. The self-fed sows had fewer (8.8 vs. 10.4 and 9.6 for treatments 1 and 2, respectively) but heavier pigs (13.0 lbs. vs. 12.4 and 11.3 lbs. for treatments 1 and 2, respectively). Even though individual pig weights were higher for the self-fed sows, total litter weights were lighter than for treatments 1 and 2 because of the smaller number of pigs per litter. The survival rate appeared to be unaffected by treatment.

This trial indicates that giving sows access to a self-feeder for three hours on each of three days a week during gestation, as a method of limiting feed intake and saving labor, is not feasible from both the standpoint of economy and reproductive performance. Even though hand-feeding three times per week produced results similar to hand-feeding

TABLE VI

MEANS AND STANDARD ERRORS FOR 21-DAY PRODUCTION RECORDS IN TRIAL I

Replication	Treatment	No. Sows	No. Pigs/ Litter	Pig Wt. lb.	Litter Wt. lb.	Survival Percentage
I	1	10	10.9 ± 0.48	12.3 ± 0.70	132.1 ± 4.54	92.9 ± 2.20
	2	9[1]	10.0 ± 1.00	11.8 ± 0.54	118.3 ± 12.04	81.8 ± 6.18
	3	9[2]	8.8 ± 1.12	13.2 ± 0.57	112.6 ± 14.15	92.2 ± 3.01
II	1	10	10.0 ± 0.72	12.5 ± 0.41	124.4 ± 9.29	89.4 ± 4.10
	2	10	9.2 ± 1.16	10.8 ± 1.27	110.3 ± 14.02	84.8 ± 9.73
	3	9[2]	8.8 ± 0.55	12.8 ± 0.67	110.0 ± 4.98	79.5 ± 4.93
Overall	1	20	10.4 ± 0.61	12.4 ± 0.50	128.2 ± 7.27	91.2 ± 3.92
	2	19	9.6 ± 0.62	11.3 ± 0.52	114.1 ± 7.46	83.4 ± 4.02
	3	18	8.8 ± 0.64	13.0 ± 0.53	111.3 ± 7.66	85.8 ± 4.13

[1]One sow failed to breed.

[2]One extremely fat sow died from heat exhaustion in the farrowing house prior to farrowing.

daily, productivity tended to favor the hand-fed daily groups.

Every Day vs. Three Times a Week Feeding

Gestation Records

The results of treatments 1 and 2 in Trials I and II and the overall treatment means for gestation are summarized in Table VII. There were no significant differences in sow gestation gains or sow farrowing condition scores between treatments within trials. However, the gestation gains and condition scores for sows in Trial I were significantly ($P<.01$) higher than those for gilts in Trial II, and condition scores were significantly ($P<.01$) higher for gilts in Trial II than sows in Trial I. Overall, there were no significant differences between treatments for gestation gains or condition scores, but there was a trend for the daily-fed group to gain more weight during gestation.

TABLE VII

MEANS AND STANDARD ERRORS FOR GESTATION RECORDS BY TREATMENT FOR TRIALS I AND II AND OVERALL

Trial	Treatment	No. Sows	Sow Gest. Gain, lb.	Sow Cond. Score
I	1	20	80.7 ± 7.84	4.6 ± 0.18
	2	19	70.9 ± 8.04	4.8 ± 0.19
II	1	14	56.9 ± 4.15	5.9 ± 0.18
	2	13	45.9 ± 3.67	6.0 ± 0.25
Overall	1	34	70.9 ± 4.93	5.2 ± 0.14
	2	32	60.8 ± 5.08	5.3 ± 0.14

Farrowing Records

The results of treatments 1 and 2 in Trials I and II and the overall treatment means for farrowing are summarized in Table VIII. There were no significant differences between treatments within trials for the total number of pigs farrowed, number of live pigs per litter, individual pig weights, litter weights or survival percentage for 24 hours post-farrowing. However, the combined treatments in Trial I were significantly ($P<.01$) higher for total number of pigs farrowed, number of live pigs per litter, litter weights and survival percentage for the first 24 hours than the combined treatments in Trial II. These variations can be expected because of differences in breed, age and parity of the animals in the trials. Individual pig weights were not affected by either treatment or trial.

When overall means were calculated for the daily-fed treatments and the three-times-a-week-fed treatments, there were no significant differences. However, those that were fed three times a week tended to farrow fewer pigs consistently throughout the study than those fed every day.

These results suggest that no marked reduction in productivity occurs when sows were fed only three times a week instead of daily. However, reproductive efficiency tended to consistently favor the daily-fed group.

TABLE VIII

MEANS AND STANDARD ERRORS FOR FARROWING RECORDS BY TREATMENT FOR TRIALS I AND II AND OVERALL

Trial	Treatment	No. Sows	No. Pigs Farrowed/Litter		Pig Wt. lb.	Litter Wt. lb.	Survival Percentage At 24 Hours
			Total	Live			
I	1	20	12.1 ± 0.66	11.6 ± 0.64	2.9 ± 0.11	34.5 ± 2.03	99.3 ± 0.73
	2	19	11.4 ± 0.67	11.0 ± 0.65	2.8 ± 0.11	32.3 ± 2.08	97.9 ± 0.75
II	1	14	9.7 ± 0.65	9.4 ± 0.70	2.9 ± 0.12	27.6 ± 1.73	84.2 ± 3.91
	2	13	8.6 ± 0.43	8.0 ± 0.45	3.0 ± 0.12	25.7 ± 1.33	88.8 ± 2.77
Overall	1	34	11.1 ± 0.45	10.7 ± 0.43	2.9 ± 0.08	31.6 ± 1.33	93.0 ± 1.46
	2	32	10.3 ± 0.46	9.8 ± 0.44	2.9 ± 0.09	29.6 ± 1.37	94.2 ± 1.51

CHAPTER V

SUMMARY

Two trials were conducted to determine the effects of feeding sequence during gestation on the reproductive performance of swine. In Trial I, 60 second-litter Duroc-Beltsville No. 1 crossbred sows were allotted at the time of breeding to one of three treatments: 1) hand-fed every day an average of 4.5 lbs.; 2) hand-fed three times a week (Monday, Wednesday and Friday) at the same total pounds per week as treatment 1; and 3) access to self-feeders for 3 hours three times a week (Monday, Wednesday and Friday). In Trial II, 27 Hampshire gilts were assigned at the time of breeding to either treatment 1 (hand-fed daily), or treatment 2 (hand-fed the same amount as treatment 1 three times a week). Animals in both trials were bred during February and March for summer litters. All animals were fed a 16 percent (wheat-milo-soybean meal) ration.

In Trial I, the self-fed sows consumed nearly twice as much feed during gestation resulting in a total cost of $34.20 per sow compared to $18.27 for the daily fed sows and $17.69 for sows fed three times a week. The self-fed sows gained significantly ($P<.01$) more weight during gestation (166.8 lbs. compared to 80.7 lbs. for every day feeding and 70.9 lbs. for those hand-fed three times a week). Sow condition score at farrowing was also significantly ($P<.01$) higher for the self-fed sows. Birth weights of pigs from self-fed sows averaged 3.22 lbs.

compared to 2.90 lbs. for pigs from every-day feeding and 2.83 lbs. for the hand-fed three times a week, but differences in litter size were not significant. However, there was a tendency for litter size to be larger for every day feeding (11.6 pigs/litter) and smaller for self-feeding (10.5 pigs/litter) with hand feeding three times a week being intermediate (11.1 pigs/litter). Differences between sows hand-fed daily and those hand-fed three times a week were not significant in either trial, but productivity tended to consistently favor those that were daily fed.

When treatments 1 and 2 in Trials I and II were compared, there were no significant differences between treatments within trials. However, the sows in Trial I were significantly ($P<.01$) higher for gestation gain, total number of pigs farrowed per litter, number of pigs born alive, litter weight at farrowing and survival percentage at 24 hours than the gilts in Trial II. Condition score was higher ($P<.01$) for the gilts than the sows. Pig weight at farrowing seemed to be unaffected by either treatment or trial.

These results suggest that giving sows access to a self-feeder three hours three times a week is not ecnomically feasible from both the standpoint of feed cost and reproductive performance. Even though there were no statistically significant differences between treatments 1 and 2, reproductive efficiency tended to favor those that were hand-fed daily.

LITERATURE CITED

Baird, D. M. 1970. Individual and "skip day" vs. group feeding systems for sows during gestation. Univ. of Ga. Research Report 82.

Becker, D. E., A. H. Jensen, B. G. Harmon and J. A. Gesell. 1964. A new method of limiting feed intake of gestating gilts. Univ. of Ill. AS-602b.

Buitrago, J., J. H. Maner and J. T. Gallo. 1970. Effect of gestation energy level on reproductive performance. J. Anim. Sci. 31:197. (Abstr.).

Cook, J. and G. H. Kroening. 1969. A comparative study of hand-feeding vs. self-feeding sows during gestation. Feedstuffs 41:26.

Dean, B. T., V. B. Reddy, J. F. Lasley and L. F. Tribble. 1958. Effect of condition on reproduction in swine. J. Anim. Sci. 17:1211. (Abstr.).

Diggs, Billy G. and Bryan Baker Jr. 1966. Comparison of daily vs. intermittent feeding of sows during gestation. J. Anim. Sci. 26:214. (Abstr.).

Elsley, F. W. H., R. M. MacPherson and I. McDonald. 1968. The influence of intake of dietary energy in pregnancy and lactation upon sow productivity. J. Agr. Sci. 71:215.

Frobish, L. T. and N. C. Steele. 1970. Influence of energy intake through three gestations on reproductive performance of sows. J. Anim. Sci. 31:200. (Abstr.).

Gesell, J. A., D. E. Becker, A. H. Jensen, B. G. Harmon and H. W. Norton. 1963. Time between feeding period for gestating swine. J. Anim. Sci. 22:1111. (Abstr.).

Gossett, J. W. and A. M. Sorensen Jr. 1959. The effects of two levels of energy and seasons on reproductive phenomena of gilts. J. Anim. Sci. 18:40.

Henson, C. B., D. W. Eason and A. J. Clawson. 1964. Reproductive performance of swine as influenced by pregestation and gestation feeding levels. J. Anim. Sci. 28:878. (Abstr.).

Libal, George W. and Richard C. Wahlstrom. 1969. Effects of interval feeding two types of gestation rations on reproductive performance of sows and gilts. Univ. of So. Dakota, A. S. Series 69.

Mayrose, V. B., V. C. Speer and V. W. Hays. 1966. Effect of feeding levels on the reproductive performance of swine. J. Anim. Sci. 25:701.

Ray, D. E. and J. W. McCarty. 1964. Effect of temporary fasting on reproduction in gilts. J. Anim. Sci. 24:660.

Snedecor, G. W. and W. G. Cochran. 1967. "Statistical Methods" (6th ed.). Iowa State University Press, Ames, Iowa.

Sorensen, A. M. Jr., W. B. Thomas and J. W. Gossett. 1961. A further study of the influence of levels of energy intake and season on reproductive performance of gilts. J. Anim. Sci. 20:347.

Svajgr, Alan J. 1968. Can sows eat every third day? Univ. of Nebr. Swine Progress Report, EC-68-129.

Tribble, L. F. 1966. Effect of restricted feeding during midgestation on sow performance. Kans. Agr. Exp. Sta. Bul. 493.

Weise, Vern M., C. V. Ross and L. F. Tribble. 1967. Influence of flushing and time between feeding periods for gestating swine. Univ. of Mo. Annual Swine Day Report, 1967.

APPENDIXES

TABLE IX

ANALYSES OF VARIANCE FOR VARIABLES IN TRIAL I

Source	d.f.	Mean Squares					
		Sow Gest. Gain	Sow Cond. Score	Total No. Pigs Farrowed/Litter	No. Born Alive	No. Live at 21 Days	Pig Wt. at Farrowing
Total	56						
Reps	1	7,515.545*	3.739*	0.533	0.448	4.854	0.005
Treatments	1	51,299.204**	22.875**	4.965	5.222	13.285	0.733*
Rep X Treatments	2	1,984.755	1.959	27.703*	17.608	1.114	0.254
Error	51	1,227.755	0.673	8.635	8.132	7.287	0.236

TABLE IX (CONTINUED)

Source	d.f.	Mean Squares				
		Pig Wt. at 21 Days	Litter Wt. at Farrowing	Litter Wt. at 21 Days	Survival Percentage at 24 Hours	Survival Percentage at 21 Days
Total	56					
Reps	1	2.359	0.165	566.492	10.388	265.866
Treatments	2	13.092	37.718	1,594.114	5.420	310.513
Rep X Treatment	2	1.646	433.809**	29.139	27.348	278.861
Error	51	5.072	82.073	1,057.337	10.787	306.474

*Significant (P<.05).

**Significant (P<.01).

TABLE X

ANALYSES OF VARIANCE FOR VARIABLES IN TRIAL II

Source	d.f.	Mean Squares						
		Sow Gest. Gain	Sow Cond. Score	Total No. Pigs Farrowed/Litter	No. Born Alive	Pig Wt. Farrowing	Litter Wt. Farrowing	Survival Percentage at 24 Hrs.
Total	65							
Trials	1	9,705.212**	20.419**	102.347**	105.128**	0.171	733.541**	2,639.889**
Treatments	1	1,605.137	0.035	11.583	12.305	0.002	66.986	21.927
Trial X Treatment	1	45.547	0.104	1.084	3.867	0.066	2.826	81.065
Error	62	825.504	0.614	6.795	6.215	0.230	60.034	72.654

**Significant (P<.01).

VITA

L. Keith Caldwell

Candidate for the degree of

Master of Science

Thesis: EFFECTS OF FEEDING SEQUENCE DURING GESTATION ON REPRODUCTIVE PERFORMANCE IN SWINE

Major Field: Animal Science

Biographical:

Personal Data: Born in Pauls Valley, Oklahoma, July 7, 1946, the son of Mrs. C. B. Frankenberg and the Late Mr. R. J. Caldwell; married Judith Ann Winter January 9, 1971.

Education: Received a Bachelor of Science Degree from Oklahoma State University in May, 1968, with a major in Agricultural Education.

Experience: County Extension 4-H Agent at Hays, Kansas, 1968-1969; Graduate Assistant at Oklahoma State University, 1970-1971; Animal Science Instructor at Colby Community College, Colby, Kansas, 1971-1972.